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CONTENTS

PHENOTYPIC VARIABILITY OF FERTILITY AND MILK TRAITS IN OFFSPRING OBTAINED BY INSEMINATION BY SEXED AND CONVENTIONAL SEMEN OF HOLSTEIN BREED BULLS

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Abstract
The objective of this paper was to compare heifers reproductive traits and characteristics of their calves after artificial insemination performed by conventional (non-sexed) and sexed sperm on 6 commercial farms in Serbia. Conception rate was 55% and 44% for conventional and sexed semen, an average gestation length being 274.6 and 274.9 days, respectively. Average body mass at birth was 37.47 and 36.75 kg for non-sexed and sexed semen, respectively. The rate of stillbirths and twinning was 6.19 and 3.78% for conventional and 7.54 and 1.13% for sexed semen, respectively. The use of conventional semen exerted no statistically significant ($P>0.05$) effect on female: male calves relationship (51.96 : 48.04) while artificial insemination by sexed semen highly significantly ($P<0.01$) changed calf sex-ratio (85.10 : 14.90). First-calf heifers originating from sires whose sperm was obtained in conventional way produced 7880 kg milk with 269 kg milk fat and 242 kg protein in standard lactation, while first-calf heifers originating from sires whose sperm was sex-sorted produced 8184 kg milk with 251 kg milk fat and 242.3 kg protein. Type of insemination (conventional and sexed semen) did not significantly affect the studied milk yield traits ($P>0.05$).

Keywords: sexed semen, conventional semen, heifers, fertility traits, milk traits.

Introduction

The purpose of the application of sexed semen is to obtain descendants of desired sex (Seidel and Garner 2002; Tubman et al. 2004; Healy et al. 2013). Today sexed semen is widely available to milk producers who use it primarily to increase the number of high genetic potential female calves and heifers. Recommendations for commercial application of sexed semen primarily refer to heifers insemination and rarely that of cows because of lower fertility and higher costs expected thereof (Garner and Seidel 2008). Limitations in sexed semen production may happen in different phases and levels of processing. Seidel (2007) points out that the process of semen sexing is both slow and only a small number of semen doses per hour are obtained (7 - 10 doses / hour). The procedure of semen sexing is very invasive one where spermatozoa are being put under a high pressure and speed what can provoke their damage under the action of physical forces. A high pressure in the system is associated with a reduced fertility (Seidel et al. 2003). For this reason it is recommended to use sexed semen primarily in heifers that show distinct signs of oestrus (Foote, 2010). Heifers are the most fertile segment of the herd and are not burdened by production and this fact is of crucial importance in the application of sexed semen. A smaller number of semen doses, costs of operating equipment and maintenance along with indispensable specialised and capable operators who control the instruments result in higher price of this semen (Prakash, 2014). Besides decreased efficiency regarding the number of doses collected per bull compared to conventional sperm, the semen collected from majority of elite progeny tested bulls is often not sex sorted in order that their semen production should not be decreased, while on the other hand, there is a trend to obtain more sexed semen from young genomic tested bulls. It is estimated that the use of sexed sperm could increase the rate of genetic improvement of milk yield in the herd by 4.4% per year compared to the herds in which sexed semen is not used in insemination. If in larger number of inseminations sexed

semen from elite tested bulls was used the rate of genetic improvement could gradually increase up to 7% per year. It is proved that the application of sexed semen can increase the intensity of selection in heifers (due to improving genetic trend), influence the decrease of stillborn calves at birth, cause less difficult calvings and have a particular effect on enlarging the herd by quality breeding offspring (Lavaf et al. 2013). The objective of this paper is to analyse the effects of the application of bull sexed sperm on reproductive and productive traits of descendants compared to the application of conventional, non-sexed sperm.

Material and methods

The research included total of 1922 heifers of Black and White breed raised on 6 farms of the Agricultural Corporation Belgrade AD from January 2012 to January 2014. Heifers included by the research were inseminated 3320 times in total out of which 1205 inseminations were conducted by sexed semen while the remaining 2115 doses applied were that of conventional semen. Sexed semen originated from 6 bulls, while conventional semen originated from 20 bulls. The conditions on all farms on which the animals were raised were equalised.

Following available data were used in the analysis: identification number of heifer, dates of all inseminations, date of calving, number of inseminating bull, type of semen used, calf sex, calf body mass at birth and a calf grading mark (1-calf with inborn anomalies; 2-poorly developed and avital calf; 3- moderately developed and vital calf; 4-5- well developed calf, vital and in type).

$Y_{ijklm} = \mu + T_i + F_j + S_k + P_l + O_m + e_{ijklm}$

In which:

Y_{ijklm} – is the phenotypic manifestation of studied trait,

μ-general average of population

T_i-fixed effect of the type of sperm (i=1,2)

F_j-fixed effect of the j farm (j=1...6)

S_k- fixed effect of the k calving season (k=1...4)

P_l- fixed effect of the calf sex (l=1,2)

O_m- fixed effect of the sire (m=1...26)

e_{ijklm}- random error.

Besides the traits mentioned in the analysis the production traits of standard lactation realised by female descendants of the sires whose semen was sexed (74 first-calf heifers) and female descendants of the same age originating from bulls used in conventional insemination (279 first-calf heifers) were included as well. The analysed traits included milk yield, milk fat content, milk fat yield, protein content and protein yield. The effects were studied by means of GLM procedures within SAS statistical package. Model used for production traits had a following form:

$Y_{ijklm} = \mu + T_i + F_j + O_k + e_{ijk}$

In which:

Y_{ijklm} – is the phenotypic manifestation of studied trait,

μ-general average of population

T_i-fixed effect of the type of sperm (i=1,2)

F_j-fixed effect of the j farm (j=1...6)

O_k- fixed effect of the sire (m=1...26)

e_{ijk}- random error.

λ^2 test, within the same SAS programme package (SAS Institute, 2013) was used to study the calf sex ratio in both types of artificial inseminations.

Results and discussion

Table 1 shows the mean values of the studied reproduction traits observed per type of insemination (conventional and sexed sperm). Rate of conception of the heifers inseminated by conventional sperm was 55% in relation to 44% for sexed sperm for average gestation length of 274.6 and 274.9

days, respectively. The mean values of calf birth weight, calf vigor, neonatal death rate and twinning are statistically highly significantly (P<0.01) dependent on the type of insemination.

Table 1. Mean values of reproduction traits according to the type of semen

Trait	Conventional semen (n)	Sexed semen (n)	P-value
Conception rate (%)	55 (2115)	44 (1205)	<0,001
Gestation length (d), mean ± SD	274,57±9,91 (1163)	274,92±9,04 (530)	=0,492
Birth weight (kg), mean ± SD	37,5±2,5 (1163)	36,8±2,0 (530)	<0,001
Calf vigour (score)	4,5 (1091)	4,1 (490)	<0,001
Stillbirth (%)	6.2 (72)	7.5 (40)	<0.001
Twin births (%)	3,8 (44)	1,1 (6)	<0,001

The effect and statistical significance of the type of sperm, farm, and season of insemination, calf sex and inseminating sire on the gestation length and calf birth weight are shown in Table 2.

Table 2. Analysis of variance for gestation length and birth weight

	Gestation length (d)			
Trait/Source	DF	MS	F-value	P-value
Semen type	1	44,021756	0,51	=0,492
Farm	5	523,579663	6,12	<0,001
Season	3	216,410126	2,53	=0,056
Calf sex	2	1,932,813916	22,58	<0,001
Sire	26	121,929896	1,42	=0,080
Error	1654	85,5898		
	Birth weight (kg)			
Semen type	1	184,906300	49,06	<0,001
Farm	5	122,531210	32,51	<0,001
Season	3	19,754216	5,24	=0,001
Calf sex	2	458,104676	121,55	<0,001
Sire	26	9,409893	2,50	<0,001
Error	1654	3,768798		

DF - degree of freedom; MS - mean square

The relation of the sexes in both types of inseminations determined by λ^2 test is shown in Table 3. The use of conventional sperm has not statistically significantly affected (P>0.05) the relation of male and female calves (52.7:47.3%), while artificial insemination by sexed sperm highly significantly (P<0.01) altered the calf sex relation (85.1 : 14.9%).

Table 3. The sex ratio of calves according to type of semen

Relative frequency (%)	Conventional semen (n=1.091)	Sexed semen (n=490)
females (n)	52.7 (575)	85.1 (417)
males (n)	47.3 (516)	14.9 (73)
χ2-value	3.19	241.50
P-value	=0.596	<0.001

Table 4 shows mean values of the traits of milk yield obtained by first-calf daughters of examined bull-sires as per type of insemination (conventional and sexed semen).

Table 4. Mean values of milk traits according to the type of semen

Trait	Conventional semen (n=279)	Sexed semen (n=73)	P-value
Milk yield (kg), mean ± SD	7880±1401	8184±1355	=0,093
Milk fat content (%), mean ± SD	3,43±0,17	3,43±0,18	=0,868
Milk fat yield (kg), mean ± SD	269±47	279±43	=0,092
Milk protein content (%), mean ± SD	3,08±0,14	3,07±0,15	=0,755
Milk protein yield (kg), mean ± SD	242±43	251±38	=0,111

The effect of studied factors on milk yield traits as well as their statistical significance is shown in Table 5. As it can be seen from Tables 4 and 5 the type of insemination had no statistically significant (P>0.05) influence on milk yield, milk fat content, milk fat yield, protein content and protein yield.

Table 5. Analysis of variance for milk traits

Trait/Source		Milk yield (kg)		
	DF	MS	F-value	P-value
Semen type	1	5985642,68	3,32	=0,07
Farm	5	1816234,98	1,01	=0,41
Sire	19	4173302,68	2,31	<0,01
Error	326	1805423,1		
		Milk fat content (%)		
Semen type	1	0,01594052	0,93	=0,34
Farm	5	0,76454621	44,43	<0,001
Sire	19	0,08838105	5,14	<0,001
Error	326	0,01720981		
		Milk fat yield (kg)		
Semen type	1	5408,80	2,77	=0,097
Farm	5	9158,06	4,69	<0,001
Sire	19	4159,26	2,13	=0,004
Error	326	1954,3821		
		Milk protein content		
Semen type	1	0,012	1,9	=0,30
Farm	5	0,570	52,50	<0,001
Sire	19	0,038	3,5	<0,001
Error	326	0,0109		
		Milk protein yield		
Semen type	1	6713,94	4,16	=0,04
Farm	5	5465,94	3,39	=0,005
Sire	19	3614,03	2,24	=0,002
Error	326	1613,73		

DF - degree of freedom; MS - mean square

Many studies show that conception rate as a consequence of the application of the sexed sperm is highly variable, and that it is lower in relation to conventional sperm. Obtained rate of conception in this paper was in harmony with the rate of conception obtained by the heifers that were artificially inseminated by sexed sperm in other countries and ranged from 39 to 57% (Cerchiaro et al. 2007;

DeJarnette et al. 2009). The determined rate of conception for sexed sperm was higher than that reported by Veigel (2004), Bodmer et al. (2005) and Healy et al. (2013). A low rate of conception realized by sexed sperm has most probably been provoked by damage of spermatozoa during sorting process and by the decreased concentration of spermatozoa in the applied doses (Seidel et al. 1999; Bodmer, 2005; Garner and Seidel 2008). Conception rate for sexed semen in this study was significantly higher than the same rate established for Holstein heifers by Healy et al. (2013) and is in line with majority of published reports in which it amounts even up to 75% (Cerchiaro et al. 2007; DeJarnette et al. 2009; Norman et al. 2010). At the same time, in a number of studies, we can notice that the highest conception rates were recorded in moderate climate conditions to which studied region also belongs. Improved efficacy of the sorting can in the future increase the rate of conception and thus contribute to wider use of sexed sperm in dairy cattle breeding. Gestation length represent the trait whose duration is characteristic for every species of domestic animals and depends on greater number of factors. Significant differences in the gestation length depending on the parents breed, sires in particular, have been confirmed by many authors (O'Ferrall et al. 1990; Cundiff et al. 1986; Gregory et al. 1997). The results obtained for gestation length were in harmony with several studies (DeJarnette et al. 2009; Norman et al. 2010) which report that the gestation length in heifers is statistically sifgnificantly influenced by the season of insemination, inseminating sire, twinning frequency and calf sex. Male sex prolongs the gestation length what is reflected in higher body mass at birth in relation to the female calves. Type of insemination, in the present study, did not statistically significantly ($P= 0.492$) shorten or prolong gestation length what is in harmony with the research by Tubman et al., 2004 and Healy et al. (2013). Studying the calf birth weight is significant for a number of reasons, among the others, a great calving mass of calves is one of the major causes of difficult calvings, and later causes the death of calves which can occur immediately after the birth. Calf birth weight is influenced by different genetic and non-genetic effects, such as sex, body mass and the age of dam, sire, calving in order, calving season, breed, gestation length, duration of a dry period (Nelsen et al. 1984; Cundiff et al. 1986). The results obtained by Tubman et al. (2004), correspond to the results obtained in the present study meaning that in addition to the sex, season of insemination and inseminating sire the type of artificial insemination also has a statistically significant ($P<0.01$) effect on calf birth weight. Calf vigor was evaluated for all live born calves by the marks from 1 to 5. The evaluation is great deal subjective, therefore due to such scoring and partly due to differences originating from dams a statistically significant difference ($P<0.01$) was confirmed between the calves produced by sexed and those produced by non-sexed semen. The results obtained are not in harmony with the results of Tubman et al. (2004), who proved that there is no significant difference in the results for calf vigor depending on the type of insemination and sex. Many farmers throughout the world today face the constant increase in the calf mortality rate, what highly unfavorably affects the economic value of milk production (Meyer et al. 2000; Steinbock et al. 2003; Zadeh et al. 2008). The rates of single stillborn calves in our research produced by heifers inseminated by sexed semen are lower than the rates obtained by Norman et al. (2010). Healy et al. (2013) report that the rate of stillborns is influenced by following factors: sex, twinning, gestation length, AI technician, semen type, the age of dam and the season of insemination. DeJarnette et al. (2009), in their study suggest that increased rate of stillborns produced by heifers inseminated by sexed semen occurs as a consequence of the process of sorting which damages sperm and leads to reduced vigor of foetus and ultimately to stillbirth. The rates of the twinning for Holstein heifers and White and Black heifers in previous studies ranged from 0.76% to 1.3% (Mee, 1991; Zadeh et al. 2008; Norman et al. 2010). The twinning rate in this study was higher than expected one for the heifers of dairy breeds and statistically depended ($P<0.01$) on the type of semen. The results obtained are consistent with the values reported by Healy et al. (2013), who, contrary to the results obtained in this study, point out that the type of semen had no statistically significant effect ($P>0.05$) on twinning rate but that it affected the sex of twins. The inheritance of the sex is the consequence of the random pairing of gamets in the proces of insemination and therefore, it is likely to expect an almost equal sex ratio (1:1) in cattle offspring. By

the application of sexed sperm, heifers will deliver female calves in about 90% cases instead of 49% what is an average frequency when we use the sperm which has no been sexed (Seidel, 2003; Cerchiaro et al. 2007; DeJarnette et al. 2009). The relation of sexes accomplished in this study which is obtained by sexed sperm was acceptable and similar to that reported by Bodmer et al. (2005) and Healy et al. (2013). However, it was somewhat lower than majority of reports in literature, which reported that by the application of sexed sperm we can obtain about 90% female calves (Cerchiaro et al. 2007; DeJarnette et al. 2009; Norman et al. 2010). The realised relation of sexes can be considered to be the consequence of reduced accuracy in sorting due to increased rapidity (Seidel, 2003). The relation of sexes in the respective research was statistically significantly ($P<0.01$) altered by the application of sexed sperm. The obtained sex ratio for conventional insemination was not in line with a majority of published results stating that about 50 to 52% male calves are being born (Tubman et al. 2004; Zadeh et al. 2008; DeJarnette et al. 2009). However, similarly to our study, Norman et al. (2010) determined 48.5% birth of male calves. Type of insemination, which involves also the inseminating bull, had a significant effect on sex ratio (Norman et al. 2010; Healy et al. 2013). The results obtained in this paper (Table 4) are consistent with majority of studies comparing the daughter's milk yield traits depending on artificial insemination either by sexed or conventional semen. Hinde et al. 2014 determined that in Holstein breed cows milk production was significantly higher in standard lactation after pregnancy which resulted in birth of female calf. These results are based on 2.39 million lactations and about 1,49 million cows. First-calf heifers which brought forth daughters had 142 ± 5.4 kg more milk in 305 days of lactation compared to the first-calf heifers which delivered of male calves (7.612 vs. 7.470 ± 69 kg). The same authors state that the use of sexed semen has a long-lasting effect on milk yield after the birth of the first female calf. A cumulative rise of milk yield in the first two lactations in cows which at first parity brought forth daughters in relation to the cows which in the first two successive calvings gave birth to sons is about 445 kg. Likewise, Zadeh et al. (2010) concluded that milk yields in heifers inseminated either by sexed or conventional semen were similar with a remark that an overall economic gain was higher in heifers obtained by sexed semen in relation to those obtained by conventional semen. The conclusion stated in the mentioned paper is that the use of sexed semen in the first insemination of heifers can decrease the cost per female calf and that this type of insemination can have a positive effect on milk yield and enable more rapid turnover of invested working capital during the first lactation. In a dairy cattle breeding the sexed semen can be used for production of a larger number of daughters from genetically superior cows. The application of sexed semen offers great possibilities to farmers to increase the efficiency of dairy production by obtaining more female calves. It is particularly important in raising certain cattle breeds (Holstein, Jersey) whose male calves are regarded as much less useful (Korora, 2012). In addition the breeders in dairy cattle breeding can use first-class sexed semen for the production of bulls for progeny and genomic testing from the population of elite cows. The costs of progeny testing of descendants of these bulls are drastically reduced due to reduced necessity for a larger number of inseminations in order that a sufficient number of daughters be produced. It is possible to expect that current method for semen sexing will be improved in the future along with a development of a completely new technology and even obtaining bulls that will produce only one kind (X or Y) of spermatozoa what shall demand a very intensive further research (Prakash, 2014).

Conclusions

For cattle breeders the insemination with sexed semen has certain advantages and privileges. It can be said without doubt that sexed semen neither leads to increased abnormalities nor in a negative way affects studied characteristics in calves. The use of sexed semen increases the rate of genetic improvement of dairy traits in comparison with the use of non-sexed semen. In addition, sexed semen makes possible for producers to use only best replacement females in the herd what results in improving the genetic base of breeding stock and therefore in improving the traits of interest in the herd.

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SHEEP BODY WEIGHT INFLUENCE ON REPRODUCTIVE PARAMETERS WHILE UNDER THE INCREASED DOSAGE OF GONADOTROPIC HORMONE DURING INDUCTION AND SYNCHRONIZATION OF ESTRUS IN ANESTRUS SEASON

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Abstract
Aim of this paper is to determine if there are differences in sexual reaction of mature Il d'france sheep depending on body weight of ewes that were treated with increased dosage of gonadotropic hormone by 250IU compared to usual dosage of 500IU that is given during induction and estrus synchronization during anestrus season. Total number of 99 ewes were treated, divided in to three weight groups depending on their body mass. First group were sheep whose body weight was within 40-50 kg limit, second group was between 50-60 kg and third group was sheep that had higher body weight than 60 kg (control group). All animals of all groups received intra vaginal sponges containing 30mg of fluorgestone acetate which remained within for 12 days. At the day of sponge removal each sheep received one dosage 750IU of gonadotropic hormone. Two days later "offhand" mating was done.Obtained results show that from first group 49,06%; II 50,00% and III 65,50% of treated ewes had kids. Average fertility of sheep per treatment I, II and III was 134,61% for I group, which was close to lower expected fertility limit for this breed, however fertility of second group was 157,89% and third group 160,00% was within limits of expected fertility for this breed when it is kept in optimal conditions.Conclusion was that sheep of II and III group reacted better on applied treatment and therefore achieved satisfying fertility.

Keywords: mature sheep, body weight, fluorogeston acetate, gonadotropic hormone of pregnant mares, sheep fertility.

Introduction

Sheep reproductive season starts when daylight becomes significantly shorter than night. It is usually at northern hemisphere where our country is in the period from middle of August until the first half of January (Stančić, 2008). Complex sheep neuro endocrine system is under direct influence of daylight period (photoperiod) during the year, so it manifests itself by mating season (estrus) and full resting season (anestrus) (Nenadić et.al., 1993). Outside of mating season sheep are not sexually active, they do not have estrus cycles, do not ovulate and do not express estrus signs (Mekić et.al. 2012; 2013). The effect of induction and estrus synchronization for sheep using progestogen and gonad tropic hormone of pregnant mares was researched by Mekić and Stojković (2002); Zonturlu et.al. (2011); Moradi et.al. (2012). Poly-ovulation is more often expressed with heavier and well fed sheep than with sheep that have lower body condition and body weight. In the research by (Alison, 1978) it has been determined that heavier sheep had larger number of follicle compared to sheep that had lower body weight. The effect of induction and synchronization of estrus as well as superovulation is significantly dependent on applied PMSG dosage, age and body weight of treated sheep (Moor et.al., 1985; Stančić et.al., 1995; Stančić et.al., 1991). Aim of our work is to help answering questions regarding the body weight influence of treated sheep in reproduction and dosage of PMSG during induction and synchronization of estrus in anestrus season on reproductive parameters.

Material and methods

Induction and estrus synchronization was conducted for 99 fully grown Il d'frans sheep in anestrus season at PKB "7. juli" farm, Donje Polje in Surčin, in the period from end of February until the middle of the April of the same year. Taking of body weight of sheep was conducted on livestock scale for small size rumnivorae. Depending on body weight sheep were divided in to three weight groups: I group were sheep weighing 40-50 kg; II group 50-60 kg and III group > than 60 kg. Considering that fully grown Il d'frans sheep averagely weigh 65-70 kg, third group was control group and first and second were experimental groups. Sheep were treated using Chrono-gest method, by applying intra vaginal polyurethane sponges with 30mg of Fluor-geston acetate (FGA). After 12 days sponges were removed and at that moment 750 IU of PMSG was subcutaneously injected, dose was by 250IU higher than usual 500IU dose which is used at the farm during induction and estrus synchronization. After 36-48h from intravaginal sponges removal and application of PMSG off hand mating was done. Observation and detection of sexual urge was conducted using rams in the morning between 7 and 8h, and in the afternoon from 18-19h. Sheep that were found to have the sexual urge were mated twice in the morning and in the evening (evening and morning). Results were calculated using standard variation statistic parameters and variance analysis method. Difference significance evaluation was determined using T-test.

Results and discussion

Sheep body weight mainly depends on genotype, breed that sheep belongs to, and values for body weight of treated sheep are shown in table 1.

Table 1. Average values and variability of sheep body weight in treatments (kg)

Parameters					
Treatment	No of treated sheep	$\bar{x}$	$S\bar{x}$	Sd	CV(%)
I	53	44,44	0,76	3,78	8,50
II	38	55,72	0,46	2,86	5,13
III	8	70,16	1,89	5,33	7,60

From data in table 1 we can say that sheep in third group had higher body weight than sheep from first group by 25,72 kg (36,66%) and from second group by 14,44 kg (20,58%). Moreover body weight of second group sheep compared to first group was by 11,28 kg or 20,24% higher. Above mentioned differences in body weight between groups were statistically very significant ($P < 0,01$).

Reproductive parameters

Influence of body weight of sheep on reproductive parameters is shown in table 2. Based on obtained results we can say that from first group 49.06% of treated sheep lambed, for second group 50,00% and for third group 65,50%. For second group more sheep lambed than for first group by 0,94%. However in third group more sheep lambed than in first group by 16,44% and by 15,50% more than in second group. At 100 sheep that lambed most kids were obtained in third group and that difference compared to first group was 25,39%. Total number of lambs was 73, in the first group 35, in the second group 30 and in the third group 8 (table 2.). In first group 48,57% were singles and in 51,43% were twins. For second group 30,00% were singles, 60,00% twins and 10,00% triplets. However in third group 25,00% singles and 75,00% twins were born. Therefore, in the third group percent of twins was higher by 23,57% than in first group while difference compared to second group was 15,00%. It has been determined that sheep in third group had body weight within expected values for fully grown Il d'frans sheep and that they achieved significantly better results than sheep in first and second group, whose body weights were below expected values for that breed (for sheep that finished growth). Our results were similar to ones by Allison-a (1978) where they researched influence of diet on sheep body weight, induction, ovulation and number of formed follicles. It has been determined that sheep of higher weight had higher number of follicles than

sheep that weighted less (8,89 and 5,71). Forcada and Abecia (2006), found that bad diet influences weight reserves and reduction of mating sheep body weight, which further effects at appearance of irregular cycles, lowering the ovulation rate and birth of weak offspring. In the research by Aliyara et al. (2012) number of born lambs was significantly higher for sheep that had higher body weight. Madani et al. (2001) in his research found that number of sheep that had lambs during estrus synchronization was 45-62% from total number of treated sheep which is similar to our results. However our results are lower than ones by Forcada et al. (1999) for Aragoneza breed (76,4 -82,8%) and Todini et al. (2007) for Sarda sheep 83,0%.

Table 2. Sheep reproductive parameters

N°	Parameters	Treatments		
		I	II	III
1.	% lambed compared to treated	49,06	50,00	65,50
2.	% sheep that didn't have lambs	50,94	50,00	37,50
3.	Total number of lambs	35	30	8
4.	Sheep fertility (%)	134,61	157,89	160,00
5.	Type of birth			
	-Singles (%)	48,57	30,00	25,00
	-Twins (%)	51,43	60,00	75,00
	-Triplets (%)	-	10,00	-

The fact that sheep fertility depends on sheep body weight in the moment of fertilization was determined by Gaskins et al. (2005), and Rihind et al. (1989), which was confirmed by our research too. Zarkawi et al. (1999) formed two groups Awassi sheep breed where first group (n=50) had average body weight of 55,6 kg, and control group (n=46) had average weight of 52,5 kg. Treatment was conducted (MAP - 14 days + 600 IU PMSG). Results have shown that for the first group 82% of sheep were in estrus in the time frame 36-49 hours after removal of sponges, while in second group it was 32,6% . Sheep fertility of first group was 137,5%, and for II 106,7%. Sheep in the first group had 30,00% twins while sheep in second group had 6,7%. Karaca et al. (2009) used FGA sponges for 7 days and 1 day before sponge removal injection of PGF2α and PMSG in the dose of 400 IU was applied. 88,8% sheep were in estrus. In the research by Mekića et.al. (2014) three weight groups of mating sheep were formed, first group averagely weighted 44,88 kg; II group 55,04 kg and III group 67,68 kg. All three groups were treated with 500 IU of PMSG. Sheep fertility in the groups I:II:III was 116,28:118,37:137,14%. Based on above mentioned results and data from literature we can say that induction and estrus synchronization for sheep in anestrus season can be done using (FGA 12 days + PMSG). Sheep that had body weight higher than 60kg, whose body weight was within expected limits for the specific genotype, reacted better on the treatment, had higher number of ovulated egg cells on ovaria, gave birth to higher number of twins compared to group with body weights between 40-50 kg and 50-60 kg. Sheep in first and second group had body weights that were significantly lower for II d'frans breed whose average body weight is between 60 -70 kg. When it comes to increased dosage of PMSG by 250IU than usual 500IU dose, we can conclude that it had positive effect on sheep fertility and that sheep that had higher body weight (body weight within the expected limits for the specific genotype) reacted much better to the treatment. Therefore, skinny sheep can't properly react to increased dose of PMSG, which means that mating sheep should be firstly prepared in such way that they are in adequate mating condition (having proper body weight) in order for them to positively react to applied treatment with hormones during induction and estrus synchronization in anestrus season with increased dose of PMSG.

Conclusions

Based on conducted research of mating sheep body weight influence during induction and estrus synchronization in anestrus season using FGA (30 mg/sheep, intravaginal 12 days) and PMSG (750 IU./sheep PMSG, one time) on reproductive parameters we can conclude that:

Percent of sheep that lambed compared to number of treated sheep was highest in third group 65,50%; then in second 50,00% and lastly in first group 49,06%, therefore conception percent is not satisfying.

Average sheep fertility was lowest for first group 134,61%. Fertility in second group was 157,89%, and highest fertility was in third group 160,00%.

Higher fertility in third group by 25,39% compared to first group was due to higher number of twins born, which was in third group higher by 23,57% than in first group and by 15,00% than in second group. Determined differences between lambed sheep and number of treated sheep and number of twins born in favor of third group compared to first and second were statistically significant ($P<0,05$). This research has clearly shown that sheep having higher body weight than 60kg had better reaction to treatment through higher ovulation rate than sheep that had body weight between 40 and 60kg. Sheep in third group had higher number of twins born therefore higher fertility and more lambs per sheep which has direct influence on higher production of mutton per sheep and to economy and profitability of sheep production. Research has shown that in order to achieve expected fertility for specific genotype it is needed for sheep to have satisfying body weight which is specific for fully grown mating sheep within the breed they belong to. In practice that means that skinny sheep in our research could not have positive reaction to applied treatment.

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COMPARATIVE STUDY OF SHEEP MILK, WHEY AND TRADITIONAL KASHKAVAL FROM GALICHNIK AND LAZAROPOLE

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Abstract

Traditional cheeses are a reflection of the local rural environment, culture and nature expressed by experience of masters through many decades. In recent years, it is noticed increased consumption of traditional sheep dairy products, especially cheese produced by traditional technology. The purpose of this study was to examine the quality of raw sheep's milk and whey during the production of traditional sheep cheese from two locations, Galichnik and Lazaropole. Samples were taken in four iterations. The physico-chemical composition on the 100th day of ripening of cheese is presented also. The mean fat content was 8.45± 1.157% in milk from Galichnik and 8.69±0.846% in milk from Lazaropole, while the protein was 6.34±0.837% and 6.15±0.242% respectively. Titratable acidity in Galichnik milk was 10.33 °SH and the milk from Lazaropole has 10.50 °SH. The Total bacteria count (TBC) and the Somatic cell count (SCC) in both locations showed wide range due to nonstandard sanitary procedures applied in primary production. The results of the chemical composition of whey showed that it has a variable composition, particular in the content of fat (Cv= 9.02% Galichnik and 21.98% Lazaropole) due to the traditional procedure for making cheese. The moisture content of the cheese on 100th day of ripening was 36.64% in cheese from Galichnik and 32.63% in Lazaropole cheese. The mean value for fat content was 27.88% and 30.00% for cheese from Galichnik and Lazaropole respectively. According to the classification of cheese in terms of moisture content on a fat-free basis, after 100 days of ripening, the kashkaval cheese from Galichnik had fallen in the group of hard cheeses, while the kashkaval cheese from Lazaropole belong to the group of extra-hard cheeses. Regarding the fat in dry matter, both cheese variants were on the border between medium fat and full fat cheeses.

Keywords: quality of milk, physico-chemical composition, traditional cheese.

Introduction

In recent years, it is noticed increased consumption of traditional sheep dairy products, especially cheese produced by traditional technology. One of the famous cheese produced in Macedonia is traditional sheep kashkaval from the Bistra mountain. The Bistra Mountain is located in western Macedonia, and it belongs to the group of mountains from the Sharplanina area. The specific climatic conditions, hilly mountain as well as the sheep breeding tradition, are excellent preconditions for the production of the cheese in this region. Milk for the production of cheese on mountain Bistra originates from local breeds, which are adapted to the specific geographical and climatic conditions. They are characterized with high resistance to climatic conditions, but also low milk yield (60-80 l during lactation). Ripening of hard cheese varieties is a long and costly process because of capital immobilization, storage facilities, weight losses, and spoilage caused by undesirable fermentations (Garde et al., 2002). Beside many factors, the final quality of the artisan cheese depends the local human factor - the cheese-maker also. The use of raw unpasteurized milk to produce a cheese that takes months to ripen puts considerable pressure on the capacity of the cheese-makers. It is the cheese-maker's professional skills that ensure that the various phases in the cheese making process are carried out correctly. He relies on his years of experience and training when making these decisions (De Roest, 2000). Although the traditional cheeses are recognized as

important for cheese producers, they are losing battle from the industry and they might extinct (Miajcevic et al., 2005). In Macedonia, the number of traditional cheese producers is continuously decreasing (Santa and Srbinovska, 2014). Furthermore, information about Macedonian kashkaval is relatively scares. Thus, there is a need for more on research and compilation of data for traditional cheese. Based, on this research the traditional cheeses can be protected and receive PDO or PGI indication. The purpose of this study is to identify data for traditional cheese by examining the quality of raw sheep's milk and whey during the production of traditional sheep cheese from two locations, Galichnik and Lazaropole.

Material and methods

The samples of bulk milk intended for cheese production and whey were taken in four iterations collected from two farms on Mountain Bistra (Galichnik – Variant A and Lazaropole Variant B), transferred under refrigerated conditions (4-6°C) and analyzed immediately. Milk samples were analysed for the content of dry matter, fat, protein, lactose and solids nonfat by infrared analyser Milkoscan. Active acidity was measured with pH meter (Mettler Toledo, Spain) and titratable acidity according to the Soxhlet Henkel method (Carić et al., 2000). The total number of bacteria for the raw milk was measured with Bacto Scan FC, while the number of somatic cells was measured with SomaScope. Cheese samples from four batches were taken on the 100th day of ripening. The cheese composition was analyzed by standard methods : dry matter (EN ISO , 2004), fat (EN ISO , 2008), protein (FIL-IDF, 1993), water soluble nitrogen (Pejić and Đorđević , 1963); salt (Mohr's method, Pejić and Đorđević , 1963), ash (Carić et al ., 2000), pH (Mettler Toledo, Spain). Moisture content on a fat-free basis and Fat in dry matter were calculated.

Results and discussion

Quality of raw sheep milk used for the production of kashkaval cheese

Results of the physico-chemical composition of raw sheep milk used for the production of variants of cheese A and B are presented in Table 1.

Table 1. Quality of raw sheep's milk, for the production of cheese from variant A and variant B (n=4)

Parameter	Variant	$\bar{x}$	Min	Max	Sd	Cv
Milk fat (%)	A	8.45	7.08	9.89	1.157	13.68
	B	8.69	7.54	9.54	0.846	9.75
Protein (%)	A	6.34	5.78	7.57	0.837	13.20
	B	6.15	5.97	6.50	0.242	3.93
Lacotose (%)	A	4.12	3.67	4.46	0.372	9.03
	B	4.30	4.15	4.51	0.164	3.91
Solids non fat (%)	A	11.49	10.83	12.49	0.779	6.78
	B	11.04	10.44	11.54	0.454	4.11
Dry matter (%)	A	19.42	17.78	22.09	1.871	9.60
	B	19.53	18.22	20.79	1.051	5.38
pH	A	6.50	6.41	6.70	0.135	2.07
	B	6.68	6.56	6.80	0.098	1.48
Titratable acidity (°SH)	A	10.33	10.00	11.00	0.472	4.56
	B	10.50	10.00	11.00	0.577	5.50

Quality of sheep milk is mainly evaluated in terms of its technological and coagulation properties, which are highely affected by its concentration of fat and protein and somatic cell count (SCC). High protein, fat and total solids concentrations in the milk are associated with high yields in the resulting dairy products. The content of milk fat is the most variable component of milk (Antunac and Havranek, 1999), which was confirmed by the results presented in Table 1. The results of milk fat content are in accordance with the studies of Pavić et al. (2002), which also emphasizes that milk fat is the most variable component in milk. Talevski et al. (2009) presented lower values in relation of

milk fat, but the difference is due to different quality of bulk sheep milk from different regions collected in his research. The overall results for the milk sheep somposition used for the production of two varieties of cheese are similar to the results by Dozet et al. (2006) for the milk from the Bosnian / Herzegovinian region. Sheep health is important and affects the quality milk. Sheep's milk, comparing with cow's contains a significantly higher number of bacteria and mechanical impurities, which is related to the breeding, nutrition and the way of milking (Antunac, 1999). Dozet and et al. (1996) noted that the main problem in the production of autohtonous products is the assurance of milk with good microbiological quality, where should be paid more attention. It is particularly important because the total bacteria count in the bulk milk which is a major indicator of hygiene in milk production. The mean total bacteria count in the milk of variant A was 676 714 CFU mL-1, and variant B showed a significantly higher number of total bacteria (1 125 750 CFU mL-1). The total somatic cells count in Variant A was 345 333 / ml, and in Variant B 412 500 / ml (Table 2). According to the data, we can conclude that the milk from both variants A and B meets the legal requirements (Rulebook, 2012), where the number of colonies (per ml) should not exceed 1 500 000 CFU ml-1.

Table 2. TBC and SCC in sheep milk for the production on Variant A and B cheese (n=4)

Variant	Parameter	$\bar{x}$	min	max
Milk – Variant A	Total bacteria count/ml	676 714	498 000	855 000
	Somatic cell count /ml	345 333	297 000	423 000
Milk – Variant B	Total bacteria count/ml	1 125 750	980 000	1 325 000
	Somatic cell count /ml	412 500	240000	620 000

From the results of the TCC and SCC in both variants, we can see that there is a large variaton of the values. This is probably due to the non-standard sanitation procedures applied in primary production. These results in terms of the TBC, especially for the milk of Variant B, indicate that it is necessary to pay more attention to improving the quality of sheep's milk by implementing hygiene measures and procedures.

Whey composition

Whey is a by product in the process of cheese production. Composition and characteristics of whey are depending on the production technology of the end product and on the quality of the used milk. (Jeličić, 2008). In general, sheep whey contains more protein and therefore is more produced than the whey from cow's milk (Antunac et al., 2011). The results from the physico-chemical composition of the whey from two variants of cheese are shown in Table 3.

Milk fat (2.15 ± 0.194% - A and 1.69 ± 0.372% - B), was significantly variable in the whey, as it can be seen from the high coefficient of variation, 9.02% in Variant A and 21.98% in Variant B. The variation is due to the traditional procedure for the cheese production, especially during the process cutting and stirring the curd with the wooden tool "krstach". The chemical composition of whey is similar with data on whey from traditional krchki cheese, made from sheep's milk (Prpić et al., 2003). Talevski (2013), determined that the dry matter of the whey in kashkaval cheese ranged from 6.30 to 6.49%, the milk fat from 0.29 to 0.42 and the proteins from 1 to 1.18%. This difference is due to the different used raw material (cow's milk / sheep milk, 9:1) used in the production of the cheese, as well as the industrial way that differs significantly from the traditional way of making of cheese. Our results for the protein, fat and dry matter of whey are higher than the results of Chizbanovski (1981), who analysed the sheep whey for the production of white sheep cheese production These differences are probably due to the different applied technological process of making the white brine cheese. From the results shown in Table 3 it can be noticed that the dry matter in the whey in Variant A is 9.37±0,513% and 8.65±0.379% in Variant B. Baltadjieva (1993) noted that the content of dry matter in whey is half of dry matter in milk, which corresponds to our sheep milk results where the dry matter ranged from 19.42 to 19.53%.

Table 3. Physico-chemical composition of whey from production of cheese from variant A and variant B (n=4)

Parameter	Variant	$\bar{x}$	Min	Max	Sd	Cv
Fat (%)	A	2.15	1.97	2.60	0.194	9.02
	B	1.69	1.30	2.06	0.372	21.98
Protein (%)	A	1.79	1.58	2.10	0.198	11.06
	B	1.75	1.11	2.10	0.438	25.11
Lactose (%)	A	4.21	4.12	5.11	0.116	2.76
	B	4.42	4.11	5.01	0.457	10.33
Solids non fat (%)	A	7.36	6.81	7.65	0.550	7.47
	B	7.07	6.14	7.65	0.697	9.84
Total solids (%)	A	9.37	8.79	8.90	0.513	5.47
	B	8.65	8.10	8.90	0.379	4.37
pH	A	6.40	6.20	6.60	0.163	2.55
	B	6.10	5.50	6.40	0.424	6.95
Titratable acidity (°SH)	A	5.13	4.90	5.30	0.171	3.33
	B	6.25	6.00	6.50	0.222	3.56

Physico-chemical composition of kashkaval cheese

The quality of the cheese depends on its composition, especially the moisture and dry matter, salt, pH, and the percentage of fat in dry matter (Fox, 2000). The moisture content of the cheese is influenced by several factors, such as acidity, processing of the curd, pressing, moulding, as well as the conditions of storage and ripening. Moisture is one of the basic factors that influence the shelf life of the cheese.

Table 4. Physico-chemical composition of kashkaval cheese on 100 days of ripening (n=4)

Variant	Moisture	Fat	Protein	Moisture content on a fat-free basis	Fat in dry matter	Water soluble nitrogen	Ash	pH	Salt
A	36.64	27.88	23.05	50.803	44.00	0.5536	4.85	5.34	2.02
B	32.63	30.00	26.65	46.577	44.63	0.6904	5.27	5.16	2.17

Some important characteristics like consistency, shelflife and even taste of cheese are in direct relation with the acidity. Each type of cheese has a characteristic pH whose value is an indication for the conversion of lactose into lactic acid in the process of cheese production (Lawrence, 1993). Our results for the pH pn kashkaval are similar with the turkish kashar cheese analyzed by Tarakci and Kucukoner (2006) and with results on egipt kashkaval by Abou Donia (2004). According to the classification of cheese in terms of moisture content on a fat-free basis, after 100 days of ripening, the kashkaval cheese from Galichnik had fallen in the group of hard cheeses, while the kashkaval cheese from Lazaropole belong to the group of extra-hard cheeses. Regarding the fat in dry matter, both cheese variants were on the border between medium fat and full fat cheeses. The difference in the fat content of both variants is due to the difference in the composition of the raw material and the processing of the cheese itself. Namely, in Variant B, higher fat content in raw milk is noticed, but its content in the whey is lower as a lower degree of processing the curd.

Conclusions

Traditional cheeses are a reflection of the local rural environment, culture and nature expressed by experience of masters through many decades. In recent years, it is noticed increased consumption of traditional sheep dairy products, especially cheese produced by traditional technology. Kashkaval from mountain Bistra is one of the famous traditional product in the country. In this research quality of raw sheep's milk and whey during the production of traditional sheep cheese from two locations,

Galichnik and Lazaropole was examined. From the results of the TCC and SCC in milk from both variants, we can see that there is a large variaton of the values. This is probably due to the non-standard sanitation procedures applied in primary production. The results of this study showed that according to the classification of cheese in terms of moisture content on a fat-free basis, after 100 days of ripening, the kashkaval cheese from Galichnik had fallen in the group of hard cheeses, while the kashkaval cheese from Lazaropole belong to the group of extra-hard cheeses. Regarding the fat in dry matter, both cheese variants were on the border between medium fat and full fat cheeses.

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DYNAMIC OF PHYSICO-CHEMICAL PARAMETERS DURING RIPENING OF PECORINO CHEESE MADE FROM GOAT MILK

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Abstract

In this study, technological process and dynamic of the main characteristics of Pecroino cheese from goat milk are presented. Analyses were performed on 5th, 10th, 20th , 40th and 90th day of ripening. Pecorino on 90th day of the ripening contained 39.8±0.57% dry matter, 60.20±0,57% fat, 26.48±0.44% proteins (1,44±0.056% Soluble N, 0,94±0.068% Peptides N, 0,54±0.064 Amino Acid N), 4.60±0.20% salt, 1.76±0.09 lactic acid and pH 5.36 ±0.20%. The most dominant Free Amino Acid (FAA) in cheese was proline (Pro) with 159.61±0,55 mg $100g^{-1}$, then leucine (Leu) 143.71± 0,44 mg $100g^{-1}$ phenylalanine (Phe) 137.21± 0.54 mg $100g^{-1}$ and isoleucine (Ile) 131,22 ±0,32 mg $100g^{-1}$. Regarding the Free Fatty Acid, capric acid (C10:0) was most dominant (1.3241 mg $100g^{-1}$) and caprylic acid (C8:0) with 1.1210 mg $100g^{-1}$. Compared with other hard cheeses from cow or sheep milk, higher concentration of FAA and FFA in goat pecorino cheese was noticed. Intensive lypolitic and proteolytic process in this cheese is due to the specific content and enzymatic activity of the goat milk especially because of the higher content of capric acid and other short-chain fatty acids (SCFA).

Keywords: quality, composition, free amino acid, free fatty acid.

Introduction

Goat milk cheeses have distinctive flavor, mostly due to particular compounds, such as medium-chain Free Fatty Acids (McSweeney, 2017). Its composition varies according to milk origin (e.g., species and breed), rearing conditions (e.g., feeding and management), and cheese-making technology (e.g., coagulation process, addition of salt, ripening period) (Manuelian et al., 2017). The quality characteristics of goat milk give us a base to consider that goat cheese is closer to the composition on the cheese made from ewe's milk (Baltadzieva, 1985). Goats are highly suitable for milk production because they can yield up to 10 % of their weight in milk (400−1500 L per lactation) (Grille et al., 2013). In the last few years in Republic of Macedonia, there is an increasing popularity of the goat's milk and its products. The increased interest on the marketplace and the scientific community is consistent with the general trend and efforts for production of healthy food, since the goat's milk has been well known for its beneficial effects on human health (Srbinovska et al., 2001). Having in mind that in the last years there is a permanent tendency to increase the number of goats in our country, as well as the increased interest for production of goat cheeses, there is a necessity to find possibilities for its processing into the characteristic dairy products. There is an increase of popularity and consumption of cheeses produced from goat's milk. The flavor and aroma are the main properties that influence the selection of cheeses by the consumers. Cheese provides essential nutrients for human nutrition and health, such as minerals and fatty acids (FA). The process of ripening of various types of cheeses has the specific path, characterized mainly by changes of protein and milk fat. These changes determine the typical quality of the product. This has resulted in more interest in research on chemical composition and fatty and amino acids profile. In this direction, it also important to research the production of pecorino's cheese from goat milk.

Pecorino's cheese is made from ewe's milk. During the ripening process of Pecorino, in the same time proteolysis and lipolysis occurred resulting to specific aroma and taste. The aim of this study is to describe the technological process and dynamic of the main characteristics during ripening of Pecorino cheese made from goat milk. The Free Amino Acid (FAA) and Free Fatty Acid profile is also presented in this paper.

Material and methods

Cheese was produced from bulk goat milk in the "Milk Way" Dairy Plant in the Republic of Bulgaria. Chemical composition of cheese from 5 batches were analyzed on the 5th, 10th, 20th, 40th and 90th days of ripening. The cheese composition was analyzed by standard methods: dry matter (AOAC, 1995), fat ((Van Gulik (Inihov, 1971)), protein (Inihov, 1971), salt (Moor (Inihov,1971)), pH meter (Mettler Toledo, Spain) Free Amino Acids were analysed on Hd-1200E, method Martini Seideim, (Inihov, 1971) and Free Fatty Acid according the Demurov (cit in Dimitrov 1976) with gas chromatograph. FFA and FAA were analyzed in cheese on 30th, 60th and 90th days from the production. Analysis were performed on the Faculty of Agricultural Sciences and Food in Skopje and Food Institute in Plovdiv, Bulgaria. The production of Pecorino cheese was followed in cheese plant in Nova Zagora, Bulgaria.

Results and discussion

Technological procedure for manufacturing of Pecorino cheese is defined on Scheme 1. Goat milk is pasteurized on 65-68° C about 30 min. Than starter culture *St. lactis* is inoculated and the ripening of the milk starts in order to give the culture time to begin acid production before the rennet is added. After that, starter culture (0.15 % *St. termophilus, Lb helveticus, Lb. delbrueckii ssp bulgaricus),* $CaCl_2$ (0.015 %) and rennet are added. Coagulation takes 5 min on 34-35 ^{o}C and after the coagulation, the coagulum is cut into small granules with wheat grain size. The curd is cooked on 45-46 °C about 45-50 min. Then, the curd is moved to a draining vat and pressed. The titratable acidity of drained whey was 14-15^{0} T (0.126-0.135 g lactic acid). The cheese is salted with brine (21 $\pm$ 1 % NaCl, 48 hours). Duration of the ripening process takes 90 days on 12-14 °C, moisture 80-85 %, with dry salting till the 30th day.

Physicochemical characteristics

The results of the changes of the main parameters in Pecorino cheese during a ripening period of 90 days are given in Table 1.From the results, it can be seen that in the ripening process the moisture from 47.7 $\pm$ 0,61 % on the 5th day decreased to 39.8 $\pm$ 0.57 % on the 90th day. More intensive decreasing of moisture was noticed in the period from the 10th to the 20th day. The results of the acidity changes show a comparatively higher acidity at that time, thus the intensive reduction of the moisture in the same period.

The active acidity (pH) in the cheese increased during the period of cheese ripening and ranged from 5.14$\pm$0.04 at the beginning to 5.36$\pm$0.02 on the 90th day. The higher result on pH was reported by Marrone et al. (2014) on pecorino made from sheep's milk.

These changes in acidity are influenced by the fermentation of lactose and the depth of the proteolysis. In this type of cheese pH is increasing gradually, which shows that the proteolysis is moderate.

Similar findings that confirm our results are also presented by several authors who examined ripening process of hard cheeses (Litopoulou-Tsantaki et al., 1985; Terner and Tomas, 1980). The total fat in the cheese did not show significant changes during the ripening period, and at the end of the period it was 26.84$\pm$0.21, and the fat in dry matter was 44.58%. Results for the fat in dry matter are in accordance with the findings by Addis at al. (2015) on Pecorino Romano cheese. The content of the total proteins in the Pecorino cheese is comparatively high due to the low moisture content in the cheese on 90th days of ripening (26.48$\pm$0.44%). The soluble nitrogen is one of the indicators for proteolysis intensity in cheese. The content of water soluble nitrogen increased during the ripening

of the pecorino cheese and on the 5th day was 0.63±0.031%, on the 20th was 0.92± 0.054 and the 90th day reached to 1.44±0.056 (Table 2.) Peptides nitrogen gradually increased during ripening and at the end of ripening the concentration was 0.94±0.068.

Scheme 1. Technology process of Pecorino cheese made from goat milk

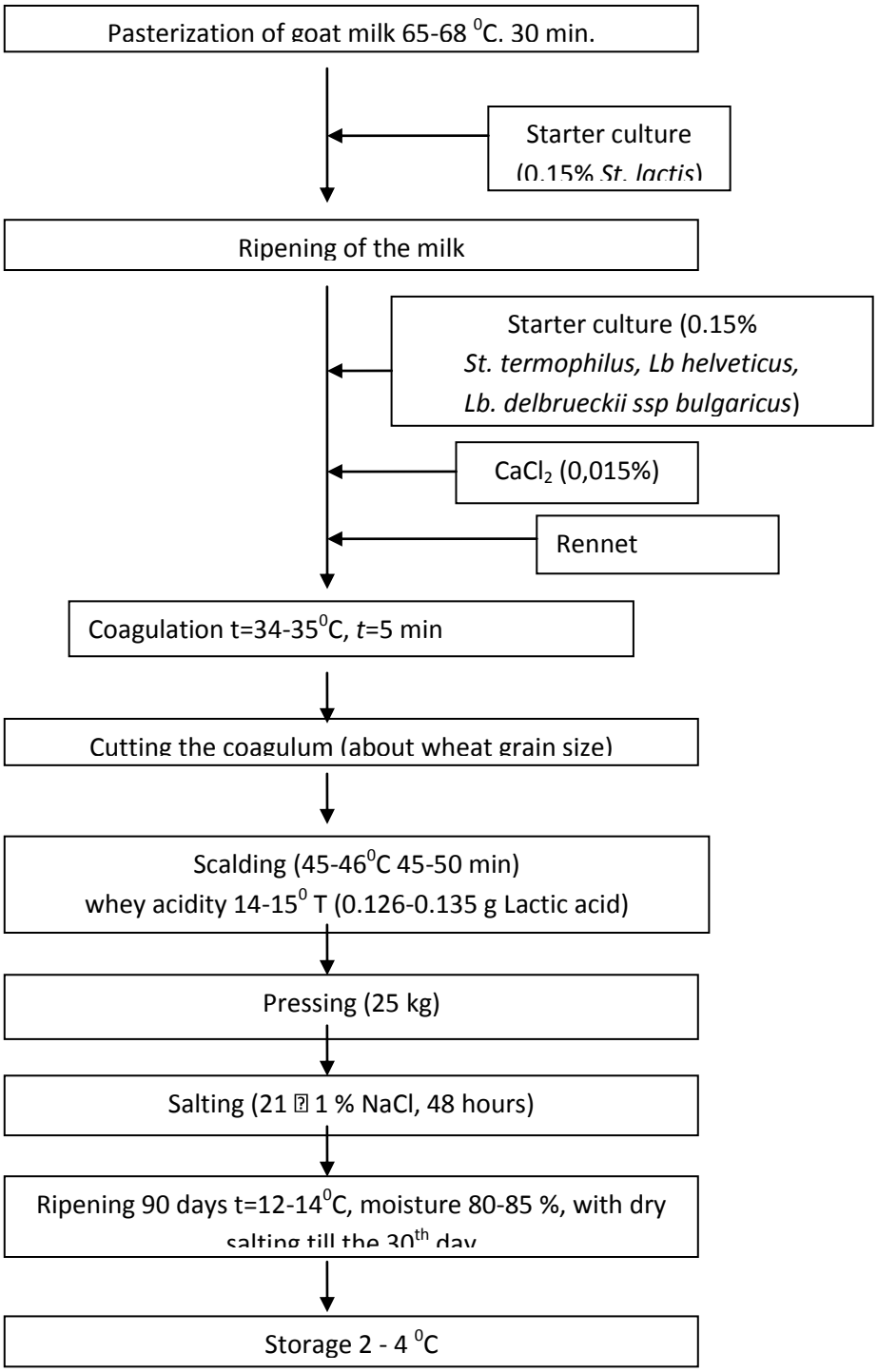

Table 1. Physicochemical characteristics of Pecorino cheese during ripening

Parameters	Ripening period (days)				
	5	10	20	40	90
Moisture %	47.68±0.61	45.34±0.49	42.48±0.72	41.15±0.88	39.80±0.57
Total solid %	52.32±0.61	54.66±0.49	57.52±0.72	58.85±0.88	60.20±0.57
Titratable acidity ^{o}T	206 ± 0.91	225 ± 0.94	220 ± 0.92	213 ± 1.10	196 ± 1.03
Lactic acid %	1.85±0.07	2.02±0.08	1.98±0.07	1.92±0.09	1.76±0.09
pH	5.14±0.04	5.17±0.05	5.19±0.04	5.25±0.01	5.36±0.02
Fat	26.85±0.60	26.40±0.71	27.10±0.31	27.20±0.53	26.84±0.21
Fat in dry matter %	51.30±1.32	48.29±1.41	47.11±0.97	46.22±1.01	44.58±0.95
Protein %	26.60±0.65	26.34±0.58	26.09±0.84	25.84±0.38	26.48±0.44
Protein in dry matter %	50.84±1.41	48.19±1.39	45.36±1.56	43.91±0.97	43.99±1.24
Salt %	3.06 ± 0.31	3.64 ± 0.16	3.65 ± 0.06	3.70 ± 0.07	4.60±0.20
Salt in dry matter	6.42±0.58	8.03±0.39	8.59±0.20	8.99±0.22	11.56±0.41

Table 2. Nitrogen fractions in goat Pecorino cheese

Parameters	Ripening period (days)				
	5	10	20	40	90
Total N, %	4.17 ± 0.36	4.13 ± 0.25	4.09 ± 0.32	4.05 ± 0.51	4.15 ± 0.17
Soluble N, %	0.63±0,031	0.81±0.042	0.92± 0.054	1.20±0.047	1.44±0.056
Peptides N, %	0.54±0.040	0.58± 0.053	0.62±0.048	0.86±0.053	0.94±0.068
Amino acid N, %	0.15±0.020	0.24±0.180	0.36±0.084	0.48±0.076	0.54±0.064

The content of Amino acid nitrogen also increased in the ripening process and the 5th day was 0.15±0,020, at 20th day increased for 2.4 times in the 90th day for 3.6 times. The participation of PN and AAN in soluble N can be significant parameters of proteolytic processes during cheese ripening. Also, they can describe «width», and especially «depth» of ripening. The participation of PN in soluble N was 65.28±3.02%, and AAN 37.50±2.21%, respectively, which give us a base to conclude that the protein degradation is more intensive in «width» than «depth» during the Pecorino cheese ripening.

Free amino acids

The profile of the Free Amino Acid (FAA) in Pecorino cheese made from goat milk is presented in Table 3. The most dominant FAA in cheese was proline (Pro) with 159.61±0.55 mg 100g^{-1}, then leucine (Leu) 143.71± 0.44 mg 100g-1, phenylalanine (Phe) 137.21± 0.54 mg 100g^{-1} and isoleucine (Ile) 131.22 ±0.32 mg 100g^{-1}. The total quantity of the essential amino acids at the end of the ripening was 652,82±0.98 mg 100g^{-1}, and on the non-essential amino acids 540.44±0.74 mg 100g^{-1}.Some of the amino acids were not detected, probably due to their transformation in the ripening process thus the occurrence of some amino acids later during ripening is explained by the selective action of the enzymes (Requena et al., 1992). Our results were slightly higher than the free amino acids determined in sheep's Pecorino analyzed by Gallistu, 1995, which is confirmed also by other authors who examined the amino acid profiles on cheeses produced from different animals than goats (Baltadzieva, 1985). Litopoulou-Tsanataki and Manolkidis (1985), comparing the content of the free amino acids in hard cheeses made from sheep, goat and cow's milk, determined the higher concentration of FAA in the goat's cheese, than sheep and cows cheese, which is explained by the increased enzymatic activity of goat milk.

Table 3. FAA profile of Pecorino cheese made from goat milk during ripening

FAA mg 100 g^{-1}	Ripening period (days)			
	15	30	60	90
Lysine	44.50 ± 0.23	57.6 ± 0.45	81.72 ± 0.13	89.21 ± 0.62
Histidine	9.40 ± 0.31	19.4 ± 0.32	32.1 ± 0.14	38.41 ± 0.32
Arginine	/	/	4.5 ± 0.12	7.42 ± 0.71
Threonine	/	/	/	18.41 ± 0.71
Valine	25.32 ± 0.41	/	42.71 ± 0.42	63.12 ± 0.37
Methionine	/	/	13.22 ± 0.54	24.11 ± 0.67
Isoleucine	31.12 ± 0.43	41.77 ± 0.23	83.73 ± 0.42	131.22± 0.32
Leucine	43.71 ± 0.36	58.45 ± 0.61	101.61 ± 0.12	143.71 ± 0.44
Phenylalanine	23.71 ± 0.27	31.66 ± 0.78	86.37 ± 0.19	137.21± 0.54
Total essential FAA	177.76±0.44	208.88±0.38	445.96±0.40	652.82±0.98
Aspartic acid	8.3 ± 0.23	12.2 ± 0.52	48.1 ± 0.33	68.21 ± 0.25
Serine	/	/	/	21.71 ± 0.21
Glutamic acid	39.6 ± 0.61	43.5 ± 0.62	101.21 ± 0.15	118.3 ± 0.41
Proline	32.17 ± 0.21	39.6 ± 0.31	143.12± 0.16	159.61± 0.55
Glycine	13.18±0.36	22.36±0.44	50.52±0.23	83.42 ± 0.71
Alanine	11.43± 0.21	19.44± 0.16	54.16± 0.71	89.19 ± 0.62
Cysteine	/	/	/	/
Tyrosine	/	/	/	/
Total non-essential FAA	104.68±0.29	137.10±0.52	397.11±0.39	540.44±0.74
Total	283.23± 0.31	350.4 ±0.62	853.21± 0.42	1201.2± 1.12

Free Fatty acids

From the results on 90th days of ripening, it can be seen that the highest concentration was determined on caprylic acid (1.3241 mg 100 g^{-1} and capric acid (1.1210 mg 100g^{-1}, followed by the butyric acid (0.8173 mg 100g^{-1}). Similar findings on dynamic and concentration of free fatty acids in semi-hard and hard goat cheese are also determined by other authors (Attaie and Richter, 1996; Ha and Landsay, 1991). It can be noticed from the results that lipolysis in this type of cheese occur with higher activity than other cheeses. It is assumed that micrococcus that are present in milk at the pasteurization regime of 65-68 °C which is applied in the production of this cheese, are also involved in the degradation of milk fat. In the Pecorino cheese milk, compared with other literature data, a higher amount of free fatty acids was found in relation to other hard cheeses obtained from cow's and sheep's milk (Baltadzieva 1985, Litopoulou-Tsanataki and Manolkidis, 1985). This is explained by the specific composition and properties of the fat in goat milk, which are characterized by the higher content of capric acid. Moreover, the fats are morebetter dispersed in the cheese, which allows a more active lipolytic process and a more active lipoprotein lipase in goat milk (Chilliard et al., 1984; Le Jaoven, 1990).

Table 4. FFA profile of Pecorino cheese made from goat milk during ripening

FFA mg 100 g^{-1}	Ripening period (days)		
	30	60	90
Acetic acid	0.0518	0.1628	0.1843
Propionic acid	0.0421	0.0073	0.0107
Isobutyric acid	0.0823	0.1623	0.2343
Butyric acid	0.4191	0.7300	0.8173
Isovaleric acid	0.5821	0.7321	0.8132
Pentanoic acid	0.0921	0.1362	0.1832
Caprylic	0.6731	1.2831	1.3241
Capric	0.5342	1.1831	1.1210

Conclusions

In this paper the technological process, dynamic of the main characteristics, FFA and FAA during ripening of Pecorino cheese made from goat milk are presented. The most dominant Free Amino Acid (FAA) in cheese was proline (Pro), then leucine (Leu), phenylalanine (Phe) and isoleucine (Ile). Regarding the Free Fatty Acid, capric acid and caprylic acid (C8:0) were most dominant. Compared with other hard cheeses from cow or sheep milk, higher concentration of FAA and FFA in goat pecorino cheese was noticed. Intensive lypolitic and proteolytic process in this cheese is due to the specific content and enzymatic activity of the goat milk especially because of the higher content of capric acid and other short-chain fatty acids (SCFA).

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STUDY OF GONADOSOMATIC INDEX OF *SALMO OHRIDANUS* STEINDACHNER FROM OHRID LAKE

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Abstract
With the aim to investigate the gonadosomatic index of Ohrid belvica (*Salmo ohridanus,* Steindachner, 1892), investigations were conducted on individuals captured in vegetative and reproductive development period of belvica, on three localities of Ohrid Lake: Kalista, Kaneo and Elesec, on depth from 45 to 70 m. Samples for researching have average body mass from 90 to 100 g and average total body length from 217 to 225 mm. The gonadosomatic index is the ratio of fish gonads weight to the body weight. It was found that this ratio varies from 0.12 to 6.77 for the three localities during the two stages of development, or that is an average of 0.14 to 5.86. High gonadosomatic indexes were recorded in the reproductive development period, which suggested the spawning period.

Keywords: *Salmo ohridanus*; gonadosomatic index.

Introduction

Ohrid belvica (*Salmo ohridanus*, Steindachner, 1892) as one of the representatives of "living fossils" represents tertiary relict and endemic trout species belonging to macrostom salmonids and lives only in Ohrid Lake. It is a small endemic trout which represents expressively a lake and depth type of fish. Fish body weight and weight of gonad gives the gonadosomatic index (GSI). It is the ratio of fish gonad weight to body weight, and it is particularly helpful in identifying days and seasons of spawning, as the ovaries of gravid females swiftly increase in size just prior to spawning. The ratio determination between the gonad weight and the body weight of various fish species has been studied by many authors (Kompowski, 1982; Witkowski et al., 1989; Heese, 1990; Chelkowski et al., 1990; Chelkowski, 1992; Karabanowicz & Kompowski, 1994; Kompowski & Blaszczyk, 1997; Roesch, 2000; Neja & Kompowski, 2001; Dziewulska and Domagala, 2003; Czerniejewski et al., 2004; Ghanbahadur & Ghanbahadur, 2012; Sadekarpawar & Parikh, 2013; Ghanbahadur et al., 2013; Jan&Ahmet, 2016). Most of the authors concluded that the development and growth of gonad simultaneously take place in the fish and fish grows and the GSI is high. Gonadosomatic index of fish is related to spawning and reproduction of fish. At maturity stage fish has maximum GSI value and after spawning the GSI value declines. The GSI value, also, is related to the amount of food available to them in water and temperature of water also. So, generally, during the breeding season, *Salmo ohridanus* shows maximum GSI value and after spawaning it is reduced. This paper presents the data for the seasonal changes in gonadosomatic index (GSI) of vegetative and reproductive development period of Ohrid belvica from the lake of Ohrid.

Material and methods

Investigations were conducted on fish species from Ohrid belvica (*Salmo ohridanus,* Steindachner, 1892). The samples were captured in vegetative and reproductive development period of Ohrid belvica, on three localities of Ohrid Lake: Kalista, Kaneo and Elesec, on depth from 45 to 70 m. Tests were performed on 15 samples of each locality and each phase of development or a total of 90 fish. Samples for researching have average body mass from 90 to 100 g and average total body length

from 217 to 225 mm. The whole body weights, the eviscerated body weights of the examined fish and the weight of gonads were measured to 0,01 g. The gonad development was presented (after Nikolski, 1961 quoted by Pravdin, 1966) by means of the gonad maturity coefficient:

$$q = \frac{g_1}{g} \times 100$$

where: q = gonad maturity coefficient; g_1 = gonad weight; g = total fish weight.

Coefficient of relative gonads size was calculated using the following formula (Chełkowski, 1974):

$$I = \frac{i}{G} \times 100$$

where: I = coefficient of relative gonads size; i = gonad weight in g; G = eviscerated body weight (weight of the gutted fish in g).

The data obtained from measurements are processed by the method of the smallest squares, and the results consist of the arithmetic mean ($\overline{X}$), standard deviation (SD), coefficient of variation (Cv) and differences in $\overline{X}$.

Results and discussion

The gonadosomatic index (GSI) is expressed from the gonad maturity coefficient and the coefficient of relative gonads size. Gonad maturity coefficient is the ratio of fish gonad weight to the total body weight. Coefficient of relative gonads size is the ratio of fish gonad weight to the weight of the gutted fish. Gonad maturity coefficient and the coefficient of relative gonads size, separately for the vegetative and reproductive stage of development of the Ohrid belvica, are shown in Table 1 and Graph 1.

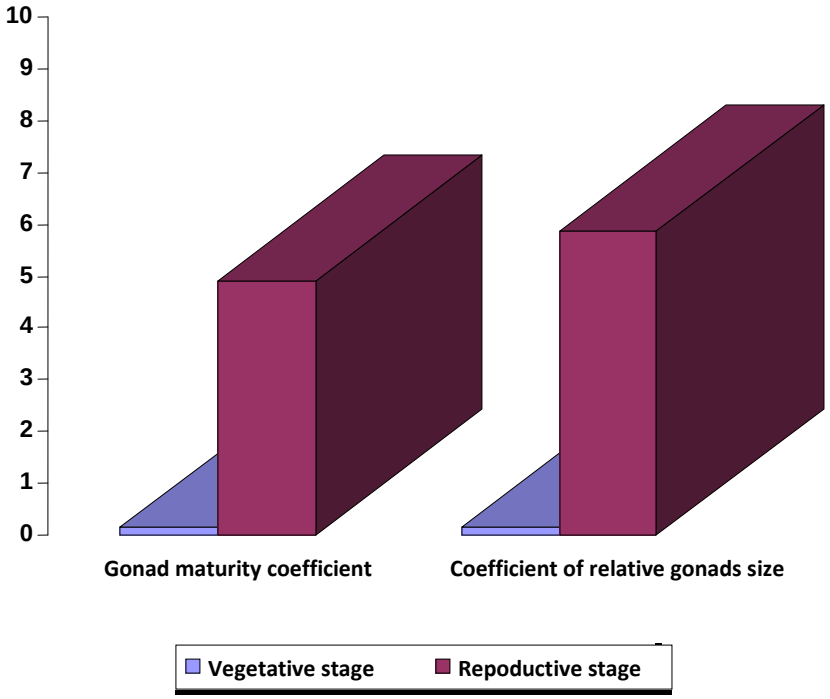
Table 1. Gonad maturity coefficient and coefficient of relative gonads size

Stage	Gonad maturity coefficient			Coefficient of relative gonads size		
	$\overline{X}$	SD	CV	$\overline{X}$	SD	CV
Vegetative stage	0,14	0,01	7,14	0,16	0,02	12,50
Reproductive stage	4,90	0,67	13,67	5,86	0,84	14,33

Gonad maturity coefficient for the investigated period of the individuals in the vegetative stage of belvica was 0.14 (0.12 – 5.60) and for the individuals in the reproductive stage – 4.90 (3.86 – 5,60). Coefficient of relative gonads size in the vegetative stage of belvica was 0.16 (0.13 – 0.18), and in reproductive stage – 5.86 (4.63 – 6.77).

The results from examination the gonadosomatic index, that is, the gonad maturity coefficient and coefficient of relative gonads size, show that the participation of gonads in the total mass of fish and in the eviscerated fish, in the reproductive stage are higher compared to the vegetative. The differences between the stages in the participation of gonads are significant ($P<0.05$). These differences are expected, because in the reproductive phase, gonads reach their maximum growth, i.e. they are sexually matured and their mass is greater. The gonadosomatic index expresses the relative change in gonad weight to the percentage of body weight. However, the unequal intensity of fish feeding during the year, is more accurate if the weight of the gonads is expressed as a percentage of the weight of the fish without the internal organs, thus avoiding the error that would arise as a consequence of the intensity of the diet at the moment of catching (Janković, 1958). The ratio of the gonad weight and the total weight of the fish Pravdin (1966) and Heese (1990) call the gonad maturity coefficient, and Witkowski et al. (1989) use the term gonadosomatic index. The relation of the gonad weight and the weight of the fish without internal organs (eviscerated fish)

Chełkowski (1974) is called as a coefficient of relative gonads size or relative gonad weight. Both relationships are parameters that have practical significance because according to them, they can judge the readiness of the population for spawning.



Graph 1. Gonad maturity coefficient and coefficient of relative gonads size

Much higher values for these coefficients (4.90 and 5.86, respectively) were found in the reproductive phase (winter period), when most of the examined individuals had maximally developed gonads (Table 1). This is, in fact, the time when most of the population of Ohrid belvica is found before the spawning or during the active spawning. In the vegetative stage of development of Ohrid belvica (autumn period), lower values of the coefficients (0.14, or 0.16) are determined, because then the weight of the gonads is small. According to Rakaj and Flloko (1995), the gonadosomatic index in the maximal development of ohrid belvica reaches 22 to 23% of the body's weight.

Conclusions

Based on the results of determination the gonadosomatic index of Ohrid belvica from three localities of Lake Ohrid, during the vegetative and reproductive stage, following could be concluded:

- The ratio of fish gonads weight to the body weight varies from 0.12 to 6.77 for the three localities during two stages of development, or that is an average of 0.14 to 5.86.
- High gonadosomatic indexes were recorded in the reproductive development period, which suggested the spawning period.

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ANALYSIS OF ANNUAL HEALTH RECORDS IN ONE DAIRY FARM

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Abstract
Modern technologies of dairy cows breeding is followed by a number of health problems. Perhaps no one single factor has the ability to affect the performance of animal populations as severely as diseases. The objective of this study was to obtain information about dairy cow's health challenges for intensive dairy farm and about the guidelines which should be improved. A one year retrospective study was performed for prevalence determination of the most common health disorders in one dairy farm. The survey included a total of 203 black-white dairy cows in lactation. Cows with health disorders were detected by clinical observation. The data for each cow were obtained from the reproductive board. The annual prevalence of health disorders was 50.25%. The most prevalent health disorder in dairy herd was mastitis (84.31%), than following arthritis (5.88), laminitis (2.94%), abscess (2.94%), indigestion (1.96%), pneumonia (0.98%) and diarrhea (0.98%). The highest prevalence was registered in winter season (88.89%) and the lowest in summer season of the year (38.16%). The older cows had the highest risk to suffer from such health disorder. During the survey, only cows that suffer from mastitis manifested repeated cases of disease during lactation. Regardless parities, the first case of health disorder in dairy herd occurred on the average 96.64±8.532 days in lactation. The average period needed for treatment of diseased cows was 3.69±0.121 days. The method of GLM, univariate procedure, was used to analyze risk factors which are responsible for occurring of health disorders in dairy farm. Among the risk factors that were found to affect the health of dairy cows, season of year had have significant influence at level $p<0.001$, while total milk yield estimated for 305 days in lactation influenced at level $p<0.01$.

Keywords*:* dairy cows, health dissorders, risk factors.

Introduction

The mean output of milk per cow has risen steadily as a result of improved nutrition, breeding and management (LeBlanc et al., 2006). Economic margins of dairy herds are, however, narrow. Optimization of the economic results, therefore, becomes important, and the need for cost minimization at every level of production is accentuated. A means of reducing the costs of production is to decrease the incidence of production disorders, as such are associated with reduced production, veterinary costs, and increased replacement rate, and, consequently, give rise to economically less efficient herds. Dairy farmers are confronted every day with challenges regarding animal health and welfare (Kielland et al., 2010). Whereas some farmers focus mainly on high milk production, others concentrate on animal health, milk quality, or other issues (Bergevoet et al., 2004; Kristensen and Enevoldsen, 2008). There is an intuitive assumption that increasing milk yields may increase the risk of failures of cow health (Berry et al., 2003). Perhaps no one single factor has the ability to affect the performance of cattle populations as severely as infectious and production diseases. Petrujkić et al. (2009) list diseases related to the production and reproduction cycle of the cow: parturient paresis, retained fetal membranes and metritis, mastitis, indigestion, abomasal displacement during the periparturient period, ketosis and pneumonia. Other diseases which are largely pathogenic in origin can occur at any time during the production cycle. Bernabucci et al. (2002) describes how the high yielding dairy cow can be placed under severe metabolic stress in early lactation reducing her resistance to other metabolic and infective diseases. Among others,

mastitis and laminitis are of considerable interest because of its high incidence and the extensive costs associated with these diseases (Sulayeman and Fromsa, 2012; Nakov et al., 2014). Animal identity, production, and disease recordings are all essential parts of good dairy farm management and good prevention of disease and quality assurance systems. Traditionally, veterinary science relies on disease diagnosis based on a mix of physical signs such as temperature, heart and respiration rate mixed with clinical observations and occasionally laboratory methods for confirmation of pathological processes and biochemical status. In effect, the herdsperson and veterinarian have an experience model in order to augmenting the herdsperson's skill at detecting deviations from normal animal condition rather than replacing the veterinary skill of diagnosis. Deviation from the normal is largely detected by the observations of the herdsperson which usually correlated with changes in milk yield. A veterinarian may then be called to make a diagnosis based on his or her training and experience. Databases with animal-disease information are valuable resources in epidemiological research as well as for evaluation of genetic progress. The national animal disease-recording systems aims to monitor the incidence of disease in animal populations, provide data on national and herd disease status, include disease data in breeding goals and provide data for research. It is based on veterinary reporting and all species of animals are included, although the emphasis is on production animals. Several countries have recordings of production organized within an animal recording system (International Committee for Animal Recording, 2007). In some countries, systematic epidemiological surveys of disease incidences in dairy production have been organized, such as the National Animal Health Monitoring System in the United States (Kaneene and Hurd, 1990) and others in Canada (Sargeant et al., 1998; van Dorp et al., 1999). However, only a few countries have reported disease recordings from the majority of the dairy cattle population within the framework of an animal recording system, as are Nordic countries (Bartlett et al., 2001). Therefore, in order to show the importance of health records in the farm management, the main aim of the performed survey was to determinate the most prevalent clinical health disorders in one dairy farm registered by a veterinarian working on the farm and data imported in the reproductive board.

Material and methods

A one year retrospective study was performed for prevalence determination of the most common health disorders in one dairy farm for intensive breeding. Management practice in the dairy farm is production in loose-housing system with enclosed shed. Milking of cows is performed in milking parlour. Pre-milking and post-milking hygiene measurements were practiced in permanency. The data for each cow was obtained from the reproductive board. The survey included a total of 203 black-white dairy cows in lactation. The research was divided in four seasons during the year. Cows with health disorders were detected by clinical examination. The objectives of observation were health disorders related to reproduction, lactation, metabolism, locomotion disorders and disorders of digestion and respiration. The risk factors for occurrence of health disorders followed were: cow parity, days in lactation, individual lactation curve based on the monthly test day milk yield, days in lactation when the case of health disorders was diagnosed and days of treatment. Statistical procedures were conducted in SPSS 20.0 for Windous. Pearson’s coefficient of correlation was used for calculation of interdependence between variables in the model. Data analysis was carried out with GLM-General Linear Model. Dependent variable in this analysis was binary value of health records which made difference between cows with case of some clinical disorder during lactation and healthy cows. Statistical significance was evaluated on level $p<0.05$; $p<0.01$ и $p<0.001$. Analysis of variance in the model, used for determination of influence on independent variables on prevalence of health disorders, was made according equation:

$$Y_{ijk}=\mu+L_i+Y\_S_j+DIM_k + M\_305_l + e_{ijkl}$$

Where, Y_{ijk} = calculated overall prevalence of health disorders; μ = average; L_i= consecutive lactation or cow parity (i = 1, 2, 3, 4); Y_S_j = year season when the case of health disorder was diagnosed (j = 1,

2, 3, 4); DIM_k = covariance of days in lactation when case of clinical health disorders was diagnosed; M_305 = covariance of test day milk yield per cow for 305 days in lactation; e_{ijkl}= error of the model.

Results and discussion

Table 1 showed data for annual prevalence of health disorders related to the seasons of the year. According the results, the highest prevalence of health disorders in dairy herd was recorded in the winter season (88.89%), while the lowest prevalence in summer (38.16%). The annual prevalence of clinical health disorders was 50.25%.

Table 1. Annual prevalence of health disorders by season of year

Season Year	n	Healthy cows	Cows suffer from health disorder	Prevalence (%)
Spring	35	18	17	48.57
Summer	76	47	29	38.16
Autumn	65	33	32	49.23
Winter	27	3	24	88.89
Year	203	101	102	50.25

When the cow parity was taken in consideration (Table 2), than the prevalence of health disorders was increased with increasing the cow parity, or consecutive lactation, beginning from cows in first lactation (46.55%) up to cows in the forth and higher lactation (57.14%).

Table 2. Annual prevalence of health disorders related to cow parity

Parity	n	Healthy cows	Cows suffer from health disorder	Prevalence (%)
1	58	31	27	46,55
2	76	37	39	51,32
3	34	18	16	47,06
4≥	35	15	20	57,14
Total	203	101	102	50,25

However, independently from the lactation, the prevalence rate of clinical disorders in dairy farm was high (50.25%). From analysis of showed results in Table 3, there might been noticed that mostly of the cows were suffered from clinical mastitis and the prevalence was 84.31%. Rarely, the cows suffer from laminitis, pneumonia, indigestion, diarrhoea, abscess and arthritis.

Table 3. Annual prevalence of health disorders in entire population

	n	%		n	%
Total observed cows	203	100,00			
Cows suffer from health disorder	102	50,25	Mastitis	86	84,31
			laminitis	3	2,94
			Pneumonia	1	0,98
			Indigestion	2	1,96
			Diarrhea	1	0,98
			Abscess	3	2,94
			Arthritis	6	5,88

In Table 4 is shown the number of cases of clinical disorders during lactation and occurrence of recurrent cases during the same lactation. Only the cows that suffered from the case of clinical mastitis during the lactation had a risk for manifestation of recurrent consecutive mastitis. The first parity cows had a longest period in lactation free form clinical disorders (114.37±16.359 days) but period in lactation free form health disorders decrease as cow parity increase. The average duration of treatment of illness cows was 3.69±0.121 days.

Table 4. Repeatability of health disorder cases per lactation

	1 case		2 cases		Total	
	n	%	n	%	n	%
Mastitis	78	90,70	8	9,30	86	100,00
laminitis	3	100,00	0	0,00	3	100,00
Pneumonia	1	100,00	0	0,00	1	100,00
Indigestion	2	100,00	0	0,00	2	100,00
Diarrhea	1	100,00	0	0,00	1	100,00
Apses	3	100,00	0	0,00	3	100,00
Arthritis	6	100,00	0	0,00	6	100,00
Overall cases	94	92,16	8	7,84	102	100,00

Table 5. Average days in lactation when case of clinical health disorders was diagnosedand average days of treatment of illness cows

		DD*	DT**
Parity	H	$\overline{x} \pm S_{\overline{x}}$	$\overline{x} \pm S_{\overline{x}}$
1	27	114.37±16.359	3.96±0.264
2	39	98.15±14.243	3.49±0.183
3	16	67.50±16.063	3.63±0.239
4≥	20	96.55±21.613	3.75±0.298
Total	102	96.64±8.532	3.69±0.121

*Days from beginning of lactation until the diagnosis of clinical health disorder
**Days in treatment of illness cows

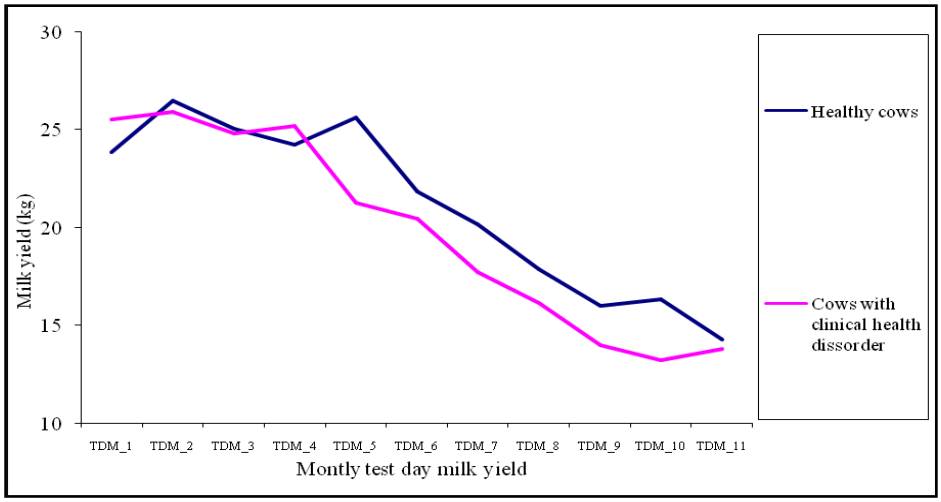

Figure 1. Lactation curves for healthy cows and cows with health disorder based on monthly test day milk yield control

The lactation curves indicate that healthy cows yielded more milk than did cows with some clinical health disorder. The milk yield of diseased cows dropped more sharply in the fifth milk control. However, in booth groups of healthy and clinically diseased cow's milk yield began to decline in the sixth milk control and continued to decline in the next milk control up to the finish of the lactation.

Table 6. Average milk yield for 305 days in lactation and duration of lactation in healthy cows and cows suffer from health disorders

		Healthy cows	Cows with health disorder	Total
		n=101	n=102	n=203
M_305*	$\overline{x} \pm S_{\overline{x}}$	6401.67±159.366	5472.71±152.317	5934.90±114.683
DIM**	$\overline{x} \pm S_{\overline{x}}$	308.4±6.048	271.47±9.094	289.84±5.61

*Milk yield for 305 days in lactation based on monthly test day milk yield control
**Days in milking

There was statistical significant difference in the milk yield for 305 days in lactation between healthy cows and cows suffer from some clinical health disorders (df=1; F=17.765; p<0.001). Healthy cows had have a longer lactation than cows with health disorder (df=1; F=11.386; p<0.01). Estimation of interdependence between variables in the statistical model was performed with Pearson's coefficient of correlation, showed in Table 7.

Table 7. Pearson's coefficient of correlation for health risk factors

	Y_S	DD	DIM	M_305
L	0,061	0,056	0,086	0,058
Y_S		0,222**	0,182**	0,023
DD			0,232**	0,285**
DIM				0,557**

**significant at level p<0.01

In Table 8 is shown the statistical analysis of the factors considered in the model used for determination of influence on independent variables on prevalence of clinical health disorders.

Table 8.The influence of risk factors on health disorders prevalence

Dependent variable: prevalence of health disorders			
Source of variations	df	Mean square	F-value
Model	9	6,817	32,540***
L	3	0,150	$0,715^{NS}$
Y_S	3	1,775	8,471***
DIM	1	0,214	$1,024^{NS}$
M_305	1	1,832	8,742**
e	194	0,210	
Total	203		
R^2 = 0.583			

***significant at level p<0.001
**significant at level p<0.01
^{NS}non significant

There was statistical significant influence (p<0.001) of year seasons on prevalence of health disorders in dairy cows. The milk yield for 305 days in lactation showed statistical significant influence on health disorders prevalence. The cow parity and days in lactation didn't show statistical significant influence on health disorders prevalence in dairy herd. Value for R^2 = 0.583 in the model was high, which means that variance for prevalence of clinically health disorders in dairy cows can be explained by the source of variations. The health management of dairy herds is critically important part from the overall farm management as has direct influence on dairy cow's productivity and reproduction. Additionally, effective health management increases the cow's welfare (Kielland et al., 2010). Regarding the Sulayeman and Fromsa (2012), mastitis and laminitis have a major impact on economical losses in dairy farms. Costs due to clinical mastitis and laminitis arise from treatment, reduced milk production, increased risk of culling and increased risk of subsequent diseases (Petrovski et al., 2006). Mastitis commonly occurs in cows with high milk production and has a long lasting effect on milk yield. The disease has a big influence on productivity and utilization of genetic potential of dairy cows. The biggest milk yield losses were observed when clinical mastitis was occurred in early lactation (Hagnestam et al., 2007). The cows that were suffered from clinical mastitis never ever were reached current milk yield during the rest of the lactation. National data from countries which are the biggest milk producers, informed that annually 20 to 40% of dairy cows have expressed clinical mastitis during lactation (Bartlett et al. 2001). According the data from the research performed in Macedonia (Trajchev at al., 2013), the annual prevalence of clinical mastitis in dairy farms was 34.13% on cow level and 30.07% on lactation level. The increase in clinical mastitis

incidence is probably due to increased awareness on the part of farmers of the need to keep the bulk milk SCC at a low level to satisfy the requirements of the quality payment system. The incidence of hock lesions and arthritis in dairy herds is indicator for cow welfare and rearing discomfort (Rutherford et al., 2008). Aseptic pododermatitis is one of the most common health problem in almost all dairy farms during the year which primarily occurs due to introduction of large amounts of easily digestible carbohydrate feeds (rumen acidosis). Pododermatitis development can be contributed by other factors e.g. short and uncomfortable bed (Relić and Damnjanović- Radenković, 2009). Literature data reported different values for laminitis in dairy farms, ranged from 4 to 55 cases per 100 cows (Clarkson et al., 1996; Whitaker et al., 2000). According Lim et al. (2013), there is positive correlation between occurrence of arthritis and laminitis in dairy cows. The prevalence of arthritis in dairy farms was ranged from 47.3% to 81 % (Brenninkmeyer et al., 2012; von Keyserlingk et al., 2012). Gastrointestinal disorders make considerable losses in the dairy farm, especially in calves when are connected with body mass losses and increased calf mortality (Torsein et al., 2011). Diarrhea is a syndrome of complex etiology, resulting from the interaction of the environment, nutrition and the mutual action of several different infectious agents (Bojkovski et al., 2009). Respiratory diseases represent a constant problem with seasonal intensifying, especially in farms with poorly implemented zoohygienic measures (Bojkovski and Relić, 2012). Clinical mastitis is also the most common disease in other studies in the literature that present disease rates. A study from France (Fourichon et al., 2001) revealed that the most common disease in dairy cattle was clinical mastitis (with 44.1 cases per 100 calvings), locomotor disorders (with 10.9 cases), digestive disorders (with 5.1 cases), retained placenta (with 8.8 cases), dystocia (with 6.6 cases), milk fever (with 5.6 cases), and chronic metritis (with 5.1 cases). A British study covering 340 herds had 36.6% mastitis, 23.7% lameness, 5.3% hypocalcemia, 8.7% assisted calving, 1.3% digestive diseases, 0.7% hypomagnesemia, and 0.4% ketosis (Whitaker et al., 2000). The newest data revealed that there is improvement in the health management of dairy cows but further research is needed for determination of risk factors that influence the health status of dairy herds (Norman et al., 2009). Some of the diseases that are very frequent, such as mastitis, may occur several times during the lactation. Other diseases are more infrequent, but some of them when occur then it is very difficult to treat. Examples of these hard-to-treat diseases are arthritis, phlegmons, respiratory diseases, hoof diseases, and malignant catarrhal fever (Muller-Dublies et al., 2001). Diseases with a low number of treatments per diseased cow were those that respond very well to therapy or those that, when veterinarians are called, mean there is a problem that has to be solved at once. For some of these diseases, it is typical that if they cannot be cured, the animal will be slaughtered. The farmers should pay attention in reduced antibiotic treatment duration because of awareness of producers' organization to reduce the unnecessary use of antibiotics.

Conclusions

In accordance with previous work udder diseases, lameness, arthritis and occurrence of abscess were the most challenging health problems in dairy farm. When diseases are recorded under practical farming conditions, there will always be some reasons for misclassification. The errors could occur at the veterinary level, the farmer level, or the reporter level. Dairy farms need consultancy services in various aspects of animal health. There is an urgent need for good animal disease recording system in Macedonia as the need for health records increases for daily farm management, breeding purposes and traceability. Good cooperation between farmers, veterinarians, and other institutions involved in livestock production is an important component in modern herd health management.

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EFFICIENCY OF INSTALLED COOLING SYSTEMS IN DAIRY BARNS DURING HOT SEASON

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Abstract

Hot season of the year has profound effects on the production, health, profitability, and welfare of dairy cows. The objective of this study was to evaluate the efficacy of cooling systems in controlling the microclimate condition inside the two dairy barns. There was set out to compare the ambient conditions inside the barn with environmental weather data obtained from local meteorological station. The experiment was carried out at the height of summer (from 15th of June to 31st of August) in two familiar dairy farms. Within the barns air temperature, relative humidity and their ratio expressed as temperature humidity index (THI) were measured hourly during the trial period using data loggers. The Pearson's coefficient of correlation demonstrates that climate condition inside the barns and the official local meteorological station significantly correlate. The air temperature and THI were significantly higher in the Farm 1 (1.53±0.239^{0}C higher, t=6.420; p<0.001, and 2.05±0.344 units higher, t=5.973; p<0.001, respectively) and in the Farm 2 (1.65±0.252^{0}C higher, t=6.549; p<0.001, and 2.12±0.357 units higher, t=5.927; p<0.001, respectively) compare with the environmental weather data. The method of GLM, multivariate procedure, showed that there was statistical significant differences in the minimal values for daily microclimate parameters inside the barns before and after installation of cooling equipment. However, the interaction between the farm and cooling system, months and days of hot summer season showed statistical significant influence on the microclimate conditions inside the cow barns with exception for the maximal values for air temperature and THI. In conclusion, due to farm specific and unpredictable variability in climate conditions inside the cow barns and their correlation with environmental weather data, the installed cooling systems could provide better climate zone in the barns for increased milk production but couldn't completely satisfy capacity of cooling during the day time with highest air temperature.

Keywords: climate condition, dairy cow, temperature-humidity index.

Introduction

Environmental conditions, such as solar radiation, high air temperature and relative humidity are the main stress factors for dairy cows (Silanikove, 2000). The etiology of heat stress consists in failure to maintain the core body thermo-neutrality with increasing ambient temperature and humidity. To gauge the level of heat stress in cattle, a composite index of heat and humidity, the temperature-humidity index (THI), is a widely used metric (Bohmanova et al., 2007). A cow may start to show signs of heat stress beginning at a temperature-humidity index (THI) of around 68 (Zimbelman et al., 2009). Exposure of dairy cows to a thermal environment is a major risk factor for decreased milk production; especially in high-yielding cows than low-yielding ones (Kadzere et al., 2002) due to combined accumulation of heat gained from the environment and metabolic heat (Rhoads et al., 2009). When dairy cows are under heat stress, than accumulated heat exceeds the body capacity for heat loss by radiation, convection and conduction. Recently, it has been demonstrated that a trend exists in the dairy industry toward fewer and larger dairy farms housing more cows under one roof (Winsten et al., 2010), which might increase the risk of suboptimal climate conditions. In order to reducing heat load of dairy cows rearing under high ambient temperatures accomplished with the higher metabolic heat production, additional cooling measures during the year season of thermal stress are required (Collier et al., *2006*). Previous studies have shown that evaporative cooling is

effective in reducing thermal stress on lactating dairy cows in worm climates (Berman, 2009). The climatic condition in Republic of Macedonia is Continental – Mediterranean, characterized with very hot and dry periods during the summer. The temperature rises up to 40^0C in the summer season. In this zone, animals are exposed to heat stress over than three months annually. Extended periods of excessive ambient heat negatively affect the productive performance and welfare of dairy cattle, causing serious economic losses to the dairy industries.This research was following the trial that was done the year before aimed to underline the detrimental impact of environmental thermal stress in terms of milk yield losses of dairy cows rearing in local conditions in the Republic of Macedonia (Trajchev et al., 2016). Therefore, the objectives of this research were to compare the microclimate conditions of two dairy facilities after installation of cooling systems for reduction of heat stress with the climate data recorded from the nearby official meteorological stations.

Material and methods

The experiment was carried out at the height of summer (from 15th of June to 31st of August) in two familiar dairy farms (1 and 2). The main reason for continuing the experiment from the previous year was installation of cooling system in two dairy farms for microclimate controlling. These farms previously didn't have any cooling system inside barns. The dairy farms included in the survey are located in the municipality of Strumica, southeastern region of Republic of Macedonia. With the small exceptions, the farms included have similar management system. Management practice in farm 1 and farm 2 is production in tie-stalls with enclosed shed. The volume of the farm 1 is around 192m^3 (8m width * 8m length * 3m height). The volume of the farm 2 is around 600m^3 (10m width * 20m length * 3m height). These farms are practicing intensive dairy cattle breeding, based on high milk yield breed. Totally 18 dairy cows from Holstein black-white breed were subjected to the study (6 cows in farm 1 and 12 cows in farm 2). Cows had free access to drinking water in the holding pen. Milking of cows is performed with transferable milking system. The cows were milking twice daily (morning and evening milking) with some exceptions of dairy cows in the period of early lactation when were milking three times daily (morning, afternoon and evening milking). The summer season of research was divided in three reporting periods: the first reporting period (from the 15th of June to the 30th of June), the second reporting period (from the 1st of July to the 31st of July) and the third reporting period (from the 1st of August to the 31st of August). Every day during the trial period hourly was measured weather parameters in the both of observed farms. In the first reporting period from the June 15th 2016 until June 30th 2016 the installation of the cooling equipment on the farms has been finished. Furthermore, monitoring and testing of the equipment was implemented. The cooling systems on the both farms were started when the first heat wave was noticed. The installed equipment in the barns of the farm 1 included one fan and three fans plus fogging system in the farm 2. The fans installed in the both of farms can be started in two ways: manually and automatically. Fans were set to start automatically when the air temperature in the barns reaches 30^0C, and they shut down when the air temperature in the barns falls down to 28^0C. For that aim, inside the electrical box a thermal probe (thermostat) was installed. The installed fogging system on the farm 2 is not a professional system as the professional one is too expensive for the small farmers. For that reason we decided to install the fogging system which is similar as that used in the vegetable production (green house). The fogging system was set to start automatically when the fans turn on, and they switch off when the fans shut down. This is regulated by the electromagnetic water valve. During the second and the third reporting period the cooling system installed in the both dairy farms (fan/fans plus fogging) was working depending of the air temperature in the barns. The cooling systems on the both farms were started when the first heat wave was noticed. For prompt observation of the variations in weather parameters, the automated temperature and humidity data loggers were set inside the barns. The air temperature inside barns (T_IB), relative humidity (RH_IB) and their interaction represent as temperature-humidity index (THI_IB) were measured hourly during the trial period. The data for environmental weather parameters: the air daily temperatures (T_E) - average minimal and maximal air temperature then the daily relative

humidity (RH_E) - minimal and maximal, were obtained by the National Hydro-meteorological Service of Republic of Macedonia from the meteorological station located in the region of Strumica. Their interaction expressed as environmental temperature-humidity index (THI_E) was calculated from obtained data. The maximum distance between each farm and meteorological weather station was around 20 km. The calculation of the average daily relative humidity was done as mean value from the minimal and maximal daily relative humidity.

Temperature–Humidity Index (THI) was calculated according to Hahn (1999) as:

THI_IB = (0.81 * T_IB) + (RH_IB/100) * (T_IB - 14.4) + 46.4

THI_E = (0.81 * T_E) + (RH_E/100) * (T_E - 14.4) + 46.4

Statistically, daily average, minimal and maximal air temperature and relative humidity were calculated from the hourly data gained from the automated temperature and humidity data loggers. Weather data in this experiment were analyzed by using the descriptive statistics and GLM, multivariate procedure of software SPSS 20.0. Statistically, the data were presented as mean ± standard error of the mean. The statistical signification of the differences between daily weather data of the official meteorological station and the climate loggers were assessed using a paired *t*-test.

Results and discussion

Variations in the average daily values for the air temperature inside the cow barns and environmental air temperature are shown on figure 1. It is obviously that the ambient air temperature inside the dairy facilities is quite higher comparing with the average environmental air temperature. There is a trend of decreasing of mean air temperature inside the barns after installation of cooling equipment.

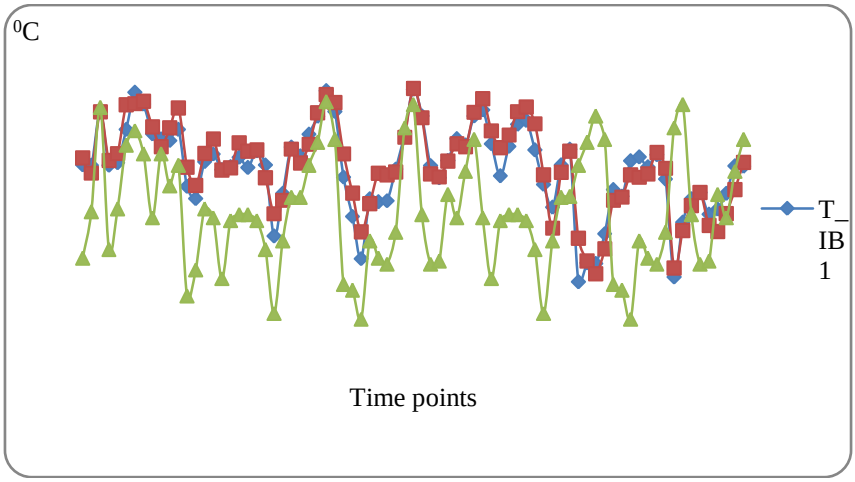

Figure 1. Variations in the mean daily air temperature readings between on-farm loggers and meteorological station readings during the trial period

Variations in the average daily values for the air relative humidity inside the cow barns and the environmental air relative humidity are shown on figure 2. There wasn't a big difference in the average daily values for air relative humidity in the cow barns and the environment. In the third reporting period there were recorded highest average values for daily air relative humidity.

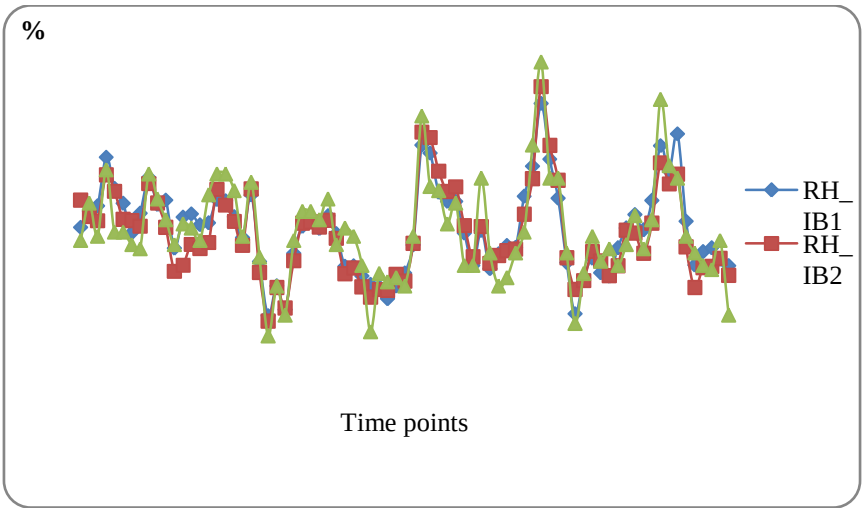

Figure 2. Variations in the mean daily air relative humidity readings between on-farm loggers and meteorological station readings during the trial period

Variations in the average daily values for THI inside the cow barns and the environmental air relative humidity are shown on figure 3. Continuously, during the whole trial period the mean daily values for THI were highest inside the cow barns compare with the environmental data for average daily THI.

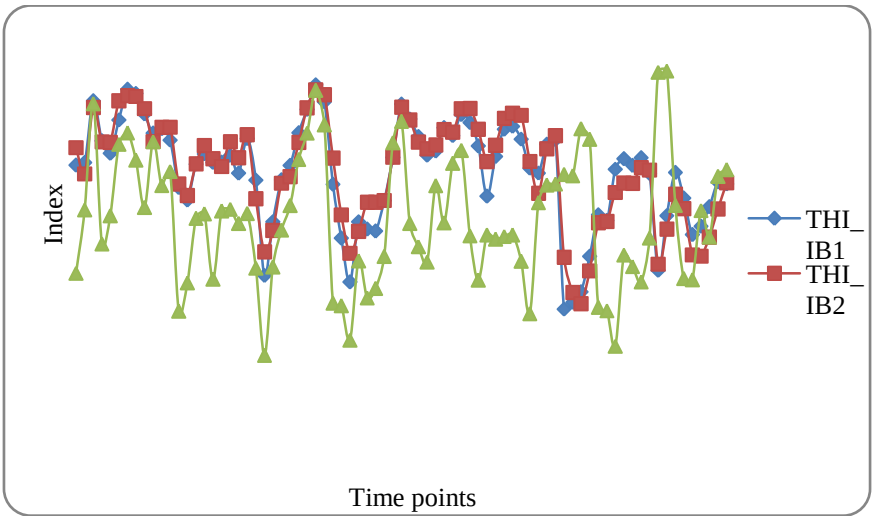

Figure 3. Variations in the mean daily temperature-humidity index (THI) readings between on-farm loggers and meteorological station readings during the trial period

Measures of correlations demonstrate that climate condition inside the barns and the official local meteorological station significantly correlate (table 1). It was found that air temperature and THI were significantly higher in the farm 1 (1.53±0.239^{0}C higher, t=6.420; p<0.001, and 2.05±0.344 units higher, t=5.973; p<0.001, respectively) and in the farm 2 (1.65±0.252^{0}C higher, t=6.549; p<0.001, and 2.12±0.357 units higher, t=5.927; p<0.001, respectively) compare with the environmental weather data. The relative humidity was 0.15±0.314% higher in the farm 1 than at the official meteorological station and this difference wasn't statistically significant (t=0.467). When compare the relative humidity in the farm 2 with data from the official meteorological station, then the relative humidity was higher at the environment than in the cow barns of the farm 2 (0.39±0.323%) and this difference wasn't statistically significant (t=1.232). The results from the statistical GLM model, multivariate procedure for influence of fixed variables on weather data inside the dairy facilities are shown in table 2.

Table 1. Mean ambient temperature, relative humidity and temperature-humidity index onsite and at the official meteorological station

	Farm 1	Farm 2
T_IB ($\overline{x} \pm S_{\overline{x}}$)	27.21±0.166^{0}C	27.32±0.170^{0}C
T_E ($\overline{x} \pm S_{\overline{x}}$)	25.67±0.224^{0}C	25.67±0.224^{0}C
N	77	77
Difference ($\overline{x} \pm S_{\overline{x}}$)	1.53±0.239^{0}C (t=6.420***)	1.65±0.252^{0}C (t=6.549***)
Correlation	0.273*	0.205*
RH_IB ($\overline{x} \pm S_{\overline{x}}$)	60.87±0.599%	60.32±0.615%
RH_E ($\overline{x} \pm S_{\overline{x}}$)	60.72±0.679%	60.72±0.679%
N	77	77
Difference ($\overline{x} \pm S_{\overline{x}}$)	0.15±0.314% (0.467^{NS})	-0.39±0.323% (-1.232^{NS})
Correlation	0.887***	0.880***
THI_IB ($\overline{x} \pm S_{\overline{x}}$)	75.83±0.253	75.89±0.254
THI_E ($\overline{x} \pm S_{\overline{x}}$)	73.78±0.321	73.78±0.321
N	77	77
Difference	2.05±0.344 (t=5.973***)	2.12±0.357 (t=5.927***)
Correlation	0.301**	0.247*

*** significant at level p<0.001
** significant at level p<0.01
* significant at level p<0.05
^{NS} non significant

The statistical model reveal that there was statistical significant differences in the minimal values for daily microclimate parameters inside the barns before and after installation of cooling equipment. In meantime, the period of year and days during the trial have significant influence on mean values for wether data. However, the interaction of cooling systems, months and days of hot summer season showed statistical significant influence on the microclimate conditions inside the cow barns with exception for the maximal values for air temperature and THI. Implementation of cooling systems in dairy herds can improve milk performance of lactating Holstein cows, and lessen the severity of heat stress during summer months. In this trial, average daily THI measurements inside the cow barns ranged between 69.90 and 79.60 and were above a threshold level 68 of THI considering to represents mild to moderate heat stress (Zimbelman et al., 2009). Previous studies has demonstrated the negative effects of heat stress on milk production start at a THI of 55 and are more evident at higher THI and high ambient air temperature (Garcia-Ispierto et al., 2006; Trajchev et al., 2016). The high temperature and humidity of the environment restrict the passing of the heat from the surface of the body, which can lead to a retrograde heat flow. Thermal stress enforced by high ambient temperatures may be alleviated by using forced ventilation and evaporation of water, which may be attained using cooling systems based on spray and fans. The results from the present research indicating that ambient air temperature and THI were higher inside the barn compared with the official meteorological station during hot climate conditions. These results are in agreement with Schuller et al. (2013), who found that temperature, RH, and THI were all consistently higher within the barn microclimate compared with official meteorological stations. A variety of factors could influence the microclimate within the barn environment and explain why they might differ from meteorological station conditions. Some structural considerations that affect the internal environment of a barn and that were not assessed in the current study include barn orientation relative to prevailing winds, presence of foliage surrounding the structure, elevation, barn width, roof slope, and roof type and insulation (Shoshani and Hetzroni, 2013). Higher air temperature in the barn during summer months may be a result of a poor ventilation and heat congestion usually caused by structural deficiencies or insufficient use of fans and sprinklers (Collier et al., 2006). Literature data reported that evaporative cooling can improve the environment of dairy cows better than using just the system of fans (Collier et al., 2006).

Table 2. Multivariate GLM for influence of cooling system and hot season of year on average daily, minimal and maximal values of weather data

Fixed variables	df	T_Ib[a]	T_Ibmin[b]	T_Ibmax[c]	RH_Ib[d]	RH_Ibmin[e]	RH_Ibmax[f]	THI_Ib[g]	THI_Ibmin[h]	THI_Ibmax[i]
Model	139	9070,368***	2354,896***	612,732***	1220,029***	283,815***	1692,408***	77495,389***	22415,215***	1885,3511***
Cooling system (C_S)	1	2,091	21,863***	,070	,905	24,334***	,001	,935	11,507**	,048
Months in year (M_Y)	1	307,384***	111,978***	14,9256**	9,467**	,632	1,114	569,347***	196,046***	13,497**
Days in months (D_M)	30	27,49***	15,257***	2,293*	7,064***	5,804***	5,954***	64,312***	31,069***	2,401*
Interaction C_S x M_Y x D_M	105	21,019***	10,826***	1,895	9,867***	6,079***	6,594***	54,471***	25,310***	2,062
Error	15									
Total	154									
[a]R^2=1.000; [b]R^2=1.000; [c]R^2=0.998; [d]R^2=0.999; [e]R^2=0.996; [f]R^2=0.999; [g]R^2=1.000; [h]R^2=1.000; [i]R^2=0.999;										

*** significant at level p<0.001

** significant at level p<0.01

* significant at level p<0.05

A large droplet from a low-pressure sprinkler system that completely wets the cow by soaking through the hair coat to the skin is more effective than a misting system. However, the fan/sprinkler system used about 10-fold more water than did the fan/mist system. Thus, attention to water delivery rate through nozzle size or the use of fans and misters has proven effective in cooling cows, and used substantially less water than systems evaluated in earlier research. Evaporative water loss of up to 1.5 kg/h of dairy cows (Berman et al., 1985), on top of poor ventilation, might contribute to the high RH inside the barn during summer months. Specifically, Armstrong et al. (1999) reported that cows housed under feed-line spray and fan systems had a lower percentage increase in respiration rate for feed line spray systems closest to the cow. In addition to cooling systems, they reported that free stalls should be constructed to provide good natural ventilation. The ridge opening should be 5 cm for each 3 m of free-stall building width. Most free-stall cooling trials have been more successful at cooling the cows in the feed-line area using spraying fans and misters than cooling the cow in the bedded stall. Although there are some concerns about re-radiation under corrugated iron roofs when the amount of heat from the re-radiation will be far less than if the animal were to have received it from a direct solar heat load (Knogdee et al., 2006). Evaporative cooling systems have improved the environment for lactating dairy cows in hot climates. These systems use high pressure, fine mist, and large volumes of air to evaporate moisture and cool the air surrounding the cow. There are questions regarding the effectiveness of evaporative systems in climates with high relative humidity because when relative humidity increases above 70%, the potential reduction in THI is less than 10%. Our results highlight the fact that time of cooling as management practice for reducing the negative effect of heat stress in dairy cows should be prolonged in whole period of environmental heat stress.

Conclusions

The installed equipment in the barns of the farm 1 included one fan and three fans plus fogging system in the farm 2. Due to farm specific and unpredictable variability in climate conditions inside the cow barns and their correlation with environmental weather data, the installed cooling systems could provide better climate zone in the barns neccesssery for increased milk production but couldn't completely satisfy capacity of cooling during the day time with highest air temperature and air relative humidity and therefore highest THI. It is planning in the near future to install one more fan in the farm1 and farm 2 in order to completely satisfy capacity of ventilation and cooling.

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QUALITY OF EGG FOR CONSUMPTION FROM DIFFERENT PRODUCERS IN THE MARKETS IN R. MACEDONIA: 2. HOUGH UNITS AND YOLK COLOR

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Abstract
Eggs from 7 different brands offered to the supermarket chains in R. Macedonia were tested for meeting the minimum quality requirements defined by the Law. Egg size (egg weight in g) as well as internal quality traits (Hough Units that unbiased expressed egg "freshness" and Yolk color expressed as Roche leader scale from 1-14) were analyzed on 140 eggs. Each group was randomly represented by 10 M-weight class and 10 L-weight class eggs from each of the 7 brands, purchased directly from the supermarket shelf and analyzed the same day after the purchasing. Egg quality was analyzed in the Laboratory for control of the marketing quality of eggs at the Institute for animal biotechnology on the Faculty of agricultural science and food, using computerized equipment for measuring egg internal quality (Egg Multi Tester EMT 5200, Robotmation Co. Ltd., Tokyo, Japan). Eggs from analyzed brands in general meat the required marketing standards in respect to the analyzed parameters: egg albumen height or freshness (average = 61.56 and 58.75 Hough Units) and yolk color (average = 12.48 and 12.28 units of Roche scale) for L and M weight class, respectively. Only eggs from brand No. 4 does not fulfill the minimum required marketing standards in respect of the Hough Units (42.49 and 40.89 Hough Units) for M and L weight class, respectively. Additionally, eggs from brand No. 5 have average value below (51.95 Hough Units) the minimal required standard for freshness of 55 Hough units defined in the Law for quality of agricultural products and average weight for L class lower (62.04g) than the minimum requirement of 63g for this weight class.

Keywords: brands, eggs for consumption, markets, Hough units, yolk color.

Introduction

One of the most desired food with defined quality in terms of nutritive value are eggs. According Seuss-Baum, 2005, *e*ggs are excellent source of high valued proteins, fats (phospholipids and unsaturated fatty acids), vitamins and minerals. Eggs are also a perfect food for microorganisms and like all other food from animal origin should be properly stored, in order to avoid decreasing of the quality but also avoid possible negative effects on human health. Regular quality control of the marketed eggs is in the baseline for keeping the eggs on the side of safe food (Kralik et al., 2012). Marketing quality characteristics of the eggs are defined in the Law for quality of agricultural products, Chapter 1 "market organization", part 4 "market organization for poultry meat and eggs" (Official Gazette of R. Macedonia 2010/140, 21.10.2010), addition of this law (Official Gazette of R. Macedonia 2011/53, 14.04.2011 and (Official Gazette of R. Macedonia 2012/55, 03.05.2012) as well as escorting Rulebook for way of marking the eggs intended for market and eggs for incubation, marks and their use (Official Gazette of R. Macedonia 2011/35, 22.03.2011). These laws and Rulebooks defines marketing of and regulates: names, definitions and general terms for collecting, grading, marking, small and big packages, holding, data collecting for production and control of the quality of the eggs for consumption. Only "A" grade eggs are allowed to be marketed according the quality (freshness) requirements of the mentioned Law for quality of agricultural products. Fresh eggs are only eggs that have Hough units values higher than 55. Additionally fresh eggs are graded

according the size (weight) in four grades XL, L, M, and S. According (Roberts, 2004) one of the most often analyzed characteristics of the egg quality are albumen quality (albumen height and Hough units) and yolk color. Significant influence of the hen's age on the egg size (weight) in the Leghorn layers is reported by Baumgartner и сор. (2007), Peebles et al. (2000), Silversides and Scott (2001), Oloyo (2003), Van den Brand et al. (2004), Rizzi and Chiericato (2005), Johnston and Gous (2007). According previously mentioned, the goal of this analyze was to investigate some parameters of the quality of eggs for consumption from different producers (brands). Egg weight, internal egg quality (albumen quality through unbiased estimates of Hough Units and yolk color were analyzed in eggs marked as M and L weight classes, in order to reconfirm their declared marketing quality.

Material and methods

Egg weight, Hough units and Yolk color of the eggs for consumption in the region of city of Skopje eggs of two different weight grades (M, L) from 7 different producers (brands 1-7) were analyzed in egg samples purchased in different markets. Total of 140 eggs are analyzed,. In the markets eggs were kept on the refrigerated shelf on the temperature lower than 5°C. After purchasing the egg samples were stored in refrigerator and analyzed.

Table 1. Number of analyzed egg samples with indicative date of production and declared date „best before"

	Number of analyzed samples		End date of use presented on the packing(28 days after laying)		Indicative date of production*	
	M	L	M	L	M	L
BRAND 1	10	10	17-Dec-13	15-Dec-13	19-Nov-13	17-Nov-13
BRAND 2	10	10	12-Dec-13	12-Dec-13	14-Nov-13	14-Nov-13
BRAND 3	10	10	10-Dec-13	10-Dec-13	12-Nov-13	12-Nov-13
BRAND 4	10	10	26-Nov-13	04-Dec-13	29-Oct-13	06-Nov-13
BRAND 5	10	10	10-Dec-13	29-Nov-13	12-Nov-13	01-Nov-13
BRAND 6	10	10	10-Dec-13	04-Dec-13	12-Nov-13	06-Nov-13
BRAND 7	10	10	12-Dec-13	12-Dec-13	14-Nov-13	14-Nov-13
TOTAL\140	70	70				

*Date of production should be 28 before the presented end date for use and no more than 30-31 days because eggs should be graded and packed no later than 10 days after the laying (because Saturday and Sunday – weekends and production during the weekends) and presented "best before" date is 28 after laying.

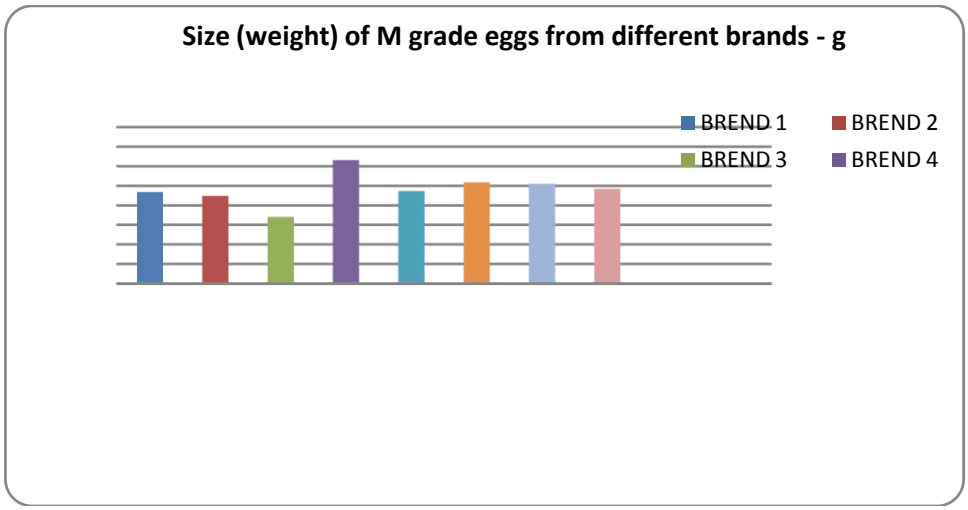
Analyzes are realized in the laboratory for control of the marketing quality of the eggs at the Institute for Animal Biotechnology at the Faculty for Agricultural Science and Food of the University „Sts. Cyril and Methodius" in Skopje, using automatic machine (Egg Multi Tester EMT 5200) for measuring the internal egg quality (egg weight in grams, albumen height, Hough units, yolk color and egg quality grade).

Results and discussion

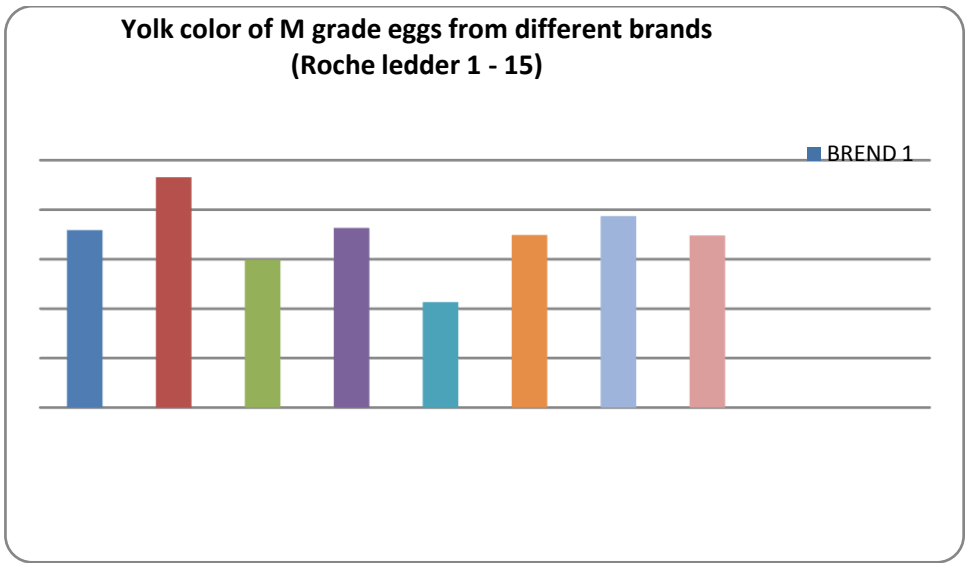
Data from analyze of the internal egg quality parameters (egg weight, Hough Units and Yolk color) in two grades (M and L) of 7 different brands are presented in table 2. No significant deviations in egg weight are notified in grade M eggs. Declared weight is in the standards for this grade (53-63 g). Hough Units standard requirements (above 55) are fulfilled in all brands except brand No. 4 (42.49 Hough Units). Additionally, in L weight graded analyzed samples of eggs Brand No.4 and 5 had also lower than the requested by Law values for Hough Units (40.89 and 51.95, respectively).

Table 2. Analyzes of egg size, Hough Units and Yolk color in weight grades M, L

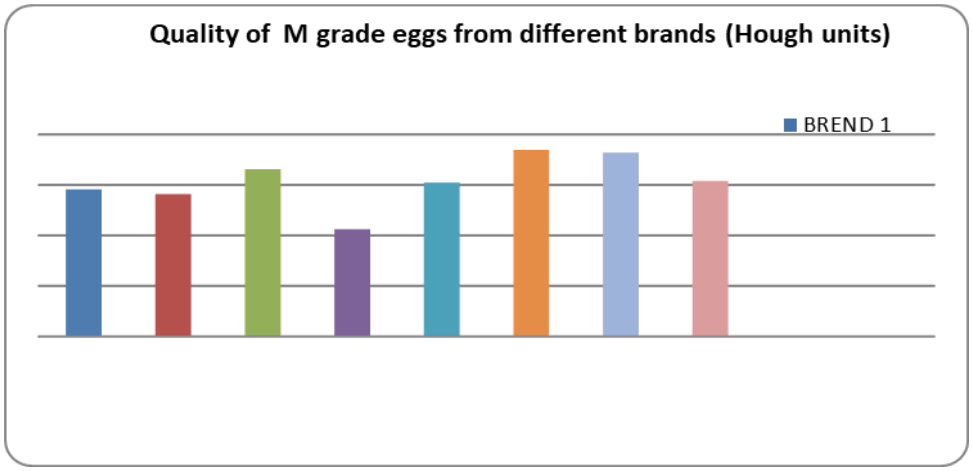
Different brands	Grade M			Grade L		
	Egg weight	Yolk color	Hough Units	Egg weight	Yolk color	Hough Units
BRAND 1	59.35	12.59	58.25	63.20	13.36	57.70
BRAND 2	58.97	13.66	56.39	64.72	12.92	65.96
BRAND 3	56.81	11.99	66.21	65.39	12.01	66.09
BRAND 4	62.62	12.63	**42.49**	63.64	11.78	**40.89**
BRAND 5	59.46	11.13	60.90	**62.04**	11.29	**51.95**
BRAND 6	60.35	12.49	73.88	65.98	12.06	58.71
BRAND 7	60.21	12.87	72.82	64.78	12.52	69.97
AVERAGE	59.68	12.48	61.56	64.25	12.28	58.75



Graph 1. Egg weight in M graded eggs from different brands

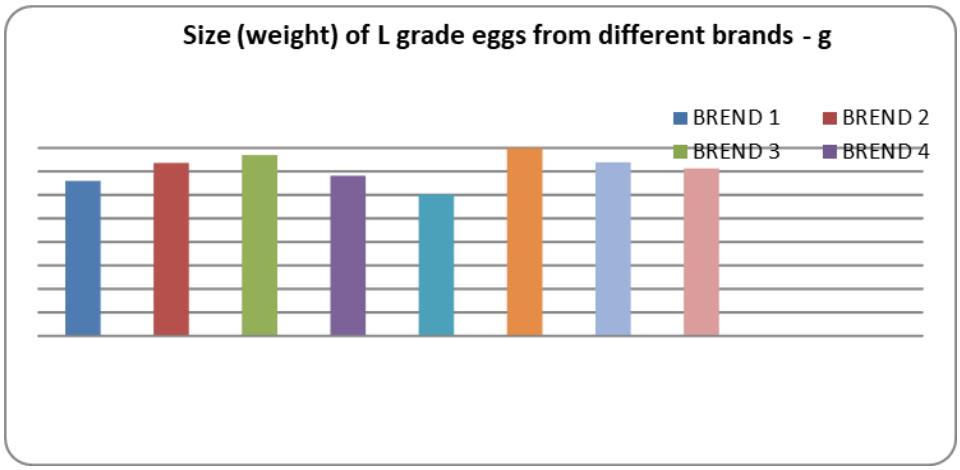


Graph 2. Yolk color in M graded eggs from different brands

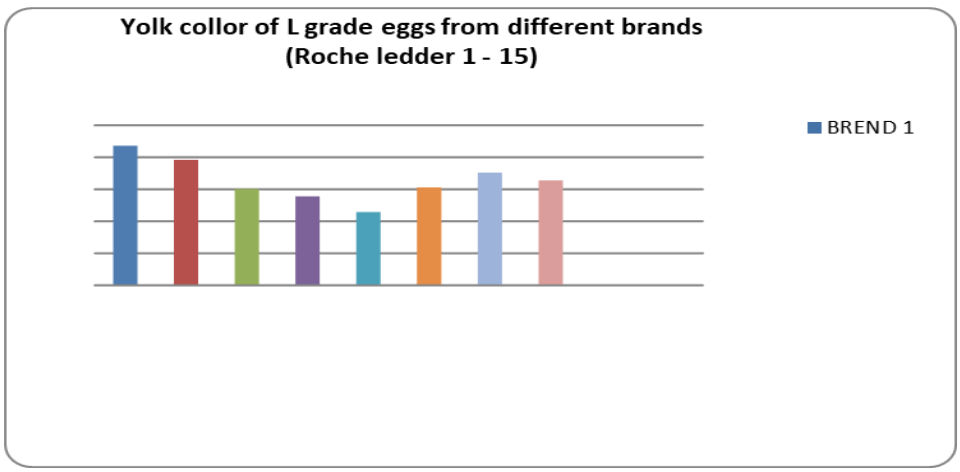


Graph 3. Hough Units (albumen quality or freshness) in M graded eggs from different brands

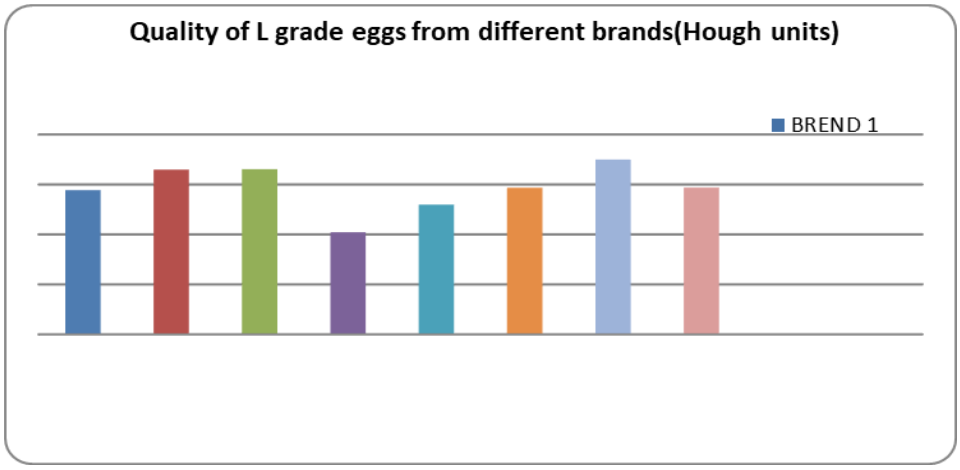
In L weight graded eggs brand No.5 eggs had average egg weight below the required standard (63-73g) for this weight class. This means that the packing center has mixed the eggs from lower grade with the eggs from the higher grades (in this case L graded eggs) with a goal to get additional income and profit from sales of lower weight grade eggs as higher weight graded eggs and actually deceive the consumers to higher price for this.



Graph 4. Egg weight in L graded eggs from different brands



Graph 5. Yolk color in L graded eggs from different brands



Graph 6. Hough Units (albumen quality or freshness) in L graded eggs from different brands

According already mentioned Law for quality of agricultural products, deviations in content of lower weight graded eggs in to the packaging of higher weight graded eggs, or more precisely presence of eggs from lower weight grades in the packages that should contain higher weigh grades should not be more than 5% or if the sample is smaller than 180 eggs such deviation should be double or 10%. Shortly this means that packers or packing centers have mixed the eggs with lower weight (lower grade eggs) with the bigger (eggs of higher weight).

Conclusions

Egg samples from 7 different brands sampled from different markets showed significant deviations from the declared and standard requirements by the Law of quality of agricultural products values for egg size (weight in g) and freshness (Hough Units) in the realized analyze. Results shows that deviations from the requred standards by Law are bigger in higher weight L class, that has a better market price due to the bigger size, but also exist in the M weight class. In general all brands meet egg quality standards determined in the regulatives (law for quality of agricultural products). Only one brand (brand No.4) out of seven brands express lower internal egg quality standard (Hough units) for albumen quality (42.49 and 40.89 Hough units for M and L weight class, respectivelly). Only one brand (brand No.5) out of seven brands express lower internal egg quality standard (Hough units) for albumen quality (51.95 Hough units for L weight class) but additionally has lower average weight (62.04g) that the standard required weight of 63g in the Law for quality of agricultural products.

Internal egg quality monitored through unbiased Hough Unit estimates in our analyze stressed the needs for more regular checks in respect to the freshness of eggs in the marketing channels. More often controls are also needed on the storage conditions of the eggs on the farm premises but also in the supermarkets warehouses and markets. This will discourage some of the distributers that use “smart approach” of buying and selling “older” eggs on lower price. Such approach have negative financial effect for all the stakeholders in the egg value chain due to consumers distrust in the egg as a product regardless of the brand behind the product.

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CALCULATIONS IN MILK PRODUCTION ON FAMILY FARMS

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Abstract
Milk production in Serbia is mostly practiced by family farms characterised by small herds of cattle, low milk yield per cow, high feed costs, and variable milk quality. Both small and specialised farms housing up to 10 lactating cows are often unable to maintain their cost-effectiveness. A study was conducted on two family farms i.e. farm A and farm B during 2013-2015 to record production data. Total production value, variable costs and contribution margin were calculated. For easy comparison between the farms, results were expressed per lactating cow. The sensitivity analysis of milk yield and farmgate milk prices showed that, at low values, contribution margins were more sensitive to changes in farmgate milk price. Through subsidies and premium payments, family farms maintain the cost-effectiveness of their production. However, small-scale producers are facing the largest threat, given low milk yields per cow and poor milk quality.

Keywords: contribution margin, price of milk, sensitivity analysis.

Introduction

In the Republic of Serbia, almost every fourth agricultural holding is engaged in cattle husbandry, and 156 thousand holdings are involved in cow milk production. Statistical data show that milk production in Serbia is mostly practiced by family farms with an average production capacity of 2.8 lactating cows. Demographic conditions are unfavourable as 56% of livestock units are owned by farmers aged between 55 and 64 years (Popović, 2014). According to data for 2000-2013, the average annual milk production in Serbia was 1.5 billion litres, 60% of which were sold and processed, and the rest consumed and processed on the farm for household purposes. Serbia's surplus in foreign trade was 35.2 million dollars, with Serbia as a net exporter of milk and milk products to neighbouring countries (Veljković et al., 2015). This production was accompanied by a decline in the number of lactating cows, as well as by a gradual reduction in the total milk produced. Milk yield per cow increased to 3,172 litres in 2013, whereas the average yield per cow in 2000-2013 was 2,620 litres (Živković, 2015). Improvement in lactating cow breeds has led to better milk performance, and will expectedly result in a further decline in cow numbers. Milk production on family farms is an important factor in rural development, and is their continuous source of income throughout the year. This production is facing a range of problems, such as unfavourable parity pricing, increases in feed and input prices, low farmgate prices of milk and beef cattle, low production capacity and outdated facilities and equipment (Radivojević et al., 2009). In order to become competitive and achieve production cost-effectiveness, farmers strive to reduce costs, provide high-quality feed, improve feed conversion efficiency (Veljković et al., 2013a), and increase milk quality through appropriate hygiene practices (Veljković et al., 2013b). Farmgate milk prices are dependent on quality standards, and the milk sold should preferably be graded as Extra Grade or First Grade. The volume of milk produced is extremely sensitive to the price paid for raw milk and the premium payments received (Vaško et al., 2012). Milk premium payments as economic incentives of the agrarian policy can substantially encourage or discourage this production.

Material and methods

The economic analysis of milk production on family farms in the present study involved the use of the calculation method. Gross margin and contribution margin were calculated. Calculations were based on variable costs, and data were analysed by MS Office Excel 2010. The analysis of the contribution margin is used to evaluate farm performance, estimate the current and future economic situation of the farm, and assess its cost-effectiveness and profitability (Grgić and Franić, 2002; Haluška and Rimac, 2005.) In similar studies, the average contribution margins were EUR 681 (Subić et al., 2010), and EUR 515 (Vaško et al., 2012). In the present research, the contribution margins were lower as the analysis covered less successful family farms facing multiple difficulties in milk production. During 2013-2015, milk production was monitored on a number of farms in Kraljevo and Čačak. Data were collected by completing the questionnaires (survey forms) delivered to farm holders. This paper provides economic analyses for two farms, farm A and farm B, covering revenues and variable costs per lactating cow per year. These family farms are traditionally experienced in milk production; they own stables, related equipment and feed production machinery; and engage mostly their family members in farm work.

Results and discussion

Calculations were used in milk production to determine economic parameters i.e. total revenues and total variable costs, and their difference as the contribution margin. Apart from calculating total revenues and costs for farms A and B, their annual economic performance per lactating cow for the period 2013-2015 was also determined. The subsidy received per lactating cow on each farm was RSD 20,000 in 2013 and 2014, and increased to 25,000 in 2015. In all three years, each farm received a premium payment of RSD 7 per litre of milk, which was a significant economic contribution to the production as these incentives accounted for 20-24% of total farm revenue. Noteworthy when making calculations, as the value of the euro changed relative to the dinar value, the calculation was made using the average exchange rate published by the National Bank of Serbia. Over the three-year period, milk production on farm A was as follows: in 2013, there were 8 lactating cows, with an average milk yield of 3,455 litres per cow per year; in 2014, there were 8 lactating cows, and the average annual milk yield slightly increased to 3,955 litres; in 2015, the number of lactating cows increased to 9, but milk yield was somewhat lower – 3,842 litres per cow per year. Being dependent on the amount of milk sold to dairies, income in 2013 was EUR 889.15 per lactating cow (Tab.1). Milk sales accounted for 49% of total revenue. In 2013, farm A achieved the highest farmgate milk price for the three-year period i.e. 0.3 eurocents (without premium). In total, 23,657 litres of milk were purchased from the farm, and 3,980 litres of milk were used for household purposes and calf diet, thus making up 8% of total revenue. In 2014, the average farmgate milk price decreased by 0.28 eurocents; farm revenue earned from milk sales was EUR 1,018.13 per cow, which accounted for 52% of total revenue. In the same year, farm A achieved the highest revenue and the highest contribution margin for the period surveyed - EUR 401.58 per lactating cow per year (Tab.1), with 29,300 litres of milk sold to a dairy plant, which was a 24% increase compared to the previous year, and 2,660 litres of milk i.e. 5% consumed for farm purposes. Farmgate milk price was the lowest in 2015 i.e. 0.23 eurocents; milk sales were the highest (32,130 litres), but due to the low farmgate price, the revenue earned from milk accounted for 48% of total revenues, whereas incentives made up 24%. The increase in feed costs and the reduction in total revenues led to the lowest contribution margin in this year – EUR 114.93 per lactating cow per year (Tab. 1). The analysis of variable costs during the survey period showed that feed costs accounted for up to 87-88% of total costs for the period. On farm A, to increase milk yield per cow, the amount of concentrate feed used per cow per year was increased. Both concentrate feed and roughage were produced on the farm to make judicious savings. Economic performance in terms of feed costs per cow was better in 2014, whereas the maximum was achieved in 2015 i.e. EUR 1,451 per lactating cow per year (Tab.2).

Table 1. Calculation of contribution margins of milk production on farm A

Revenue across years and per lactating cow in Euros*	Amount per cow 2013	%	Amount per cow 2014	%	Amount per cow 2015	%
Milk sold to dairies	889.15	49	1018.13	52	832.79	48
Milk for household purposes	54.87	3	50.73	3	28.38	2
Milk for calf diet	94.71	5	41.70	2	34.99	2
Calves (aged 10 days)	244.03	13	244.29	12	241.61	13
Manure	179.75	10	205.33	11	191.62	11
Milk premium	180.41	10	215.97	11	208.20	12
Incentive for high-quality breeding cows	174.31	10	168.48	9	208.28	12
TOTAL REVENUE	1817.23	100	1944.63	100	1745.87	100
TOTAL VARIABLE COSTS	1471.15	100	1543.05	100	1630.94	100
Concentrate feed	624.85	43	619.16	40	743.56	45
Roughage	667.60	45	721.08	47	707.32	43
Litter	85.89	6	97.29	6	74.52	5
Veterinary services and drugs	10.89	1	10.53	1	12.50	1
Insemination	21.79	1	28.43	2	24.99	2
Consumables	13.06	1	12.64	1	12.50	1
Selection costs	26.15	2	33.70	2	33.33	2
Electricity	20.92	1	20.22	1	22.22	1
CONTRIBUTION MARGIN	346.08		401.58		114.93	

(*in Euros, official average exchange rate, NBS)

Table 2. Costs expended on concentrate feed and roughage on farm A

Feed costs per lactating cow in Euros	Amount per cow 2013	Amount per cow 2014	Amount per cow 2015
Concentrate feed	433.15	619.16	743.56
Meal	108.90	0.00	0.00
Maize	82.80	0.00	0.00
Total concentrate feeds	624.85	619.16	743.56
Maize silage	188.26	291.47	279.09
Lucerne	87.15	75.82	254.94
Hay	392.19	353.79	173.29
Total roughage	667.60	721.08	707.32

Based on these calculations, positive gross contribution margins were generated, with 2014 as the economically most favourable year for farm A. Rather than having a positive effect, the economic performance of farms, as presented in Tables 1 and 2, led to the stagnation of milk production. In contrast to farm A, farm B achieved a somewhat higher average milk yield per cow. In 2013, farm B had 7 lactating cows, with 4,955 litres of milk produced per cow per year. In 2014, the number of lactating cows increased to 8, and the average milk yield decreased to 3,703 litres. In 2015, the number of lactating cows remained the same, but the average annual milk yield increased to 4,470 litres. Farmgate milk prices on farm B were somewhat lower for the same period. Milk sales to dairies were highest in 2013 i.e. 31,295 litres at 0.28 eurocents per litre; the lowest amount of milk sold to dairies was in 2014 i.e. 25,000 litres at an average price of 0.25 eurocents; in 2015, the amount of milk sold was 29,500 litres at a farmgate price of as low as 0.22 eurocents, being the lowest farmgate milk price on both farms. As the farmgate milk price decreased over the years, the farm retained substantial amounts of milk for its own purposes, e.g. up to 6,260 litres or 10% of total revenues in 2015. At sufficiently high farmgate milk prices, milk producers are more motivated to sell their milk than to consume and process it on their farms, as was the case with farm B.

Table 3. Calculation of gross margins of milk production on farm B

Revenue across years and per lactating cow in Euros*	Amount per cow 2013	%	Amount per cow 2014	%	Amount per cow 2015	%
Milk sold to dairies	1246.84	57	789.74	47	798.76	45
Milk for household purposes	29.08	1	57.65	3	39.53	4
Milk for calf feeding	105.98	5	88.45	6	129.97	6
Calves (aged 10 days)	244.03	11	235.87	14	233.28	13
Manure	123.26	6	150.05	9	148.40	8
Milk premium	272.75	12	184.27	11	215.05	12
Incentive for high-quality breeding cows	174.31	8	168.48	10	208.28	12
TOTAL REVENUE	2196.25	100	1674.51	100	1773.27	100
TOTAL VARIABLE COSTS	1521.56	100	1427.96	100	1418.90	100
Concentrate feed	578.96	38	664.11	47	364.28	26
Roughage	764.36	50	565.77	40	854.87	60
Litter	65.44	4	90.30	6	74.36	5
Veterinary services and drugs	26.15	2	17.53	2	41.66	3
Insemination	21.79	2	22.43	1	16.66	1
Consumables	11.95	1	12.64	1	12.50	1
Selection cost	30.50	2	33.70	2	33.33	2
Electricity	22.41	1	21.48	1	21.24	2
CONTRIBUTION MARGIN	674.69		246.5		354.37	

(*in Euros, official average exchange rate, NBS)

Table 4. Costs expended on concentrate feed and roughage on farm B

Feed costs per lactating cow in Euros	Amount per cow 2013	Amount per cow 2014	Amount per cow 2015
Concentrate feed	286.30	326.69	364.28
Maize	292.66	337.4	0.00
Total concentrate feeds	578.96	664.11	364.28
Maize silage	278.35	439.31	657.75
Lucerne	322.47	0.00	77.98
Hay	163.54	120.46	119.14
Total roughage	764.36	559.77	854.87

The highest contribution of milk sales to total revenues was in 2013 (57%), followed by 2014 (47%), and lowest in 2015 (45%). In 2015, subsidies accounted for 24% of total revenues (Tab. 3). The lowest revenues and the lowest contribution margin of EUR 246.5 per lactating cow per year (Tab. 3) were achieved by farm B in 2014. Due to unfavourable economic conditions for milk production, farm B significantly reduced cow feed costs to make savings in concentrate feed and roughage production and ration balancing. Costs of feed for lactating cows were lowest in 2015 i.e. EUR 1,219 per cow per year, with a greater proportion of roughage in the diet (Tab. 4). For easy comparison between farm A and farm B, all values were calculated per lactating cow across years. The farms were similar in production capacity, and had 8 lactating cows on average. In 2013, the farms achieved higher farmgate milk prices than in 2015. The highest contribution margin generated by farm A was in 2014, and that by farm B in 2013. Parity pricing was unfavourable for both farms in 2015. On farm A, the ratio of the farmgate price of a litre of milk to one kilogram of concentrate feed was 0.23 to 0.29 eurocents, whereas the ratio on farm B in 2014 was 0.25 to 0.26 eurocents. In these years, the contribution margins achieved by the farms were the lowest. Based on the calculations of milk production on farms A and B, contribution margins were analysed and a sensitivity analysis was used to indicate determinant factors, primarily farmgate milk price, average milk yield per cow and production costs. The sensitivity of the contribution margin was analysed relative to the change in

farmgate milk price and milk yield per cow. The lowest values of the contribution margins were used: the contribution margin generated in 2015 for farm A, and that achieved in 2014 for farm B.

Table 5. Sensitivity of gross margin to changes in farmgate price and milk yield per cow for farm A in 2015

	Price in Euros per litre of milk					
		-20%	-10%	Achieved	10%	20%
Milk yield per cow in l		0.18	0.21	0.23	0.25	0.28
-20%	3073.6	-203.19	-132.49	-61.80	8.89	79.58
-10%	3457.8	-132.49	-52.97	26.56	106.09	185.62
Achieved	3842.0	-61.80	26.56	114.93	203.30	291.66
10%	4226.2	8.89	106.09	203.30	300.50	397.70
20%	4610.4	79.58	185.62	291.66	397.70	503.74

The sensitivity analysis showed that the low values of the contribution margin were more sensitive to changes in farmgate milk price, as confirmed by farm A. The contribution margin has negative values if farmgate milk price and milk yield per cow decrease by 10 and 20%, respectively (Any decrease in these factors at a low contribution margin leads to its negative value, Tab. 5). As shown by the sensitivity analysis, in the worst case scenario, farm A would suffer a loss of EUR 203 per cow per year or, in a better case, the contribution margin would increase to EUR 504 per cow per year. For farm B, the contribution margin would have negative values if only a single factor decreased by 20%; the contribution margin thus ranging from a loss of EUR 87 to an increase to EUR 654 per cow per year (Tabs. 5 and 6).

Table 6. Sensitivity of gross margin to changes in farmgate price and milk yield per cow for farm B in 2014

	Price in Euros per litre					
		-20%	-10%	Achieved	10%	20%
Milk yield per cow in l		0.20	0.23	0.25	0.28	0.30
-20%	2962.4	-86.71	-12.65	61.41	135.47	209.53
-10%	3332.7	-12.65	70.67	153.99	237.30	320.62
Achieved	3703.0	61.41	153.99	246.56	339.14	431.71
10%	4073.3	135.47	237.30	339.14	440.97	542.80
20%	4443.6	209.53	320.62	431.71	542.80	653.89

While having no effect on the farmgate price, farms should preferably plan their contribution margins through milk yield increases, as any increase in the contribution margin improves farms' resistance to fluctuations in farmgate prices. A combination of factors positively affecting and increasing the contribution margin should be used.

Conclusions

The analysis of the economic performance of milk production on family farms and low contribution margins show difficulty in maintaining its cost-effectiveness. The decrease in farmgate milk price and the increase in feed costs during the survey period had a negative effect on contribution margins. The annual contribution margins per lactating cow were mostly low, except in favourable years for farm A in 2014 and farm B in 2013. Milk yields achieved per cow are not sufficient to ensure production stability and cover negative economic effects. Milk production on these family farms is largely dependent on subsidies received, notably premium payments per litre of milk and incentives per lactating cow. Without economic support and improvement in milk production, small-scale farms will gradually disappear, and this will adversely affect rural development, leading to rural devastation.

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THE USE OF BOOKKEEPING IN THE FADN SYSTEM DATA COLLECTION IN THE REPUBLIC OF SERBIA

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Abstract
Establishment of the Serbian Farm Accountancy Data Network - FADN system based on the use of bookkeeping with the additional information necessary to meet the specific needs of the system from the methodological point of view. FADN system data collection are covered by commercial farms, which according to existing legal regulations in the Republic of Serbia are obliged to use of bookkeeping in two cases. The first case is if the farm has an entrepreneurial status, which has a binding character through the submission of tax returns to the competent tax authority. The second case is if the registered farm payer of value added tax. This paper analyzes the use of bookkeeping in the FADN system data collection in the Republic of Serbia through the appropriate methodological model. The main objective of this paper is to highlight the importance of bookkeeping records on commercial farms in the Republic of Serbia, which contributes to the rationalization and efficiency of data collection for the FADN system.

Keywords: bookkeeping, commercial farm, FADN system, a methodological model, rationalization and efficiency of data collection.

Introduction

The aim of the paper is to point out the connection between FADN evidency *(Farm Accountancy Data Network)* and the bookkeeping records. The research led to the conclusion that the bookkeeping records can provide only information on production values, while information on quantities, as well as basic and general data concerning consumption on the farm itself, must be provided from the FADN system. The participation of agricultural holdings in the FADN survey is voluntary and legal and natural persons, as well as those who lead or are not in charge of accounting, can be involved. The subject of this paper will be agricultural holdings that already carry out accounting records. The paper will provide a schematic representation of a methodological model that facilitates the collection of data and the completion of questionnaires by FADN experts from such farms.

Material and methods

The basis of research and writing of work are officially published laws and by-laws on the level of the Republic of Serbia and at the level of the European Union (EU). Also, were used official statistical data which Statistical Office of the Republic of Serbia publish every year. The method of work is based on the use of internet research to review the opinions of experts competent to deal with this issue. The main method used is the descriptive, but the analysis and synthesis method is inevitable.

Reasons for the introduction of fadn system in Serbia

Given that there is currently no official system for collecting accounting data from agricultural holdings in Serbia, there is a need for designing a new or introducing an existing system that is successfully implemented in the countries of the European Union (EU). One of the potential sources of collecting accounting data from agricultural holdings is the publication Economic Accounts of Agriculture in the Republic of Serbia 2007-2014 whose publisher is Statistical Office of the Republic

of Serbia (SORS)[1]. The Study states that the Economic Accounts for Agriculture (EAA) are part of the international statistical system and their primary purpose is to monitor and evaluate the effects of agricultural policy. It should also provide the basis for the analysis of the agricultural production process and the earned income in agriculture. In addition, they allow international comparability with other countries, but also comparison with other activities within the national economy. The economic accounts include the following groups of agricultural producers (SORS, 2015):

a) family farms with at least 0.5 ha of agricultural land they are cultivated;

b) family farms with less than 0.5 ha of agricultural land in which they perform some form of agricultural production (including areas under greenhouses) and intended for the market, as well as fish farming, cultivation of snails, mushrooms, bees etc;

c) companies, agricultural cooperatives, entrepreneurs, institutions and other organizational forms with the status of a legal entity whose agricultural activity is predominant.

A special challenge for Serbia is the establishment of the FADN system. The purpose of applying the FADN system is multiple:

a) Collecting accounting data (income and expenses) from agricultural holdings;

b) assessment of the efficiency of agricultural production and

c) analyzing support of agricultural policy.

Establishment of the FADN system is regulated by Article 33 of the Law on Agriculture and Rural Development (Official Gazette of RS, No. 41/2009, 10/2013 and 101/2016). The aforementioned Law defines the FADN system as *"a set of data on the structure, production, income and expenditures of agricultural holdings that are obtained on the basis of the annual survey in agricultural holdings in accordance with special regulations".* The legal framework for the implementation of the FADN system measures is carried out under the following laws:

a) Law on incentives in agriculture and rural development (Official Gazette of RS, No. 10/2013, 142/2014, 103/2015 and 101/2016),

b) Law on the performance of advisory and expert activities in the field of agriculture (Official Gazette of RS, No. 30/10) and

c) Law on Personal Data Protection (Official Gazette of RS, No. 97/2008, 104/2009, 68/2012 and 107/2012).

Agricultural holding in FADN system is a commercial farm holding income in agricultural activity, volunteering in the FADN system and recording data collected by FADN research. Commercial agricultural holdings are those agricultural holdings that are large enough to ensure the main activity of farmers and the amount of income sufficient to maintain the personal existence and the existence of the family. There is currently no legislation in the Republic of Serbia that obliges farmers to keep accounting. However, in some cases, there are legal solutions that still bind farmers:

a) The Law on Income Tax of Citizens[2] and

b) The Law on Value Added Tax [3].

There is a certain group of agricultural producers that are obligated to keep accounting, which are precisely defined by these laws. Natural persons - farmers who earn income from the activities of agriculture and forestry, that is, income from agricultural and forest products, have the obligation to keep accounting in certain cases, such as:

[1]According to the Calendar, the publication of SORS study was published in December 2015 and available is on the following link:
http://pod2.stat.gov.rs/ObjavljenePublikacije/G2015/pdf/G20159083.pdf

[2] Official Gazette of RS, No. 24/2001, 80/2002, 80/2002, 135/2004, 62/2006, 65/2006, 31/2009, 44/2009, 18/2010, 50/2011, 91/2011, 7/2012, 93/2012, 114/2012, 8/2013, 47/2013, 48/2013, 108/2013, 6/2014, 57/2014, 68/2014, 5/2015, 112/2015, 5/2016 and 7/2017.

[3] Official Gazette of RS, No. 84/2004, 86/2004, 61/2005, 61/2007, 93/2012, 108/2013, 6/2014, 68/2014, 142/2014, 5/2015, 83/2015, 5/2016, 108/2016 and 7/2017.

1) if the holder of the agricultural holding voluntarily decides to have the status of an entrepreneur - that the holder of the agricultural holding should be granted the status of an entrepreneur must fulfill two conditions:

a) that the farm is registered in the Register of Agricultural Holdings and
b) must keep the business books.

If the physical person - holder of the agricultural holding does not fulfill the two conditions mentioned above, does not have the status of an entrepreneur. It is important to mention that in Serbia, acquiring the status of entrepreneur has a voluntary character. Farmers who acquire the status of entrepreneur, according to Article 32 of the Law on Personal Income Tax, become taxpayers of value added tax. Taxpayer on income from agriculture and forestry is a natural person - holder of a family agricultural holding registered in the Register of Agricultural Holdings. According to the same Law (Article 32), entrepreneurs are obliged to keep business books and to present business changes in the manner prescribed by this Law. Entrepreneurs keep books on a simple and dual bookkeeping system in accordance with the law governing accounting and auditing. In the books on the system of simple bookkeeping, data on revenues, expenditures, fixed assets, tools and inventory, as well as other data, are provided in accordance with the Law on Personal Income Tax.

2) if the registered agricultural holding is a taxpayer of the value added tax - the registered agricultural holding becomes a taxpayer of value added tax if in the previous 12 months there was a turnover of goods and services exceeding 8 mln. RSD[4] (Law on Value Added Tax, Article 34). In this case the farmer is obliged to keep the books and records prescribed by the Law on Value Added Tax and the obligation to keep books in this case is mandatory and it is created "by force of law". Agricultural holdings can be voluntarily identified and recorded in the VAT system if they have a turnover of less than 8 mil. Din. If they estimate it is convenient for them. The said holdings are kept by the business books according to the system of simply or dual bookkeeping. Based on data from the publication Agricultural Census 2012 (implemented by SORS) in 2012, there were 631,552 registered farms owned by natural and legal persons. Of the total number of registered farms, 0.5% (about 3,158) are holdings that are legal entities and entrepreneurs by legal form. The FADN system in Serbia includes physical and legal persons, that is, agricultural holdings that run and do not keep accounting. The only condition for selecting agricultural holdings is to cross the lower limit of an economic size of EUR 4 thousand. Because the decision of the National Board for the FADN system, these farms form the field of research of the FADN system in Serbia.

Networking accounting and fadn methodology

In the EU countries the obligation of accounting is defined by the document International Financial Reporting Standards[5], which is applied to different type of entity: Public interest entity (PIE), Large, medium and small entities and Microentities. Definition of micro-entities in EU are companies which their balance sheet dates do not exceed the limits of two of the three following criteria (micro-entities):

a) balance sheet total 350,000 EUR;
b) net turnover 700,000 EUR and
c) average number of employees during the financial year 10[6].

The application of the FADN methodology in Serbia should be created to include holdings that use and don't use accounting. Accordingly, a methodological model for data collection has been developed that is in compliance with the current EU regulations 220/2015[7]. This methodological

[4] According to the middle exchange rate of the National Bank of Serbia on June 19, (1 EUR = 122.1076 RSD) RSD 8 mln. is about EUR 65 thousand.

[5] Officially translated in Serbia and published as "International Financial Reporting Standard (IFRS) for small and medium entities" (Official Gazette of RS, No. 117/2013)

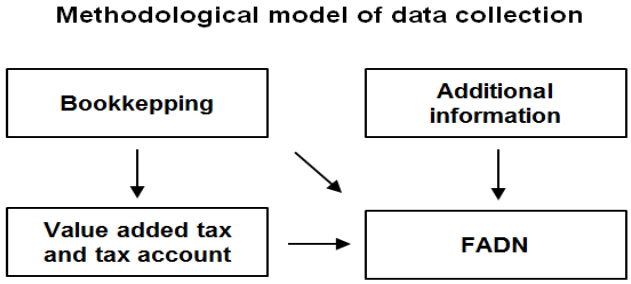
[6] Directive 2012/6/EU of the European Parlament and the council of 14 March 2012.

[7] Corrigendum to Commission Implementing Regulation (EU) 2015/220 of 3 February 2015 laying down rules for the application of Council Regulation (EC) No 1217/2009 setting up a network for the collection of accountancy data on the incomes and business operation of agricultural holdings in the European Union.

model enables the use of already existing accounting data on agricultural holdings that accompany them, based on two sources *(Figure 1):*

1. Bookkeeping data already done on the holding[8];
2. Additional information needed to meet the FADN methodology.

Figure 1. Schematic representation of the methodological model for data collection



Source: Author's illustration according to FADN documentation

The National Coordination Group for Data Collection Methodology has prepared an additional Data Collection Guide for FADN agricultural holdings that have bookkeeping. The purpose of this guide is to establish ways to save time so that the data collection process is maximally efficient. The structure of the instructions should describe the link between the information that can be obtained from the bookkeeping (chart of accounts). Thus, all the tables in the questionnaire are linked to show that the relevant fields can be filled in with data from the appropriate accounts. The bookkeeping records can only provide information about the values, while information on the quantities, basic and general information must be provided from the FADN system. It is defined that as many fields are associated with the values between the accounts and the selected fields of the FADN questionnaire. On the other hand, this increases the risk that we will not have all the information from the bookkeeping records, if the agricultural producer and his accountant use double-digit accounts. Also, in order to obtain more precise relevant data, a three-digit or four-digit account can be used (xxx or xxxx). The data collection guide is based on the relevant FADN questionnaire for the current year, using the relevant regulations for holdings accounting and set of regulations under the accounting law[9] (Table 1).

Table 1. Relationship between FADN questionnaires and bookkeeping records

FADN questionnaires			Bookkeeping records	
The number and name of the table of indicators to be monitored	Description of the indicator	Comments	Bookkeeping account	Comments

Source: Author's illustration according to FADN documentation

The data collection process implies that an agricultural producer collects data in accordance with an agreement with an advisor and bookkeeper. The counselor is obligated to visit the farm four times a year, and the accountant provides information to the advisor once a year, prepared with the help of

[8] Accounting law (Official Gazette of RS, No. 62/2013) and Law on Accounting and Auditing (Official Gazette of RS, No. 46/2006, 111/2009, 99/2011, 62/2013).

[9] Rulebook on the Chart of Accounts and Contents of Accounts in the Chart of Accounts for Companies, Cooperatives and Entrepreneurs (Official Gazette of RS, No. 95/2014), Rulebook on the content and form of financial reporting forms for companies, cooperatives and entrepreneurs (Official Gazette of RS, No. 95/2014 and 144/2014), Rulebook on the manner of recognition, evaluation, presentation and disclosure of positions in the individual financial statements of micro and other legal entities (Official Gazette of RS, No. 118/2013 and 95/2014) and Rulebook on the form and content of the statistical report for companies, cooperatives and entrepreneurs (Official Gazette of RS, No. 127/2014).

the Instruction. The obligation arising from the law is to provide accounting information and accounting reports arising from accounting data processing. The financial statements include balance sheets, which show the "picture" of the holding at a certain point, and the profit and loss accounts that represent the result of the business of the household at a particular moment, i.e. revenues and expenditures. The financial statements may also include reports on changes in equity and cash flows, and the like.

Conclusions

Although the implementation of accounting in agricultural holdings is not a mandatory activity in Serbia, the FADN methodology highlights its benefits arising from their implementation. The most important conclusions that represent the purpose of the research are:

1. rationalization of the time in recording FADN data, because the existing data from the holdings are used (in case the holding has conducted the accounting);
2. Considering that accounting only monitors the value, the FADN methodology includes information on the quantities produced and/or delivered;
3. Significant inclusion of larger agricultural holdings with the form of legal entities and entrepreneurs.

In general, the networking of accounting with FADN methodology provides a more complex picture of the standard of living of the agricultural holding, its potentials to produce and market its products and the result of operations.

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FINANCIAL EFFECTS FROM INTRODUCTION OF EUROPEAN EGG MARKETING STANDARDS ON THE LAYER FARMS IN R. MACEDONIA

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Abstract
This paper presents the financial effects from introduction of the new EU method for grading the eggs according the size (weight) in 4 classes instead of Macedonian method of grading in 7 weight classes based on the comparative analyze of production records in three flocks of ISA commercial layers (Flock 1 - 18125, Flock 2 – 17587, Flock 3 - 16818). The comparison of the financial effects of the introduction of the EU grading system is made by the partial budgeting analysis. Application of European model for egg grading resulted in increased income of about 18-37 denars per average hen-day layer that improves the financial effects at the layer farms. Expressed per unit of production, egg grading based on the egg weight in 4 classes results in increased income per unit of production of 0.1-0.2 denars and is significant increase of the farm profitability knowing that each layer produces around 300 eggs during one production cycle of one year. Hence, the use of standards goes beyond marketing aspects, and can financially support the market without budgetary implications.

Keywords: layers, eggs, grading, profitability.

Introduction

Quality is highly subjective attribute determined in the buyer's mind. Nevertheless, food quality standards are commonly accepted differentiation of food products in term of their value to buyers. It is so, since grades, as uniform categories according to quality standards, reduce marketing and transaction costs. They contribute to greater consumer satisfaction by matching their needs with the different available qualities and also enable producers to gain from price premiums (Kohls and Uhl, 2002). Size is one of the quality traits that contribute to the food products value. Egg weight is a direct proportion of albumen, yolk and shell (Shi, Wang, Dou, and Yang, 2009). Therefore, egg size is considered to be the most important quality trait that influences the egg quality, and subsequently the grading and market price (ibid). The egg weight classification of eggs allows a uniform formation of the price of eggs, which is easily acceptable for all stakeholders, i.e. producers, retailers and consumers. Still, some studies debate whether the egg quality standards truly reflect consumer preferences, questioning the consumers' distinction of egg grades in blind test and their willingness to pay premium prices (Kohls and Uhl, 2002). In order to harmonize with the EU standards and the single European market, since 2010 the egg size standards in the Republic of Macedonia (hereafter MK classification) (OG 1989) has been replaced with the European Union classification system (hereafter EU classification) (OG 2007, OG 2008.). The new classification system is introduced with the Law on quality of agricultural products (OG, 2010, OG, 2011a, OG, 2011b, OG, 2012). According to the MK classification there are seven classes of eggs: SS (Super Sofia, weighing 70 grams and more, S (Sofia, 65-70 grams), A (Ana, 60-65 grams), B (Bertha, 55-60 grams), C (Caesar, 50-55 grams), D (Dora, 45-50 grams) and E (Emma, weighing less than 45 grams). The EU classification has four classes: extra large (XL, with 73 grams and more), large (L, 63-73 grams), medium (M, 53-63 grams) and small (S, less than 53 grams). With the new classification the number of egg classes is reduced (from seven to four), whereas the weight range per class is increased (from five to ten grams). Changes in the standardization of market weight, qualities and practices may affect the financial

results in the related industry. The economic benefits of these changes in the classes reflected through the price changes are still unconfirmed. The aim of this paper is to determine the financial effects of the replacement of the egg weight standards of consumer eggs and their impact on the profitability on an egg farm. To perform a comparative analysis of the financial effects of the two different classification systems we use data (distribution of eggs per classes according to the both classifications) on three flocks analyzed in the first cycle of exploitation. Small adjustments decisions also affect farm revenue and expenses. They could be evaluated by comparing two-whole-farm budgets, but on behalf of the time, costs and effort to collect and organize all information, even those that do not change with the proposed change and therefore does not affect the decision. The comparison of the financial effects of the introduction of the EU classification in this paper is made by the partial budgeting analysis, as a convenient and practical quantitative method for analysing such small changes (Kay and Edwards, 1999) to compare the effects of change to the previous situation. After the introductory part, the paper presents the material and method used to evaluate the effects of the change in the classification system. Then the results and discussion are presented. The paper ends with conclusion.

Material and methods

One of the biological features of the laying hens is the variation in egg size during the exploitation cycle that depends on age, diet and breeding conditions. This constraint reflects in the realized income per laying hen, and is therefore taken into account in analyzing the financial effects on the egg farm. During one egg production cycle, the young layers produce eggs with a smaller weight. Once they reach full adult live weight, the eggs size gradually increases, so that sometimes at the end of the cycle, the size of the eggs should be controlled not to cause a drop in the quality of the egg shell. This biological constraint leads to a production of approximately 300-315 eggs of varying size distributed in several weight classes during one-year exploitation.Therefore, we use data on distribution of eggs per egg size in three flocks analyzed in the first cycle of exploitation. The flocks belong to a Company “ZIVA-JAJCE” daughter company of “ZITO VARDAR” holding. Layers were housed in farm houses located on one location, equipped with battery cages system (approximately the same in-house environmental conditions) and fed with complete feed mixtures formulated following nutrient recommendation of the breeding company according age and intensity of egg production. The observation is made in 2013/2014 production year. Based on the distribution of eggs per weight classes and price per class, we calculated the expected revenue according to the both classifications (MK and EU). These data are presented along with the table with results, Table 2.The partial budget analysis is a “formal and consistent method for calculating the expected change in profit from a proposed change in the farm business” (Kay and Edwards, 1999, p. 182). As such, it is a useful tool that assists the decision-making process by showing the effect of the change. The term "partial" refers to the fact that only the costs and revenue that are affected by the potential change are included, i.e. the additional revenue and costs and the reduced revenue and costs. Given that, in this case, the change occurs only on the revenue side (change in the price of eggs due to new class), without changes in the breeding technology or in the input prices, the used partial budget analysis has a simplified form where the net-result is a difference between the total revenue per average hen calculated according to the EU classification and the total revenue per average hen calculated according to the MK classification.

Results and discussion

Sample description

The basic production data for the three flocks included in the survey are shown in Table 1. The first flock is the largest with an average number of 17.357 layers, the second flock has 15.986 layers, whereas the third flock is the smallest with 15.016 layers. The mortality rate of the layers goes in the reverse order: the highest rate is observed in the flock 3 (28,58%), slightly lower in the flock 2 (25,19%), whereas the lowest rate is observed in flock 1 (11,11%). Hence, most of the eggs are

produced in the first flock (5.435.250), less in flock 2 (5.240.700) and the least in flock 3 (5.011.040). Presented per average layer, the number of eggs is the lowest in the first flock (313 pieces), whereas little higher in the second and the third flock (328 and 334 pieces, respectively). The feed consumption per layer, as one of the most significant costs in the egg production, ranges from 46,06 kg to 48,01 kg that indicates a similar breeding technology.

Table 1. Basic production data

Indicator	Flock 1	Flock 2	Flock 3
Average layers, number	17,357	15,986	15,016
Egg production, total	5,435,250	5,240,700	5,011,040
Eggs per hen	313	328	334
Total feed consumption, in kg	813,690	735,990	720,950
Feed consumption per layer, in kg	46.88	46.04	48.01
Mortality rate, %	11.11	25.19	28.58

Source: own calculation

Weight class structure

The distribution of the number of eggs and expected revenue per classes according to the both classification are presented in Table 2. The table is divided into two parts: the first part, part A, contains the number and value of the eggs according to the MK classification, whereas the second part, section B, contains the number and value of the eggs according to the EU classification. The analysis of the structure in the egg size in the first flock shows that a quarter of the eggs are of class Anna (25%), followed by class Sofia (20%) and Bertha (17%), whereas 10 percents of the eggs are the Super Sofia class and 6% are of class Caesar, and only small shares are class Dora and Emma (2 and 1 %). This flock produced largest share of eggs in non-marketable class, as dirty or cracked (18 and 2%). The same pattern is observed if analysed the revenue structure per egg classes. The structure in the eggs size in the other two flocks (flock 2 and 3) is quite similar. The largest share of eggs are in class Anna (30%, both) and class Bertha (27 and 26%), followed by class Sofia (16%, both) and class Caesar (9%, both). The largest egg size class, class Super Sofia, is represented with only 5%, whereas, the smallest egg size are represented in very small share (class Dora with 2% in both flocks, and class Emma with 1% in flock 3). Regarding the eggs in non-marketable class, these two flocks produced smaller number of eggs as dirty (10%) or cracked (1% and 2%, respectively). The structure analysis according to the EU classification shows that none of the flock produces extra large eggs. The largest share of eggs are medium size (42% in flock 1, 57% in flock 2 and 56% in flock 3), followed by large eggs (30% in flock 1, and 20% in flock 2 and 3). Small eggs are represented at least (9% in flock 1, and 12% in flock 2 and 3). The share of dirty or cracked eggs is the same, since they are not included as classes in the both classifications.

The same pattern is observed if analysed the revenue structure per egg classes, in both MK and EU classification (Table 2). According to the MK classification, the expected revenue from the first exploitation cycle of Flock 1 is 1202.38 denars per average hen, in Flock 2 it is 1238.50 denars, and Flock 3 is 1260.54 denars. According to the number of eggs and the income generation, the classes Sofia and Anna in the first flock take the largest share, whereas Ana and Berta are the most significant in the other two flocks. If sorted by to the EU classification, the expected revenue in the first flock is 1220.25 denars per average layer whereas in the other two flocks (2 and 3) the total revenue is 1274.90 den and 1297.28 days per average layer. According to EU classification, the largest share the number and produced income in the flock 1 is from large eggs and medium size eggs, whereas the medium size eggs are the most common in the other two flocks.

Table 2. Distribution of egg number and expected revenue per classes

A: Number of eggs and expected revenue per average layer by MK classification							
Class	Price	Flock 1		Flock 2		Flock 3	
	MKD	Number	MKD	Number	MKD	Number	MKD
SS (above 70 g)	4.50	31.21	140.45	15.21	68.45	15.47	69.62
S (65-70 g)	4.20	61.29	257.42	51.71	217.18	52.83	221.89
A (60-65 g)	3.90	78.89	307.67	98.21	383.02	101.19	394.64
B (55-60 g)	3.60	51.99	187.16	88.07	317.05	86.87	312.73
C (50-55 g)	3.30	19.10	63.03	28.65	94.55	29.56	97.55
D (45-50 g)	3.00	5.93	17.79	7.54	22.62	7.41	22.23
E (below 45 g)	2.70	2.57	6.94	1.58	4.27	2.23	6.02
- dirty	3.60	55.97	201.49	32.32	116.35	33.14	119.30
- cracked and broken	3.30	6.19	20.43	4.55	15.02	5.02	16.57
- melange	3.00	0.00	0.00	0.00	0.00	0.00	0.00
Total		313.1	1,202.4	327.8	1,238.5	333.7	1,260.5
B: Number of eggs and expected revenue per average layer by EU classification							
Class	Price	Flock 1		Flock 2		Flock 3	
	MKD	Number	MKD	Number	MKD	Number	MKD
XL (above 73 g)	4.50	0	0.00	0	0.00	0	0.00
L (63-73 g)	4.20	92.50	388.50	66.92	281.06	68.3	286.86
M (53-63 g)	3.90	130.88	510.43	186.28	726.49	188.06	733.43
S (below 53 g)	3.60	27.61	99.40	37.77	135.97	39.2	141.12
- dirty	3.60	55.97	201.49	32.32	116.35	33.14	119.30
- cracked and broken	3.30	6.19	20.43	4.55	15.02	5.02	16.57
- melange	3.00	0.00	0.00	0	0.00	0	0.00
Total		313.14	1,220.2	327.83	1,274.9	333.71	1,297.3

Source: own calculation

Partial budget analysis

The procedure and the result of the partial budgeting analysis are shown in Table 3. The table has the common form including the four categories: additional costs, reduced revenue, additional revenue and reduced costs. The net-results is calculated step-wise, by first calculating the positive aspects of the change (sum of the additional revenue and reduced costs) and the negative aspects of the change (sum of the additional costs and reduced revenue), and then the difference between them. The net-change in profit is presented in absolute and relative value. The reduced revenue due to the replacing the MK classification, in the first exploitation cycle of Flock 1 is 980,46 denars per average hen, in Flock 2 it is 1107.13 denars, and 1124.67 denars in Flock 3. On the other side, the revenue gained by implementing the EU classification is 998.33 denars in Flock 1, 1143.53 denars in Flock 2, and 1161.41 denars in Flock 3. The net change in profit per average layer in Flock 1 is 17.87 denars more than the previous classification, whereas in the other two flocks, 2 and 3, the increased profit per layer is 36.40 denars and 36.74 denars, respectively. The positive sign of the net-result calculated in the partial budget analysis confirms the higher revenue per average hen gained from the introduction of the EU classification (Table 3).

Table 3. Partial budget analysis

Problem: Replacement of the MK classification of eggs with the EU classification of eggs							Unit: MKD, per layer
	Flock 1	Flock 2	Flock 3		Flock 1	Flock 2	Flock 3
Reduced Revenue:				Additional Revenue:			
Total	980.46	1,107.13	1,124.67	Total	998.33	1,143.53	1,161.41
SS (above 70 g)	140.45	68.45	69.62	XL (above 73 g)	0.00	0.00	0.00
S (65-70 g)	257.42	217.18	221.89	L (63-73 g)	388.50	281.06	286.86
A (60-65 g)	307.67	383.02	394.64	M (53-63 g)	510.43	726.49	733.43
B (55-60 g)	187.16	317.05	312.73	S (below 53 g)	99.40	135.97	141.12
C (50-55 g)	63.03	94.55	97.55				
D (45-50 g)	17.79	22.62	22.23				
E (below 45 g)	6.94	4.27	6.02				
Additional Costs:				Reduced costs:			
	0	0	0		0	0	0
A. Total additional costs and reduced revenue				B. Total additional revenue and reduced costs			
	980.46	1,107.13	1,124.67		998.33	1,143.53	1,161.41
				Net change in profit (B minus A)	17.87	36.40	36.74
				Increase (%)	1.49	2.94	2.91

Source: own calculation

Farm profitability is analysed by comparing income and expenses, whereas partial budget compares only the changes in revenue and expenses. Therefore, we should emphasise that partial budget analysis measures only the change in profit, but not the existing profitability. The results from the partial budget analysis show that the analysed change brings a positive impact on the farm profitability.The increased revenue comes from the larger span of the medium size eggs (according to the EU classification), which has the largest share in the income structure in all three flocks; it includes eggs according to three classes from the MK classification (Anna, Bertha, and Caesar), with a price that is at the level of class Anna. This comparison of egg weight classes' span and market price is visually presented in Figure 1.

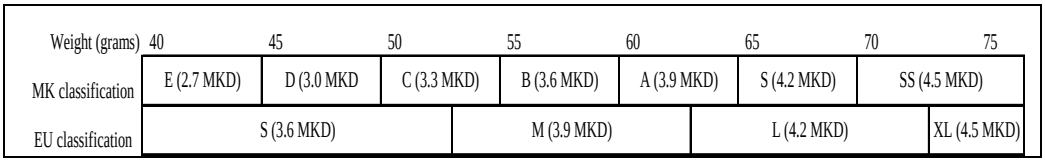

Figure 1. Comparison of egg weight classes and market price

Source: own

This visualization reveals that almost all classes gain from the new prices for weight ranges. For instance, with the EU classification, eggs that weight less than 55 g (class Emma, Dora and Caesar according to MK classification) are valued as the class Bertha, whereas class Bertha is valued as class Ana. Class Sofia has the same price, but due to the wider weight range it brings an increase in the price for those eggs that were previously sorted under class Ana. The only shortfall is noted for eggs weighting 70-73 grams that were previously sorted as Super Sofia and valued with the premium price. The evaluated flocks do not have eggs from this size; thus this price change did not affect their expected revenue in the observed flocks.

Market implications

The increased price of eggs due to a change in the classification of eggs brings an increase of the producer income. This change in price is expected to alter the behavior of producers and consumers, and shift the demand and supply curves. Considering that there is not any budgetary support in this process, and based on the welfare economics principles, the increased price increases the producers' surplus on behalf of the consumers' surplus. We try to illustrate the expected revenue

increase in the whole egg sector with a simple calculation. If we assume the same revenue increase as in the sample in this paper affects the whole egg sector in the Republic of Macedonia (30.34 denars per layer or 2.46%, an average), we estimate the broader market implications of introducing the new classification. The total number of layers in the Republic of Macedonia in 2015 is 1,352,564, out of which 929,387 (69%) are in the individual agricultural holdings (with 118 eggs per hen), and 423,177 (31%) in the agricultural enterprises (with 221 eggs per hen) (SSO 2016). If applied the average increase of 30.34 denars per layer to the total number of layers, we estimate the increase of the sector revenue for about 43 million denars (that is 667 thousand Euros), without any budgetary implications. If calculated per egg, this revenue increase is in average 0.20 denars. This is a good example, how standards can be used for a broader agricultural policy purpose, and support the market without any budgetary implications.

Conclusions

The aim of this paper was to determine the financial effects of the replacement of the egg weight standards of consumer eggs by introducing the EU classification system and their impact on the profitability on an egg farm. The applied partial budget analysis reveals that the EU classification of eggs provides higher revenue per average hen than the previous classification system, thus an increase of the profitability level on an egg farm. The increased revenue comes from the larger span of the medium sized eggs (according to the EU classification), which has the largest share in the income structure in all observed flocks. This class includes eggs according to three classes from the MK classification (Anna, Bertha, and Caesar), with a price at the level of class A (Anna). The evaluated flocks do not have eggs weighting 70-73 grams that were only egg size with a price decrease. Therefore, the introduction of the new classification system brings an increase in the sector income. It also reveals that the use of standards can go beyond the marketing aspects, and can be used as a measure to financially support the market without any budgetary implications.

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ENTREPRENEURSHIP IN THE PUBLIC UTILITY COMPANY "CITY MARKETS"

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Abstract
The aim of this paper is to highlight the important aspects that determine entrepreneurship and its importance to the economic development, it is their effects on the development of City Markets Co. This study was conducted using various methods such as analytical methods, interview and direct observation. In addition, hypothetical-deductive method, statistical methods and descriptive methods were also used. Data were obtained from different sources - the internal and electronic documentation of Public Utility Company (PUC) - City Markets, professional literature and the internet. The Public Utility Company City - Markets follows the rhythm of technological development intensively and adapts to the changing needs of consumers. These changes were primarily influenced by the appearance of supermarkets and megamarkets, the expansion of cashless payment system, credit cards and sprecific changes in habits, desires and tastes of customers. The Law on Communal Activities will open the possibility for cooperation with the private sector and various subcontractors, which will greatly contribute to the development strategy for the future development of market activity.

Keywords: technological innovation, organizational structure, strategy, urban markets.

Introduction

Entrepreneurship is the innovation of factors of production, the creation of new ideas in the organization as a whole, and taking the risk in decisions making. The main role of entrepreneurship in modern economy is reflected in the innovative action that creates the conditions for technological development, the formation of flexible organizations and improvement of employability (Živković and Peševski, 2011). The application of innovations refers to new products, new methods of production, new markets, new raw materials and new forms of organization. Markets are organized to supply the population with fresh food and non-food products. As such they are integral and inseparable part of communal infrastructure, especially in urban areas. At the same time, markets also represent public spaces accessible to all segments of the population regardless of whether they appear as sellers or buyers. Markets provide the most complete response to different demands of customers, because they are legal and regulated forms of sales of certain types of goods, with most elements of free trade. Three basic concepts in the basic presentation of the market are: communication, possibility of choice, and food - the most common selling item on the market. The aim of this paper is to highlight the important aspects that determine entrepreneurship and its importance to the economic development, it is their effects on the development of City Markets Co. Appropriate methodological procedures and available sources of information were used to perceive the conceptual definition of entrepreneurship and entrepreneurs, innovation, technology, knowledge, organizational structure of this company, as well as the determinants of entrepreneurial success.

Material and methods

This study was conducted using various methods such as analytical methods, interview and direct observation. In addition, hypothetical-deductive method, statistical methods and descriptive methods were also used. Data were obtained from different sources - the internal and electronic

documentation of Public Utility Company (PUC) - City Markets, professional literature and the internet.

Results and discussion

City markets operate as a public utility company. Public enterprise is founded by the state, and the rights of the founder are realized by the Government of the state. Local self-government unit establishes a public utility company determining its activity as a communal, based on the Law on Communal Activities. Communal function places the market activity in the group of activities of special importance for the normal and undisturbed functioning of cities, municipalities and settlements. The first Belgrade market, so-called the market of St. Andrew's - The Big market, was created in 1824 at the Students' Square, which soon became the main trade center in Belgrade. After that, with the growth of population and settlements, other markets opened, so today there are 32 markets as part of the City Markets (www.bgpijace.rs, 2013). Under this name, the company has been operating since 1990, and its activity is: maintenance and equipping of markets and business facilities, issuing business premises and premises for markets for wholesale and retail trade of agro-food products, issuing facilities and premises for sale of products of domestic craft labor and other non-food products and livestock, construction and reconstruction of markets and drinks facilities, procurement of beverage equipment and devices for their own needs by own funds and founders funds, keeping records of retail trade of agricultural products and prices for the individual sector for statistical purposes. The City Market Company is a member of the World Union Wholsale Markets (WUWM) in which it is a member of the Council. City markets modernizes the way of doing business in all aspects. This company has started projects for reconstruction of “Zeleni venac” market, square at the Youth Square in Zemun, similar to markets in towns in other European countries. Market Square is a mobile market with mobile stands, so the square performs market activity during the day, while in the afternoon the square is the space where different types of events take place. At the market “Vidikovac“, the realization of capacities expansion is in progress, as well as the construction of the canopies of the market, the steel construction upgraded with solar photovoltaic panels, which enable the production of electricity using solar light and contribute to a better and healthier life of citizens. The most modern market is definitely a “Block 44“ with a canopy of 3200 m², under which there is a system of adiabatic cooling of the market plateau, in order to provide a pleasant environment for customers and sellers in the summer period. Namely, under the market canopy there are sprinklers that disperse a small amount of water and create the effect of water fog, thus maintaining the natural freshness of the product. A new facility with 10 shops and 400 stalls was established at the market. There is a market square built on one part of the market plateau where organic foods market take place every weekend. One of the important projects is the introduction of identification boards on stalls, which is being conducted in cooperation with the Ministry of Agriculture. That way buyers will be informed about the origin of goods and protect sellers against unfair competition. The board will point out whether the seller is a producer or trader. The producer will point out what he has sown on his own land during the year, and the resellers will have boards with a label trader. The first markets where this will be introduced are Kalenic, Bajloni, Vidikovac and Banjica. In addition to the listed projects, milk halls were built on the markets with complete equipment that is necessary for the sale of easily perishable dairy and other products, eggs and the like. The construction of three new markets is planned, and the selected locations are Medaković, Gornji Zemun and Trudbenik. Establishment of a market for the sale of antiques, handicrafts, old crafts, organic products, products with geographical origin and geographical brand, etc. is also planned.

Entrepreneurial innovation are the main means of enhancing competitiveness and become one of the key determinants of economic growth and development (Drucker, 1996). For the third year in a row, PUC "City Markets" has been successfully implementing the project "Volunteer Center" as well as practice for students. This is a significant shift in the overall system of the company, which is confirmed by the fact that in 2011 the company received the European Award for this project for

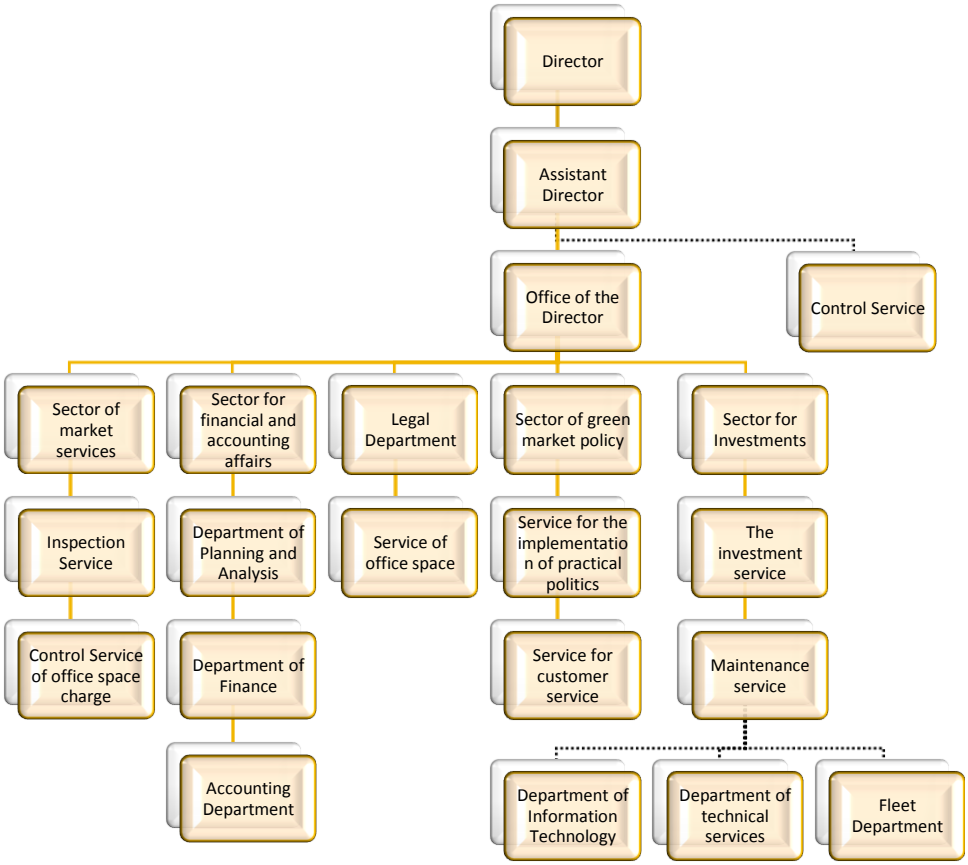
volunteering employees in the "Newcomer" category, whose awards are aimed at supporting employment. The aim of the project is to promote volunteer work and to enable volunteers to engage in the activities of the company, as well as to acquire the necessary work experience for continuing careers and faster employment. The project also aims to make connections between institutions from the state, private, civil and education sectors. This project involves the following institutions: The Ministry of Agriculture, Forestry, Trade and Water Management, The Ministry of Environmental Protection, then The Faculty of Agriculture and The Faculty of Veterinary Medicine and The Faculty of Law. In addition, various associations, private companies and farms cooperate with the Volunteer Center. In addition to enabling young people to acquire the necessary experience, this Center has contributed to the development of mentoring skills of employees and the improvement of team work, which is very important for the successful operation of the company. Significant technological advancement in PUC "City Market" is the introduction of a program that allows all markets to be computer-linked. Thus, all records in the daily billing are sent directly to the company headquarter. In addition, all markets send data about agricultural product prices to the customer service and the directorate once a week. After final processing, the final report on the prices of agricultural products is published in the media. The IT (Information Technology) department is in charge of integrating the system. The introduction of electronic identification of employees in the company is also planned. Creating a clear vision of market business development is a developmental opportunity and it includes: work on improving sales skills at the market, clear positioning the advantages that markets have over their competitors and more serious cooperation with the competent state authorities and services with the aim of creating joint incentive projects in relation to sellers. Branding of market activities is also a chance, as well as giving a proposal for a future brand, a symbol of Serbian markets, which in the near future could become recognizable as a trademark through the logo, in all markets in the country. The organizational structure is a form of clustering and networking of activities, material and labor resources, as well as establishing links and relationships between them and within them (Munćan, 2009). Very important resource, as an element of organizational structure, is workers' collective that deliberately and plannedly invests its knowledge, skills and abilities, in order to successfully fulfill all tasks, which contributes to more efficient business operations. At the very top of the organization is the Director General, who has behind him the Deputy and the Executive Director. Within the company there are five sectors, within which there are appropriate services, and each sector has its own manager (Diagram 1).

Market service sector performs supervision over legal and proper use of equipment and facilities in the markets, cares about respect for law and order in this field, related to daily collection of stalls, trade and transportation of goods, technical maintenance, waste disposal, etc.

Financial and accounting affairs sector performs tasks related to compliance with rules and regulations adopted pursuant to the Law on Accounting and Auditing, do the planning and reporting of business peduzeća, business periodical accounts and the balance sheet, as well as the process of keeping proper documentation and actions related to tax and other obligations of the company.

Legal affairs sector carries out tasks and affairs of common interest for the enterprise and the activities necessary for the smooth conduct of the basic activities of the services, sections and departments, as well as the care of the regularity and correctness, timeliness and legality of activities in the field of the use of market capacities, procedures related to use of business facilities and equipment, realization of receivables and other relevant indicators for the work of certain bodies and services in the company.

Market policy sector of high-skill jobs that will improve the company's operations, promote and affirm its resources and creative potentials and enhance the strategic positioning and creating a favorable climate and conditions for successful business enterprise.



Picture 1. Organizational structure of the "City Markets"
Source: Internal documents of City Markets Co, 2013

Sector of investment, construction supervision and information technology activities performed on the programming and development directions and plans of action plans companies in their field, work on monitoring the implementation of all programs and plans, monitoring and supervision of works, users of the market space. Considering the factors of the business environment of City markets can be said to be significantly affected by the government and state institutions that collaborate with the company. As the founder of City Markets, Belgrade City Assembly, by its authorities permit to work, decide on locations where you can perform market activity, prescribe the conditions under which the activity takes place and approve the pricing of public utility companies relating to these services. Of course, economic factors have a significant impact on the enterprise. The purchasing power of the population is an important factor because the markets there is no pre-determined price, or the price depends on the current supply and demand. So in times of crisis, the company marketed to facilitate the survival social most vulnerable population because they are always areas with the most flexible product prices. City markets tend to follow and to adapt to the technological environment, and in order to further develop the company launched a plan general regulation of markets in Belgrade, whose essence is the improvement and modernization of the market. Regarding the impact of the market and its participants, we can say that the market is the only market institution that allows direct contact between producers and consumers, and this is the main advantage of this activity, in situations of growing competition from other forms of trade, especially super and hypermarkets. The advantage of this method for supplying consumer is that the consumer and the seller, as time goes by, create and nurture a very special relationship of mutual trust, which guarantees the customer supplying with quality goods, but the seller a stable client. In a sociological sense markets are irreplaceable form of encounter and communication between people, particularly in urban areas and large cities with markedly

increasing isolation, loneliness, disorientation and anonymity of the people. The most important role in the struggle against the alienation of a public, free, public spaces, streets, squares, parks and markets. These facilities generate human role directing people to contact, meetings and gatherings. Markets provide the greatest opportunities for mutual socialization of participants in the trade as are available to all social and educational groups of inhabitants. From an environmental point of view City Markets plans to introduce environmental management system according to ISO 14001, to manage packaging waste from markets, in cooperation with Delta-Pak, aimed at better utilization of waste from the city's markets and its recycling and conversion to biogas, and hence a cleaner and greener city. The plan is to set up solar panels, which contributes to a healthier life and the environment (Milosavljević, 2012). Determinants of entrepreneurial success is certainly good market location markets, that their spatial position on the highly frequented locations and receptive customers, which eventually became an integral and inseparable part of the urban areas of cities and municipalities (Đorović and Tomin, 2009). Vitality and adaptability to change are two very strong market characteristics. Among the most important chances are definitely organized introduction of biologically valuable and healthy food on the market which brings new content and prerequisites for the establishment of standardization model for all, or at least one part of the market services. Infrastructure and technical equipment market becoming a priority development plans. To offer other market specific, and it was more complete, stores will be in terms of infrastructure and more important. Quality management is a set of actions and activities that affect the quality of the product, labor and confinement. City Markets in April 2012 introduced a quality management system ISO 9001 which meets the demands of customers in terms of quality of services that the company provides. System on a daily basis to innovate and improve in order to better adapt to market demands, with special emphasis on consumers and thereof on the needs and current trends. In addition to the introduction of quality management systems in the plan is the introduction of an environmental protection system according to ISO 14001, as well as the system of health and safety according to OHSAS 18001 certified. Market activity has to build its own model of dialogue with their audiences. Projection of market development activities should be sought between the further enrichment of content offerings, infrastructure development and equipment market, at one and the preservation of its wealth on the other. In January 2012 National market was formed on the territory of pre-existing wholesale market. Wholesale logistics center has a character that offers the possibility of marketing the products in bulk according to veterinary-sanitary conditions. It promotes the development of agriculture, increased assortment and sale of goods, networking and cooperation of manufacturers and retailers lower prices and increase export potential, enhance competitiveness of all its participants. Wholesale market covers an area of 18 hectares, has 870 outlets (7 ha) on the plateau, and 3,000 m² of office and warehouse space (18 bars, 87 tents, 28 warehouses and 24 storage areas) and 750 parking spaces. In technical terms, is equipped with loading and unloading areas lift truck service, the separate waste recycling, transport and logistics. In addition, restaurants, financial institutions, etc. makes this institution of higher market standards. Provides wholesale services: sales of the plateau (Truck sales), monthly book sale, lease prefabricated buildings (tents and kiosks), monthly book prefabricated structures (tents), rental of warehouse and warehouse space, lease office space. Ability to trade on wholesale markets are: farms, farmers, businesses that are registered for agricultural activities and small shops. Wholesale markets will be in a position to supply the public sector at prices equal or lower than the stock market price on the delivery date. Wholesale clearing system will establish a business that will take care of all the agreements made at the wholesale market, manage deposits and intervene in the event of non-compliance with contractual obligations. Domestic small and medium farmers will be able in this way to be involved in the competition, thus encouraging domestic agricultural production. The market will be spared the large fluctuations in commodity prices, as it will offer the wholesale markets to be constant. The main problem faced by entrepreneurs is finding quality sources of funding for business or startup businesses, as well as the amount of potential financial gap that has to be met from other sources (Avijaš, 2010). Since the City markets operate as a public

utility and that its founder, the city of Belgrade, all the investments and funds provided by the city and the income from business. Sources of income of the company derived from renting public services market commercial area. According to the Regulation on issuance market commercial space, commercial space marketplace is divided into regular structures, market structures and market equipment. The permanent facilities include office buildings, restaurants, rooms, offices, warehouses and depots. The shopping facilities include small, temporary prefabricated buildings, structures formed from standard prefabricated mass production gross floor area of $3m^2$ - $30m^2$. The market equipment includes counters, display cabinets, boxes, frames, etc. Users of the market space can be natural persons, legal persons and entrepreneurs, and rental market area is regulated by the Lease Agreement which amount starting price determined by the Management Board of the company. For example, the market for housing reconstruction, Green Venac total investment is 522 million, of which the share of resources allocated City Council, and part of the City Market. Reconstruction of the market in block 44 has cost 153 million, and the market in Zemun about 40 million. The company does not exist any form of debt or external funding.

Table 1. Total revenue from stalls issued by product type in 2010 & 2011 (000 Ft.)

Collection stands by product	Issue the capacity		% participation		The revenue		% participation	
	2010	2011	2010	2011	2010	2011	2010	2011
Fruits and vegetables	828.710	836.870	69.96	69.5	184.109	201.123	62.1	61.8
Milk products	101.461	98.886	8.6	8.2	35.376	37.255	11.9	11.4
Eggs	41.687	40.106	3.5	3.3	10.603	10.982	3.6	3.4
Fish	2.642	3.366	0.2	0.3	1.179	1.777	0.4	0.6
Clan poultry	24.745	24.417	2.1	2	10.535	10.985	3.6	3.4
Other stalls	185.374	200.774	15.7	16.7	54.550	63.411	18.4	19.5
TOTAL	1.184.619	1.204.419	100	100	269.355	325.536	100	100

It can be seen from Table 1 that the largest company of its revenue from charging rent stalls selling fruit and vegetables, whose share in the total income of the issued stalls over 60%, while the lowest share of income, about 0.5%, with the tenants whose business selling fish. The company is both the largest share (13%) of the proceeds of the daily collection of stalls and achieve the Kalenic market. Tables 2 and 3 shows total income and total expenditure structure by structure in 2010 and 2011.

Table 2. Total income of the structure in 2010 and 2011

Type of income	Achieved in 2010	Achieved in 2011	Index (3/4)
1	2	3	4
A. operating income	984,463,343.79	1,011,990,973.28	101,78
B. financial income	91,415,456.74	70,178,424.71	76,77
C. Extraordinary and non-operating income	62,942,681.12	60,990,100.95	96,90
D. Profit from discontinued operations and transmission revenues	0.00	5,747,042.03	-
Total income (A+B+C+D)	1,138,821,481.65	1,148,906,540.97	100,89

From the table below it is evident that the largest share in the total income for operating income or income arising from the performance of business enterprises, accounting for over 85% in both years. Also, in 2011 the Company achieved a higher total revenue compared to 2010 by 0.89%.

Table 3. Total expenditure by the structure in 2010 and 2011

Type of expences	Achieved in 2010	Revised plan 2011	Achieved in 2011	Index (4/2)	Index (4/23)
1	2	3	4	5	6
A. operating expenses	944,629,751.33	1,030,712,225.00	984,603,332.59	104,23	95,53
B. financial expenses	553,679.75	371,379.00	19,020.03	3,44	5,99
C. Extraordinary and non-operating expenses	85,307,445.59	17,827,594.00	104,430,712.09	122,42	585,78
D. Loss from discontinued operations and transmission revenues	0.00	2,000,000.00	1,666,937.54	-	83,35
Total expenditure (A+B+C+D)	1,030,490,876.67	1,050	1,090,720,002.25	105,84	103,79

Data show that the company is in 2011 had higher expenditures compared to 2010 as a result of major investment companies in the reconstruction of the market and the construction of wholesale markets.
List of Tables 4 shows that the income from operations in the 2011 is lower by 46.29% compared to 2010 as a result of higher expenditures for that year.

Table 4. Profit from continuing operations in 2010 and 2011

Position	Achieved		Index(2011/2010)
	2010	2011	
A. Total income	1,138,821,481.65	1,148,906,540.97	
B. Total expenditure	1,030,490,876.67	1,090,720,002.25	
PROFIT (A+B)	108,330,604.98	58,186,538.72	53,71

Pursuant to the said share of net income in total income of 2011 decreased by 4.64% than in 2010 (Table 5).

Table 5. Share of net income to total revenue in 2010 and 2011

Position	Achieved in 2010	Achieved in 2011	% participation	
			2010	2011
Profit before tax	108,330,604.98	58,186,538.72	9,51	5,06
Tax	9,154,081.00	11,428,505.00	0,80	0,99
Net profit	99,176,523.98	46,758,033.72	8,71	4,07
Total income	1,138,821,481.65	1,148,906,540.97	100,00	100,00

It is interesting to observe the structure of the financial results observed in both years (Table 6).

Table 6. Structure of financial results in 2010 and 2011

Balance position	Achieved in		The percentage share	
	2010	2011	2010	2011
1.Operating income	984,463,343.79	1,011,990,973.28	86,45	88,08
2. financial income	91,415,456.74	70,178,424.71	8,03	6,11
3. Extraordinary and non-operating income	62,942,681.12	60,990,100.95	5,53	5,31
4. Profit from discontinued operations and transmission revenues	0.00	5,747,042.03	0,00	0,50
5.TOTAL INCOME (1+2+3+4)	1,138,821,481.65	1,148,906,540.97	100	100
6. Operating expenses	944,629,751.33	984,603,332.59	91,67	90,27
7.Financial expenses	553,679.75	19,020.03	0,05	0,00
8. Extraordinary and non-operating expenses	85,307,445.59	104,430,712.09	8,28	9,57
9. Loss from discontinued operations and transmission revenues	0.00	1,666,937.54	0,00	0,00
10. TOTAL EXPENSES (6+7+8+9)	1,030,490,876.67	1,090,720,002.25	100	100
11. Financial result of operating income (1-6)	39,833,592.4	17,387,640.50	36.77	29.88
12. The financial result of the funding (2-7)	90,861,776.99	70,159,404.68	83.87	120.57
13. The financial result generated from operating activities (11+12)	130,695,369.40	87,547,045.18	120.64	150.45
14. The financial result of extraordinary and non-operating income (3+4)-(8+9)	-22,364,764.47	-39,360,506.56	-20.64	-67.64
15. Gross financial result (5-10)	108,330,604.98	58,186,538.72	100	100

Besides the indicated fact that the gross financial result was higher 46.29% in 2010, it should be noted that the financial results from continuing operations in 2011 has decreased by 6.89%, while the financial result of the financing structure of the share of the gross financial result increased by 36.70%. Also, the overall financial results from continuing operations declined in 2011, compared to 2010, but its share is higher for structurally 29.81%.

In the process of doing business City markets it is important to consider the elements of the income statement in 2010 and 2011 (Tables 7 and 8).

Table 7. The elements of the income statement in 2010

Income/expense Profit / loss	Income	Expenses	Profit	Loss	difference
Business	984,463,343.79	944,629,751.33	39,833,592.46	-	39,833,592.46
Financial	91,415,456.74	553,679.75	90,861,776.99	-	90,861,776.99
Remaining	62,942,681.12	85,307,445.59	-	22,364,764.47	- 22,364,764.47
Income, expenses, bug fixes from earlier years	-	-	-	-	-
Total	1,138,821,481.65	1,030,490,876.67	130,695,369.45	22,364,764.47	108,330,604.98

Foregoing table it can be concluded that a much smaller share of the total profit with operating income, which is a 30.48% share, compared to income from financing, with a share of 69.52%, which means that the company has not generated the largest share of the profits revenue arising from the

performance of activities of the company. The company was in 2010 had higher other expenses in relation to other income, apropos the share of other losses in the total loss amounted to 17.11%.
In 2011 the share of operating income to total profit was 26.95%, while the share of financial gain 69.04%. The participation of other losses in the total loss was significantly higher in than in 2010 (42.74%).

Table 8. The elements of the income statement in 2011

Income/expense Profit / loss	Income	Expenses	Profit	Loss	Difference
Business	1,011,990,973.28	984,603,332.59	17,387,640.50	-	17,387,640.50
Financial	70,178,424.71	19,020.03	70,159,404.68	-	70,159,404.68
Remaining	60,990,100.95	104,430,712.09	-	43,440,611.14	- 43,440,611.14
Income, expenses, bug fixes from earlier years	5,747,042.03	1,666,937.54	4,080,104.49	-	4,080,104.49
Total	1,148,906,540.97	1,090,720,002.25	91,627,149.86	43,440,611.14	48,186,538.72

Perceiving a need for balance sheet items and to consider the number of workers by educational attainment and average earnings per worker (Tables 9 and 10).

Table 9. Number of employees by level of education

Level of educational attainment	Number of employees		
	woman	man	total
Secondary education	29	86	115
College	6	28	34
High	15	23	38
Primary education	5	4	9
Q	1	8	9
Total	56	149	56

Of the total number of employees most of them are those with secondary education (115), and within them the 86 men. From the table it can be seen that the majority of men with college and university degrees than women. From the table below we can see that in 2011 had increased the average number of employees and average gross and net earnings per worker. The share of gross wages in total income in 2010 amounted to 26.37%, while 2011 there was an increase of its 28.01%. In the process of financing business enterprise is very important to make an insight into the investment profile of the project construction (Table 11). However, the City Market is faced with certain risks in its business. The most pronounced risks in PUC "City Market" are external. Certainly, the general situation in the state itself, socio-political and economic relations, such as inflation and the economic crisis, pose risks in trade in agricultural and other products, and therefore reduction in number of market tenants. In addition, the most common risks are in markets are: communal mess, lack of parking spaces, illegal vendors, or resellers, non-compliance with regulations and terms of sale of easily perishable food products. In this regard, one should observe the conclusion that "today we are increasingly moving towards that the entrepreneurship risk management should be a unique

Table 10. Average earnings per worker

	2010	2011
Average net income per worker	63,551.42	67,169.75
The average gross wage per worker	89,703.42	94,780.83
Average number of employees	325.70	239.36
Gross earnings	300.283,885.98	321,815,306.98

Table 11. Displaying investment profile Construction of the Market

Realization time	First stage: the construction of 10,400 m² hall for fruits and vegetables, 34,000 m² SNB paved parking for trucks with adequate infrastructure, a new entrance and a fence around the complex (completion in 2013) Second stage: the construction of a hall for meat, fish and flowers (after the completion of Phase I) Third stage: the construction of an additional hall for fruits and vegetables * Implementation of phase II and III depends on the needs of the market
The expected level of investment (total)	18 mil. € (first stage-8 mil., the second and third phase-to 5 mil. each) * Calculated value of building with associated fees
The investment of the City of Belgrade	6 mil. € (for the Phase I)
Amount of individual roles	150,000 € (min) provides benefits at a point of sale; 300,000 € to two shops; 450,000 € to three outlets
Size of leased premises	Minimum space leased area-150 m^2 of warehouse space, along with that goes min. 25 m² and 25 m² of exhibition space office
Rent	5 €/m² for investors (to fully depreciated investment investors) 10 €/m² for others (based on current estimates)
stake	0.4% on average invested 150,000 € (after the completion of the first phase) * In the event of a capital increase of € 6 mil. €
expected annual income	3.5 mil. (at the end of the first phase), the total income of 12% investition
Expected profit (estimate School of Economics)	approximately 4% dividend, plus 8% of the savings to lease (the investment is fully depreciated)
Credit line for investors	Available line of Banca Intesa, with a grace period until the beginning of the first hall; loans are available in DIN and €

There are a large number of resellers in the market, bringing various goods from Hungary, such as meat and meat products, dairy products, confectionery, alcohol, tobacco, household chemicals and other necessities. The price of these goods does not include VAT, nor excise duties are charged on excisable goods. Sellers report these goods to customs when they leave Hungary to receive tax refunds, while the same goods are not applied for customs in Serbia, but enter the country illegally, and are illegally sold without any analysis of food samples. Consequently, City Markets work on the implementation of regulations on standardization and quality standards, product specifications and product brands. Therefore, identification boards will be introduced at the markets to inform customers about the origin of goods and protect sellers against unfair competition.

Conclusions

Entrepreneurship is the basis of the development of a market economy. Entrepreneurship includes all activities focused on investing and combining the necessary resources, expanding into new markets, creating new products, new consumers, new technologies and technological solutions. The level of production of certain products and services, as well as the level of satisfaction of human needs depends on the available resources, human creativity and innovation. Within the current processes of globalization, the struggle over market space becomes more aggressive and more dynamic, and only those companies that have high level of flexibility and innovation embedded into the business environment can survive. Reaching the maximum in meeting consumers demands in terms of quantity, quality, price of products and services, at the right time, provides competitive advantage on the market. Therefore, the Public Utility Company "City Market" closely follows the pace of technological development and adapts to the changing consumers' needs. Adjustments to the new wave of changes were primarily influenced by the emergence of supermarkets and megamarkets, expansion of non-cash payments, credit cards and certain changes in habits, as well as desires and tastes of customers. Historically viewed, although it is not possible to talk about

organized forms of reaction, however, the vitality and adaptability to different business conditions are two constant features of this activity. The tradition of shopping at markets exists for centuries in this region and it has very important sociological aspect. Markets are the places where people gather and communicate amongst themselves. Therefore, in a global sense, the projection of market development activities should be sought in enrichment of offerings, infrastructure development and the equipping of the market, on the one hand and the preservation of their specificities, on the other. The most important perspective of the market activity in Serbia is placing biologically valuable food and organic products on the markets. The Law on Communal Activities will leave open the possibility of cooperation with the private sector and various subcontractors, which will greatly contribute to the development of a strategy for the future development of the market activity.

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WHOLE FARM REVENUE INSURANCE AS A NEW MODEL OF CROP INSURANCE

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Abstract
Agricultural production is a specific area of business that is strongly influenced by natural, climatic, market, financial and institutional factors. These are all hazards not depending on the will of man and his activities, and it is necessary to foresee them and to insure against them. Crop and fruit insurance is the most effective risk management instrument in open field crop production. The aim of this paper is to present a new model of crop insurance which began to apply in 2015 in the United States. Every farm, by its implementation, provides farm's expected total revenue that may be affected by the operation of both natural and climate risks, and market risks too, which are manifested through fluctuations in market prices. In this way all farm crops are insured against any risks with just one policy. Analyzed farm has experienced revenue loss due to drought, therefore it has indemnity right in the amount of 2,500 €. Premium costs amount to 330 €.

Keywords: crop insurance, revenue, farm, one policy.

Introduction

Insurance is a financial arrangement that reallocates the costs of unexpected losses (Dorfman, 2007). Insurance of crops and fruits, as a contemporary form of protection of the production is the best risk management instrument in crop production (Kokot et al., 2017). The emergence of modern risk management in agriculture is increasingly becoming focused on ensuring total farm revenue (Turvey, 2012), considering that thus eliminating the disadvantages of traditional insurance systems, like adverse selection and moral hazard. The aim of the whole farm insurance is to unite all the risks that threaten farm under one insurance policy. Whole-farm revenue protection (hereinafter WFRP), as the latest model of the whole farm insurance, provides protection against loss of revenue that farmer expects to earn or will obtain from commodities (crops, fruits, livestock etc.) produced or purchased for resale during the insurance period. WFRP protects against revenue loss due to any unforeseen natural phenomena that cause a decrease in yield, or due to market fluctuations that cause the revenue loss during the insurance year (Stokes Nayda and English, 1997; Zhu et al., 2008; Johnson et al., 2008). The Risk Management Agency (RMA), which is located within the Ministry of Agriculture of the United States, begin to apply WFRP under the Farm Bill from 2014. WFRP is the successor of the Adjusted Gross Revenue (AGR-Lite), which also represents a model of the whole farm insurance (Shields, 2012). The benefits of applying WFRP as compared to AGR-Lite are: a wider range of coverage level, increased maximum amount of coverage (from 1 to 8,5 mil. $), replant coverage, higher government subsidies and coverage of the market readiness costs (Chalise et al., 2017; Shields, 2015). Whole farm insurance provides more efficient coverage then ensuring each commodity separately with particular insurance policy (Bielza Maria and Garrido, 2009). The ratio of this insurance model is based on a simple diversification and portfolio management. For example, if a farmer grows two crops, A and B, the insurance policy based on the total farm revenue will be cheaper than the sum of the premiums for two individual insurances for crops A and B, which provides the same expected revenue. Saving is inversely proportional to the correlation between revenue from the analyzed crops (Hennessy et al., 1997). On the other hand, WFRP has an important

positive side for insurance companies because the negative financial result, which the farmer realizes in one product can be offset with the positive financial result of another product. In this way there is no significant reduction in total farm revenue, therefore insurance companies will not have to compensate the damage. The aim of the research is to present the theoretical basis of WFRP, as the most modern insurance model in agriculture, and to analyze the possibility of applying this model in Serbia based on a practical example.

Material and methods

For the purposes of research, primary data is obtained from a private farm located in the northern part of Serbia, Province of Vojvodina. Additional sources of data are the Statistical Office of the Republic of Serbia, the Commodity Exchange in Novi Sad and the United States Department of Agriculture. The data was analyzed within the period of five years (2010-2014). A literature review was carried out to outline the theoretical framework for this paper. A practical implementation of WFRP is shown in the case of the aforementioned farm. When projecting the expected farm revenue in the insurance year, data on average realized revenue in the period from 2010 to 2014 are used. The expected revenue (R) is calculated as the product of the total area sown (a), the expected yield (y) and the commodity price (s).

$$R = a \cdot s \cdot y \quad (1)$$

The amount of insurance premium (P) that farmers have to pay to an insurance company, as compensation for the transfer of risk, is the product of the insured revenue (R_o) and premium rate (p), whereby the insured revenue is obtained as a product of the approved revenue and the selected level of coverage:

$$P = R_o \cdot p \quad (2)$$

The level of premium rate depends primarily on the diversification factor, which is determined based on the number of commodities on the farm and the Weighted Commodity Rate. The Risk Management Agency (RMA) allows all farmers to calculate themselves how much the insurance policy would cost them. Namely, the Cost Estimator, located on the RMA website, where each farmer will, by entering the appropriate parameters, receive the amount of the premium to be paid. In the event of failure to achieve guaranteed revenue, the farmer is entitled to indemnity (I_n) which is calculated as the difference between the insured revenue (R_o) and the realized revenue (R_p). On the other hand, if the farmer generates revenue at the end of the year equal to or greater than the guaranteed revenue, it can be concluded that the insured event did not occur, and consequently there is no need for an indemnity:

$$I_n = R_o - R_p \quad (3)$$

Results and discussion

Basic characteristics of WFRP

WFRP is the only insurance model in agriculture which is available at the national level respectively in all 50 USA states. This model represents a system that is based on revenue. In this way, protection of total farm revenue is provided with one insurance policy. In other words, this approach represents an "umbrella policy". A trigger level forms within the policy, and if realized revenue falls below that level, indemnity right will be acquired. WFRP protects the farm from the loss of revenue that is expected to be earned from: (i) commodities produced during the insurance period, regardless of whether they are sold or not; (ii) commodities purchased for resale during the insurance period; (iii) all commodities on the farm, except timber, forest and forest products, or animals for sport and show or pets. The farmer should choose the appropriate coverage level of the

insured revenue when applying for the WFRP insurance program. WFRP provides coverage levels ranging from 50 to 85% of the farm insured revenue. It is necessary to have an expressed diversification of production if certain farm wants to be qualified for the highest coverage levels. It practically means that at least 3 commodities must be on the farm (for example, wheat, corn and sunflower), which each individually contributes significantly to the total revenue in order to farm qualifies for coverage level of 80 and 85%. The diversification level is very important for WFRP and is measured by the number of commodities on the farm. Higher production diversification except allowing a higher percentage of coverage, it also allows a higher subsidy amount in order to pay lower premiums. This is because the higher diversification reduces the risk of total farm revenue decrease. In addition to product diversification, authors Pejanović and Njegomir (2011) mention spatial diversification, diversification of businesses, diversification by off-farm employment and diversification by association in cooperatives, as ways to diversify the risks that the farmers are exposed to. The insurance period is based on the fiscal year. If the farmer is a tax filer who pays taxes on the basis of the calendar year, the insurance period is from January1 to December 31. There are certain documents that must be submitted to the insurance agent when concluding policy, and which are related to farm operation in the last five years (the so-called historic period):

1) WFRP application
2) Whole-Farm History Report
a) Tax form Schedule F for all the previous 5 years of historic period
b) Allowable Revenue Worksheet for all the previous 5 years of historic period
c) Allowable Expenses Worksheet for all the previous 5 years of historic period
3) Farm Operation Report
4) Beginning Accounts Receivable and Accounts Payable Report

(if applicable)

5) Market Animal and Nursery Inventory Report.

Furthermore, these and all other documents that must be submitted when concluding the insurance contract and during the insurance year will be explained through a practical example of the implementation of WFRP insurance.

WFRP implementation in the analyzed farm case

A farm located in the northern part of Serbia, province of Vojvodina, will be analyzed in this particular case. The farm has a total of 28 ha of arable land that is deployed on four plots of 3, 5, 8 and 12 hectares and is engaged solely in crop production. In all years of the analyzed period, spring wheat, corn, soybean and sunflower are represented in the sowing structure. The first step will be the drafting of the Whole-Farm History Report (Table 1). The Whole-Farm History Report is a report that documents allowable revenue and allowable expenses for each tax year that is used in determining the whole farm historic average of revenue and expenses (WFRP Pilot Handbook, 2016). Historic period covers five consecutive tax years prior to the tax year immediately before the insurance year (lag year). Particularly, it is necessary to provide copies of tax forms for the period from 2010 to 2014 for the insurance year 2016.

Table 1. Whole-Farm History Report (Insurance year 2016)

Tax year	Allowable revenue (€)	Allowable expenses (€)
2010	30,700	20,198
2011	28,587	18,807
2012	25,882	17,028
2013	28,778	18,933
2014	30,600	19,999
Total	144,547	94,965
Whole farm historic average	28,910	18,993

Source: Farm; Authors' calculation

The next step is compiling the Intended Operation Report, which represents a form on which the insured provides all necessary information in relation to all crops planned for production during the insurance year and the expected revenue from those crops during the insurance period. In particular, it is necessary to enter data regarding the specific area under each crop (number of hectares), the total expected production, the expected selling price per commodity unit, and the total value of each commodity. The approved revenue amount is determined on the basis of Farm Operation Report and represents a lower amount of: (1) Farm Expected Revenue in the insurance year, or (2) Whole-Farm Historic Average Revenue (Table 1). In this specific case, as stated above, the analyzed farm is engaged solely in crop production, and it is planned 12 ha of spring wheat, 3 ha of corn, 5 ha of soybeans and 8 ha of sunflower to be grown in the insurance year. Total expected revenue at the farm level is calculated on the basis of expression (1) and amounts 25,895 €, which in this case also represents the value of the approved revenue, while the value of approved expenses is 17,012 €. At the end of production year, it is necessary to complete Schedule F, which represents a tax form that is most commonly used for the application of the federal farm tax. This means that actual realized revenue and expenses during the production (insurance) year are determined on the basis of Schedule F (Table 3). Copies of the applicable tax forms of Internal Revenue Service (IRS), such as Schedule F, must be submitted to the insurance company for each tax year within the farm historic period (2010-2014).

Table 2. Farm Operation Report

Commodity	Measurement unit	Yield (t x ha^{-1})	Expected Value (€ x t^{-1})	Expected Revenue (€)	Intended area (ha)	Total Expected Revenue (€)
Spring wheat	Ha	4.74	161	763	12	9,156
Corn	Ha	8.62	142	1,224	3	3,672
Soybeans	Ha	3.42	353	1,207	5	6,035
Sunflower	Ha	2.98	295	879	8	7,032
Total at sales closing date						25,895
Total Expected Revenue at sales closing date (SCD)						25,895
Whole-Farm Historic Average Revenue (Item 5 from Table 1)						29,344
Approved Revenue (Lesser of item 9 and 10)						25,895
Approved Expenses (Approved Revenue/item 5 from Table 1 for revenue x item 5 from Table 1 for expenses)						17,012

Table 3. Allowable revenue and expenses' calculation

Serial no.	Description	Amount (€)
1.	Gross farm revenue in 2016 (Schedule F)	37,544
2.	Gross farm expenses in 2016 (Schedule F)	38,662
3.	Adjustment revenue amount	18,034
4.	Adjustment expenses amount	10,181
5.	Allowable revenue for tax (insurance) year (5=1-3)	19,510
6.	Allowable expenses for tax (insurance) year (6=2-4)	28,481

Source: Authors' calculation

Allowable revenue is the revenue derived from farm's commodities produced within the farm operation, or from commodities that are purchased in order to continue its growth and development on the farm. In short, the allowable revenue includes revenue from all insured commodities and all items that make up the allowable revenue are accurately listed in Schedule F

tax form. Calculating the allowable revenue is needed to show which revenue can be insured under WFRP policy, and which adjustments should be made to eliminate the revenue that cannot be insured. Allowable revenue excludes: (1) Revenue from any post-production operations, (2) Net gain from commodity hedging or speculation, (3) Revenue from custom hire and rental activities, (4) Revenue earned as an animal contract grower, (5) Revenue from wages, salaries, tips and cash rent, (6) Revenue from government agricultural programs, etc. Adjustment amount used in Table 3 includes amounts of revenue i.e. expenses that are not considered allowable revenue and allowable expenses for the WFRP purposes. Allowable expenses specifically exclude any expenses related to post-production operations or commodities in which farmer has no insured interest. Adjustment amount is also calculated on the basis of information from Schedule F. Allowable revenue and allowable expenses' amounts represent the basis for composition of Whole Farm History Report (Table 1). When considering expenses, it is important to state that their only role in WFRP insurance model is to correct (reduce) the value of the insured revenue if expenses during the insurance year are not at the level of at least 70% of the approved expenses (Table 2). This basically means that if farm production has no expenses during the insurance year in the amount of at least 70% of approved expenses, the insured amount of revenue will be reduced by 1% for each percentage point of approved expenses which fall below 70% of the approved expenses. In this way, the possibility of moral hazard is also neutralized. In the analyzed case, the allowable expenses are higher than the approved expenses, so it is not necessary to make adjustment (reduction) of the insured revenue amount. By insurance, the farmer transfers the risk of loss to the insurer and undertakes to pay an insurance premium for that (Berg, 2005). In other words, insurance premium is the amount of money which in this case farmer pays to the insurance company as a service for risk transfer. It can be represented as a price risk and cost of insurance (Marković, 2013). The premium is directly proportional to the size of the risk, the value of the insured sum and duration of insurance (Petrevska et al., 2010). Expression (2) is used to calculate the premium to be paid by farmers to the insurance company. The total amount of the premium consists of functional (net) premium and administrative fees, which in this model of insurance amounts 20 €. Administrative fees include the costs of concluding the insurance contract, the costs of collection of premiums, salaries and other administrative fees. Also, it should be noted that depending on the number of crops produced on the farm, U.S. Department of Agriculture subsidizes certain percentage of WFRP insurance premium (www, USDA). In Serbia, the Ministry of Agriculture, Forestry and Water Management subsidizes insurance premiums in 40% of the total amount, but the maximum area on which the right to return can be realized is limited to 20 ha.

Table 4. The calculation of premium borne by the insured

Approved Revenue (€)	Coverage level (%)	Premium Rate (%)	Subsidy amount (%)	Premium amount (€)
1	*2*	*3*	*4*	*5=(1x2x3)-(1x2x3x4)*
25,895	85	3.2	56	310

Source: Authors' calculation; www.ewebapp.rma.usda.gov

Irrespective of the realized revenue at the end of the year, the farmer has an obligation towards the insurance company in the amount of 330 €, which is the amount of insurance premium when value of administrative costs is added. In this model of insurance, losses occur in a situation where allowable revenue (Table 3), obtained from commodities produced during the insurance year, fall below the insured revenue which is calculated as the product of the approved revenue and selected coverage level (Table 5). Due to unfavorable weather conditions (drought) in the production year 2016, analyzed farm has achieved below-average revenue in the amount of 19,510 €. Considering

that value of realized revenue is less then value of insured revenue, it can be concluded that there was an occurrence of the insured event in the current year. Insurance company is obliged to pay to the farmer, i.e. farm owner, indemnity in the amount of 2,500 €, based on expression (3).

Table 5. Claim for Indemnity Form

CLAIM FOR INDEMNITY FORM								
1. Insurance Year: 2016	2. State/County: Serbia/Vojvodina	3. Insured information: N.N. Insured Vojvodina, Serbia Phone: xxx xxx SSN: xxxxxxxx		4. Agency information: N.N Agent Vojvodina, Serbia Phone: xxxxxx Agent Code: XX Policy: xxx		5. Companion Policy(s): NONE		
6. Date of Damage: July 2016		7. Cause of Damage: Drought		8. Primary Cause (100%): 100		9. Date(s) of Notice: 01.08.2016.		
CALCULATION OF CLAIM								
10. Allowable Expenses for Insurance Year (Table 5) (€)	11. Approved expenses (Table 2) (€)	12. Expense Percentage (10/11)	13. Expense Reduction Factor	14. Approved Revenue (Table 2) (€)	15. Expense Reduction Amount (13x14) (€)	16. Approved Revenue Adjusted for Expenses (14 – 15) (€)	17. Coverage Level (%)	18. Insured Revenue (16x17) (€)
28,481	17,012	1.67	0	25,895	0	25,895	85	22,010
19. Allowable Revenue for Insurance Year (Table 4) (€)	20. Inventory Adjustment (€)	21. Accounts Receivable Adjustment (€)	22. Market Animal and Nursery Adjustment (€)	23. All Other Adjustments (€)	24. Revenue-to-count (19+20+21+22+23) (€)		27. Revenue Loss (18-24) (€)	
19,510	0	0	0	0	19,510		2,500	

28. Narrative: Items 20, 21, 22 and 23 are not filled because analyzed farm has no stored commodities, nor due Accounts receivable and due Accounts payable, nor livestock.
Source: Authors' calculation

Conclusions

Agricultural production, as one of the most important industries, is faced with many production risks. This is reflected in direct dependence on the achieved results and the weather (non)conditions. Different insurance systems are the most efficient in managing weather risks. Whole-Farm Revenue Insurance is one of the newer models, which is still only available in the United States. The emergence of modern risk management in agriculture is increasingly becoming focused on farm revenue insurance. The aim of this insurance system is to combine all farm risks under one policy, while achieving numerous advantages over traditional insurance. Unlike traditional insurance, there are no problems of moral-hazard and adverse selection with whole farm revenue insurance, which can be seen in the case of the analyzed farm. Whole farm revenue is determined at the end of the production year and, if the revenue is below a threshold level (insured revenue), the insurer is obliged to pay indemnity to a farmer. In the analyzed case, due to the fact that value of realized revenue is lesser then insured revenue, the insurer is obliged to pay indemnity to the farmer in the amount of 2,500 €. On the other side, a farmer who cultivates 28 hectares of land, has monetary obligation towards insurance company in the amount of 330 €, which amount includes premium and administrative fees. That is certainly not the large amount, if taken in account that whole farm is completely insured from all natural and price risks. A clear strategy on the state level, by establishing a legal framework and financial incentives, analyzed insurance model could be successfully implemented in other parts of the world, and thus insure a large number of farmers, especially those who perform their activity in countries where climatic conditions are unstable.

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INFLUENCE OF CLIMATIC CONDITIONS ON YIELD AND PROFITABILITY OF QUINCE BRANDY PRODUCTION

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Abstract
The aim of this study was to show how climatic conditions could affect the yield and profitability of quince brandy production. The study was conducted using various methods such as content analysis, analytical methods, interview and direct observation. In addition, hypothetical-deductive method, statistical methods and descriptive methods were also used. Data were obtained from different sources i.e. the internal documentation of agricultural holding where the quince, as a raw material for production of brandy was produced, the internal documentation of distillery, as well as professional literature and the internet. The analysis was done for the period 2013 - 2016. The study showed that climatic conditions can affect the yield and profitability of quince brandy production, and the production of quince brandy in analyzed years was profitable.

Keywords: climate conditions, yield, profitability, quince brandy.

Introduction

Rakija is the national drink of Serbia. It is one of the most popular alcoholic drinks there. It is made of different fruit species. Quince is one of them. Rakija made of quince fruits is called Dunjevacha. It is a brandy with a characteristic fruity taste, preserved in the liquor due to the complex processing of the fruit and the distillation process. In addition the production of Dunjevacha can be a very profitable.

Material and methods

The study was conducted using various methods such as content analysis, analytical methods, interview and direct observation. In addition, hypothetical-deductive method, statistical and descriptive methods were also used. The data was obtained from different sources, ie the documentation from the agricultural holding where quince as a raw material for the production of brandy was produced, the documentation from the distiller, the professional literature and the internet. The analysis was done for the period 2013 - 2016.

Raw materials for the production of fruit distillates

For the production of fruit brandy, all fruit raw materials containing sugar can be used, from which during the process of alcoholic fermentation (ebullition), ethyl alcohol (ethanol) is formed. In the Republic of Serbia, stone fruits (plums, apricots, peaches, sour cherries and cherries), pome fruits (apples, pears and quinces), berries (raspberries and blackberries) are most often used for this purpose as well as the fruit of the vine. Top quality fruit brandy can be achieved only with the processing of quality fruits i.e. those that are healthy and at a stage of full technological maturity. Fruits that are unripe, rotten, moldy or insufficiently formed are not suitable for production (Pischl, 2011). The full technological maturity of the fruit is achieved when the maximum concentration of sugar and aromatic substances is reached in it. At this stage of ripening, the fruit is most suitable for any kind of processing, and also the production of fruit brandy. Most fruit varieties have characteristics of an aromatic substance, therefore the characteristic flavoring brandy is obtained by processing them.

Quince as a raw material for the production of brandy

Quince (Cydonia oblonga) is an old fruit species, as most of the group of pome fruits that it belongs to. It was grown 4,000 years ago, and most often as a subsidiary fruit species. It is believed to be originating from the Caucasus region, from where it spread to the east and south (to Asia Minor), and from there into ancient Greece. Before the beginning of Common Era, it was transferred from Greece to Rome, and then to other parts of the European continent (Mratinić, 2010). It is mostly cultivated in the Mediterranean region and in the wine-growing zone of moderate continental climate. Quince has never had economic significance as some other fruit species, such as plum, apple, apricot, peach, grapevines, and so on, and it grew most sporadically on individual agricultural households. In the total amount of fruit produced in the Republic of Serbia, quince has been represented for about 0.8 - 0.9% over the years (SORS, 2017). The quince trees are the most common in the valleys of the Zapadna Morava river and the Velika Morava river and in the Danube region. The variety of quince, compared to other fruit species, is rather modest. It is believed that there are about 500 varieties of quince, of which about 30 are in the wider production. What is important for industrial processing are the varieties of the correct shape, with fewer unevennesses, a smaller content of skeletal cells and with higher content of sugars and aromatic substances. The most recommended varieties for growing and processing are: Leskovačka, Vranjska, Constantinople and Champion. In Serbia, the most common varieties are Leskovačka and Vranjska. Quince starts to bear fruit in the fourth year, and the highest fertility is when it is between 15 and 20 years old. Yields are 40 - 200 kg per tree. Of the total weight of the fruit of the quince (depending on the variety: 150 - 1050 g) soft parts make up 85-90%. The content of certain substances that determine the quality of the quince fruit can range in a wide variety, most often: sugar 7 - 15%, dry matter 11.3 - 22%, total acids 0.6 - 1.8% and pectic substances 0.7 - 1.9% (Nikićević and Tešević, 2010). The fruit has a characteristic, beautiful and intense fragrance and represents a rich source of vitamin C and mineral substances (K, Na, Zn, Fe, Mn). It is used in the food industry for the production of compotes, canned fruit, jam, homemade marmalade, fruit juices and nectars, but first of all for the production of the quince fruit brandy so called 'dunjevača'. It is assumed that about 90% of the produced quince in Serbia is processed into the brandy 'dunjevača'. In the observed case, quince variety Leskovačka was used for the production of brandy (Picture 1).

Picture 1. Quince variety Leskovačka

Source: http://edenskivrt.hr/sadnice/dunja-leskovacka

The fruit of this variety is apple-shaped, medium-sized (290 - 400 gr), very juicy, with fine grain, without stone cells, with sweet-acid flavour and having a very pleasant smell. On average, there is 15

- 16% soluble dry matter, of which about 6 - 7% of total sugars and 0.8% of total acids. The scarf skin is even, smooth, of a very attractive appearance. For its cultivation, it requires favorable climatic conditions, fertile soil and sufficient humidity. It matures in the second half of October, and it is kept for a long time under normal conditions. It gives top quality brandy.

Production of quince brandy

Quince brandy ('dunjevača') is a fruit brandy produced by alcoholic fermentation and distillation and / or rectification of a fermented crushed fruit (fleshy fruit) or wider quince with or without seeds, up to a maximum of 86% vol. of ethanol, so that the distillate has the smell and taste of distilled raw materials. The quince brandy must contain volatile substances in the amount of at least 200 g/hl calculated on 100% vol. alcohol and the maximum amount of methanol of 1350 g/hl calculated on 100% vol. alcohol. The minimum alcoholic strength of quince brandy is 37.5% vol. As with any other fruit brandy, it is not allowed to add carbohydrate sugar and alcohol. Quince brandy cannot be flavored. From 100 kg of quince can be obtained 5 - 7 liters of brandy of 40% vol. or 2 - 3 liters of absolute alcohol. The technological process of the production of quince brandy includes 5 phases: fruit production; alcohol fermentation (ebullition) of crushed fruit ; distillation and / or rectification; maturation (aging) in wooden pots or maturing in inert pots; cold stabilization with correction, blending and adding permitted additives. The quince fruit is very sensitive to mechanical injuries. Even minor harm caused by pressure on the cells cause the appearance of black spots on the scarf skin. In these places, the molds develop rapidly and with their hyphae "pierce" the scarf skin, penetrate into the fruit and damage it. That is why the quince in the "bulk" must not be in the layer thicker than 1.2 m, and it is best to be kept in crates for apples that can hold 15 kg. One damaged moldy fruit can very quickly contaminate the entire basket of quince of 300 kg. Therefore, the production of quince brandy begins with the harvesting of fruits in full technological maturity. It is very important that the fruits remain on the branch for a full maturation as long as possible. Fruits achieve full technological maturity in the second half of October and early November. If it is harvested earlier, it is necessary to keep them for a shorter time for ripening. Insufficiently mature fruits have less sugar and aromas, and more acids and this will give less randman and poorer quality of brandy. It is extremely important for the quality of quince berry that the fruits of the quince are mature, healthy and clean, and that the process in the processing is appropriate. Quince is a climacteric fruit, so it is desirable to mature for a certain period of time, usually from 7 to 20 days, at a temperature of about 15°C before further processing. This enables the achievement of full phenol and technological maturity of the fruits. After the harvest, however, the fruits can not be stored for too long, because, due to various damages, they quickly fall under the influence of microorganisms. During storage, there is also a change in the structure of the fruit with the appearance of putridity which is manifested by the color change of the mesocarp, by darkening, by reducing the acidity and softening of the tissue, which is negatively reflected on the randman and the quality of the brandy. After a very good wash, which must be done by dipping and spraying the fruits, an inspection is carried out with the separation of other impurities, moldy and damaged fruits. Washing the quince fruit is very important, because the quince contains an extremely aromatic waxy coating that is rich in some undesirable multi-fatty acids, terpenes and norisoprenoidal compounds that smell on oil (petroleum). That is the reson the washing is sometimes done with strong wash sprays so that the wax coating is removed before further processing. Fruit disintegration can be done on choppers or hammer mills. On this occasion, the seeds should not be damaged, as this has a bad effect on the quality of brandy. Because of its solid structure, quince is practically very difficult to be mashed. Therefore, the inedible parts of the seeds loggia are not usually removed, but the whole crushed fruit is transferred to the fermenters for alcohol fermentation. Alcoholic fermentation, as it is the case with apple processing, can be applied to the chopped fruit of the quince or this mass can be subjected to squeezing, so only the juice is placed on ebullition, thus avoiding the negative impact of the seed of loggia. The quince brandy produced by the distillation of wine from the quince has a lower content of methanol, a smaller content of aromatic substances, but it is more drinkable,

"gentle" and of better quality because the fermentation and distillation does not include the seed in loggia. One ebullition is usually not sufficient to achieve a satisfactory randman, so the pulpy residue is extracted extensively with water or with enzymatic process with appropriate pectolytic enzymes. The quince is rich in polyphenolic compounds, and therefore is highly susceptible to oxidative changes. With these changes, the crushed fruit and juice get a dull-yellow color that degrades the aroma. In order to reduce these undesirable changes, the processing should be done quickly, without delay and trying to keep the crushed fruit or juice out of the air. In general, further processing of the quince fruit can be by the so-called cold or hot, with or without the separation of the seed in loggia. A better procedure is the cold one, with the separation of the seeds of loggia, since then there is no separation of a larger amount of norisoprenoid compounds (C_{12} atoms in the molecule), which are natural ingredients of the fruit of the quince, and they smell on oil (petroleum). The crushed fruit is, due to the presence of high concentrations of protopectins, very dense and difficult to process. Therefore, in order to liquidize the crushed fruit with the cold process without heating, and for the purpose of achieving greater randman, and prevention of germination during distillation, 60-100% of water from the quince mass is added to the crushed fruit. The water must be previously prepared and purified (reverse osmosis, softening with ion-exchange or distilled). Together with water, protopectinases and pectolytic enzymes are immediately added to the crushed fruits. It is necessary to maintain temperature of 20 - 50°C for their effect in the next 24 hours. Protopectinase decomposes protopectins to colloidal soluble pectinic and prectic acid fractions, while pectolytic enzymes continue further degradation of pectin substances to lower products (galacturonic acid, araban, etc.). In this way, the crushed fruit can be liquidized and subjected to alcohol fermentation and subsequent distillation without any problems. Adding enzymes also has an effect on the improvement of aroma in distillates, because they release some of the aromatic substances from their glucosides, which make them volatile and they are converted to distillates. The quince is a late fruit, and therefore it comes to alcoholic fermentation when cold weather has already arisen. For these reasons, it is recommended for manufacturers who do not have controlled fermentation conditions to add selected yeast, ammonia-phosphate, vitamin B1, complex nutrients and citric acids, or 5% H2SO4 to lower the pH of the crushed fruit under 3 in fermentation. The purpose of adding acid is to stop the reproduction of "wild" yeasts and bacteria. The crushed fruit is cooled to about 15-20°C, after which it is added the activated selected yeast, and as such it is transferred to the fermenter. During alcoholic fermentation the temperature should be 15-20°C, which is optimal for performing alcoholic fermentation with moderate intensity. When alcoholic fermentation begins, the created carbon dioxide raises the thick part of the hook to the upper part of the fermenter, and the liquid part remains below. It is desirable, at least once a day, to raise this dense part of the crushed fruit by hand, mixing it manually or by transferring the liquid part with the pump from the bottom to the top. It is mandatory that the fermenters are closed so that only carbon dioxide can be released, through spraying with water at the top. If the fermentors are open, they must be covered during fermentation to prevent the evaporation of ethanol and aromatic substances, the presence of air and acne flies that can cause unwanted acetic bacteria. After the alcoholic fermentation has been completed, which, depending on the temperature, takes place for 10 - 30 days, the obtained crushed fruit is subjected to distillation. If the distillation has to be postponed, the fermented crushed fruit must be protected from deterioration. Distillation of the wine from the quince, and also the fermented quince crushed fruit, especially if water and pectolytic enzymes are added to it before it is started, can be performed almost in all types of appliances and devices with intermittent or continuous operation. Distillation is most often performed on disposable devices with a shorter rectification column and a copper catalyst or standard two-way distillation on the batch apparatus. The advantage of a disposable distillation apparatus with a short rectification column and a copper catalyst is undeniable. Benefits are seen in obtaining aromatic and quality distillates, higher yields and easier, cheaper and simpler work. If the full amount of water is not added to the crushed fruit before ebullition, and it is thick, it is necessary to add about 10-20% of water in order to reduce the danger of heating. Regardless of the amount of water, it is necessary

for the mixer to work all the time during distillation. Regardless of which type of apparatus or device is used for distillation, it is necessary to separate the fractions. During the distillation, the fractions of the first, middle fractions ("heart") and the third part are separated. Separate side fractions may be returned to re-distillation together with the distillation of the fermented crushed fruit or separately. The concentration of ethanol in the middle fraction (heart) should be 60-65% vol. for batch two-fold distillation and 70-75% in single column distillation. Fruit distillates from quince are very suitable for maturation in wooden vessels. Primary aromatic ingredients from quince fruit, the secondary produced during fermentation and the tertial produced during distillation are highly compatible with quaternary aromatic ingredients that the ethanol-water mixture extracts from wooden vessels (usually oak). For these reasons, distillates of quince are often subjected to maturation (aging) in wooden, usually oak barrels and casks. It is necessary for the distillates to mature in wooden pots for at least two years. On the other hand, in some regions, the distillates do not go to aging (maturation), they only merge and harmonize themselves in neutral vessels of glass, stainless steel or food plastics. In order to harmonize the resulting quince distillate, it should be placed in an inert vessel for at least 6 months. The quince brandy is finalized and released to the market with an ethanol concentration of 40-43% vol. as colorless or with golden-yellow color of wooden vessels. Brandy is full, heavy, impressive with smell and taste, with specific aromatic properties.

Results and discussion

This paper analyses the data on the production of quince brandy for the years 2013-2016. During the analyzed period the brandy was produced from the Leskovachka Quince variety at the plantations in the Kosmaj mountain. The following was analyzed for each production year: the quantity of the quince harvested and the related waste, ie the fruits unsuitable for the production of brandy, as well as the fruit harvest and the processing dates. For each observed production year, the analysis also included the climatic conditions and whether any additional ripening process took place. Furthermore, the analysis included the quality of the harvested quince, the purchasing price and brix.

Table 1. Overview of the important parameters in the production of quince brandy for the period 2013-2016

Observed		Year			
parameter		2013	2014	2015	2016
Quince variety		leskovačka	leskovačka	leskovačka	leskovačka
The location of the orchard		Kosmaj	Kosmaj	Kosmaj	Kosmaj
Quantity of quince produced		18.992	42.085	45.500	33.154
Waste	(kg)	230	757	540	578
	(%)	1,21	1,8	1,18	1,74
Date of harvest of fruit		01.11.	01.10.	01.11.	13.10.
The date the processing started		03.11.	03.10.	08.11.	15.10.
Assessment of climatic conditions		favorable	unfavorable	favorable	unfavorable
Condition of the fruit		Large, nice, not juicy	Large, nice, juicy	not juicy	Large, nice, juicy
Additional ripening		no	no	7 days at 12-18°C	no
Price of quince fruit (din/kg)		45	50	30	40
Briks		16	14	15,8	13,7
The amount of brandy obtained (l)		1.600	2.950	3.450	3.580
Randman (%)		8,4	7	7,6	7,2
Alcohol content in brandy (%)		40	40	40	40
Sensory evaluation		18,1	17,2	18,1	17,8

Source: Internal documentation of agricultural holding, 2017.

Sugar was not added during the distillation process in any of the production years. Following the processing of the fruit, of the quantity of the produced quince brandy, the randman, and eventually the grades obtained from the sensory analysis of the produced quince brandy were also analyzed. The yield of quince varied from year to year, both in terms of quantity and quality, which had a direct impact on the both the quantity of the produced quince brandy and its quality. This is also indicated in the data taken for the analysis presented in Table 1.

Analysis of the quince brandy production costs and retail price

The second part of the study refers to the analysis of the quince brandy production costs and retail price. The cost of raw materials required for the production of 0.7 liters of brandy 40 vol. % is calculated from the quantity of raw materials required for the production of the said quantity of brandy and the retail price of the quince. However, in order to calculate the quantity of the raw material required for the production of 0.7 liters of brandy, the randman, which is indicated in Table 1, must be also considered. The result showed that the quantity of the raw material required in the observed years (2013-2016 was: 11.9; 14.3; 13.2 and 13.9 kg respectively. There was no variation in the retail price of quince brandy during the years covered in this study. The 0.7 l packaging was on the markets the Republic of Serbia was analysed. Considering that during the analysed years the technology of the production of the quince fruit, including its processing into brandy, was unchanged, it is an assumption that the variation in the quantity and quality of the quince, as well as the brandy produced from it, was a direct result of the climate. This ultimately influenced the profitability in the production of quince brandy.

Table 2. Overview of the cost for the production of 0.7 liters of quince brandy for each year in the period 2013-2016

Observed	Year			
Costs	2013	2014	2015	2016
The price of the raw material needed for 0,7 l of brandy [10]	535,7	715	396	556
Transportation of raw materials from plantation to factory (3 din/kg)[11]	35,7	42,9	39,6	41,7
Fermentation agents (din/0,7 l) (yeasts, enzymes, yeast feed, citric acid)	17,5	17,5	17,5	17,5
General expenses (din/0,7 l)	5,6	5,6	5,6	5,6
Aging in burials (maturation) (din/0,7 l/year)	14	14	14	14
Packaging	178,44	178,44	178,44	178,44
• Bottle 0,7 l (din/piece)	120	120	120	120
• Cap (din/piece)	12	12	12	12
• Front label (din/piece)	20	20	20	20
• Back label (din/piece)	3,25	3,25	3,25	3,25
• Excise stamps	0,95	0,95	0,95	0,95
• Box	22,24	22,24	22,24	22,24
General bottling Costs (din/piece)	5,6	5,6	5,6	5,6
Total costs	792,54	979,04	656,74	818,84
Earnings (Total costs : Earnings = 1 : 1)	792,54	979,04	656,74	818,84
Excise (125,98 din/l[12] x 0,7 l)	88,19	88,19	88,19	88,19
VAT (20%)	158,51	195,81	131,35	163,77
Selling price of the product (din/pieces)	1831,8	2242,07	1533,01	1889,63
The amount of quince brandy obtained (l)	1.600	2.950	3.450	3.580
Units produced (pieces 0,7 l)	2.285	4.214	4.929	5.114
Total income	4.186.912	9.448.740	7.555.569	9.664.128

Source: Internal documentation of distillery, 2017.

[10] Purchase price of the raw material (din/kg) x quantity of raw material needed for the production of 0.7 l of brandy (kg)

[11] The amount of raw material needed for 0,7 l of brandy x cost of transport per kg of raw material (3 din/kg)

[12] Law on excise, Official Gazette of the Republic of Serbia, http://www.paragraf.rs/propisi/zakon_o_akcizama.html

Conclusions

The aim of this study was to show how climatic conditions could affect the yield and profitability of quince brandy production. The analysis was done for the period 2013 - 2016. The study showed that climatic conditions can affect the yield and profitability of quince brandy production, and the production of quince brandy in analyzed years was profitable.

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PRODUCTION OF PORK ON PIG FARMS WITH MINIMAL PRODUCTION COSTS

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Abstract
The study deals with the analysis in the development of pork production, as and the economic analysis of the farmer in the production conditions of the pig breeding farms in the Republic of Serbia. The survey included a cooperative farm "1. December "in Žitorađa in Toplič District. In 2016, technology was monitored production of farmer at the farm, and analyzed economic results in production. During the observed period, it was found that 35,442 heads were farmed at the farm. The price of a 100 kg per 100 kg cost was 132 euros, while pork meat in half-carcasses cost 1.84 euros / kg. The average weight of the hemisphere on the farm is equal to about 78.5 kg. The proportion of pig meat in the hemisphere varies from 79% to 78%.

Keywords: breeding, price, pork, costs, profit.

Introduction

Regardless of what the natural indicators in intensive, market oriented production of pigs are, it is very difficult to provide a detailed insight into the production cost of fattened pigs, which represents the research basis of the paper and proof that the pig production process is cost effective. Mičić, (2016a) determines that with an increase in the number of piglets per sow from 10 to 20, the production cost per piglet reduced by 79.09%, while cost per sow increased by 11.67% per annum. Increase in the genetic basis of pigs represents a necessary precondition for the achievement of greater intensity in this branch of livestock production.So Vidović et al. (2012) report that the annual genetic progress for average daily growth was 8-11 gr, food conversion from 0.03 – 0.05 kg as well as 0.35 – 1.00% for the content of meat in sides. Based on previous research and results in practice there is opinion that betterresults can be expected in due time as follows: 30 fattened pigs per sow per year, conversion of food bellow 2 kg, less than 120 days of life to reach 100 kg of body weight, daily gain of live weight of about 2 kg. Mičić, (2016b) states that the characteristic of breeds of pigs as well as individual characteristics of livestock to achieve greater daily weight gain, greater amount of meat and better carcass yield in same growing conditions are of great significance to successful and cost-effective pork meatproduction. By better use of these properties the fattening period is reduced and at the same time total production is increased. Živković, Perunović, (2012) state that pork meatproduction in Serbia is characterized by the increasing participation of large farms (10,000 to 30,000, and more fattened pigs per year), and quality of pigs has significantly increased, especially on farms, and it can be said it is approaching the European average. Pork meatproduction is carried out by determining production cost of 1 kg, produced pork meatsides in first and second phase. Research of the economic parameters of producing fattened pigs deals with costs in the first phase of the production process and determining total cost of producing pork meat sides in the second phase, by the division calculation method. This allows for the given results to have common, rather than only local significance Andrić, (1998).

Research goal

Research goal: During research and proofing, the scientific method is primarily used, whose basic application allows an explanation and prediction of the relationship between individual relevant inputs and results of the achieved effects in the production of pork meat. In accordance with the strategy of developing pigmeat production. The aim of the research is to improve the quality of pig meat production from noble pure races erected on the farm. During The preparation of this work was used data from multiple sources. The data was used the amount of production, analysis of pig and pig production in the long run period. An analysis of this data would not have been possible if it had not been approved and farms and data were processed by mathematical-statistical methods.

Material and methods

The survey was conducted at the cooperative farm "December 1st" in Zitoradia. The farm has an indoor production cycle that involves the production of piglets. At the farm they produce about 35,442 livestock a year. At the farm, 80 people are employed with appropriate qualifications. Farm production costs on the farm are based on natural indicators based on surveys carried out in 2016 and all costs of variable categories according to the production process. Material costs refer to the consumption of nutrients and medicines used in the production process. Depreciation costs cover 2016 based on the standards of required space and equipment, access to investment estimates, estimates of depreciation costs based on which the categories of fixed costs are calculated. In determining production costs, we begin with the price of pigs, the weight of slaughtered pigs, the variable costs of slaughter and cooling. The results of production on the farm relate to a period of one year (2016). The following are the production parameters: food consumption per 1 kg of growth, total growth and food costs per farm for one year.

Results and discussion

Starting from previously highlighted facts and characteristics of pork meat production strategy:

- Production of fattening pigs on the farm,
- Characteristics of pig meat quality on farm.

In addition to theoretical explanation and application in general examples, we has shown the optimal feeding efficiency for an example of a nutrient mixture for Fattened pigs on the farm. Production costs and deaths of pigs on farm are based. The calculation of fixed and variable costs was calculated on the holding in accordance with the production process. Also included are costs related to consuming nutrients and drugs used in the production process, as well as livestock depreciation, existing space and equipment.

Pricelist of mixture for feeding pigs on farm

During the calculation of the price of a mixture for pig breeding, the prices of all products, calculated in tonnes (t), were taken into account. More information about this is shown in Table 1. The price list of the concentrate mixtures at the feeding farm of pigs of all categories is shown in Tab. 1. The Farm has its own blenders that operates independently and is located by the entrance gate and by the above mentioned pricelist of mixture entrusts farm.

Productivity of sows and upbringing of piglets on farm

Farm has 1,500 sows Landrace + Yorkshire which had two farrowing a year in the average of 10.3 raised piglets per breed, i.e. 20.6 piglets a year. Piglets are weaning after 28 days with the average body weight of 6.6 kg. Their upbringing lasted 34 days after that up to body weight of 25 kg, with the achieved daily growth of 0.54 kg a day. More data on productivity of sows and raising piglets on farm is given in Table 5.

Table 1. Price of concentrate mixture on farm

PRICELIST OF FEED MIXTURE FOR PIGS ON FARM 1. DECENBAR IN ŽITORAĐI IN SERBIA IN 2016		PRICE EUR/kg
Pre-starter mixture for feeding piglets to 10kg	(PS)	0.48
Grovermixture for feeding piglets from 15 to 25 kg	(SS)	0.34
Startermixture for feeding piglets to 15 kg	(SG)	0.33
Mixture for feeding fattened pigsfrom 25 to 60 kg	(TS-1)	0.28
Mixture for feeding fattened pigs from 60 to 100 kg	(TS-2)	0.26
Mixture for feeding pregnant gilts and sows	(SK)	0.25
Mixture for feeding lactating sows and boars	(SKD)	0.29

Source: Authors' calculation based on data from Mičić, 2016

Table 2. Productivity of sows and raising piglets up to 25 kg on farm in 2016

I	REVENUE	Number of livestock	kg/ livestock	Total/kg	Price unit	Total €
1	Raising piglets put for fattening:	35,442				
2	Average end weight of piglets:	30,000	25	750,000	2.39	1,792,500.00
3	Manure (sows)total	1,500	500	750,000	0.01	7,500.00
A	T o t a l (1 to 3)					1,800,000.00
II	EXPENSES					
5	Feeding piglets/ mixture according to pricelist Table 1					
6	-pre-starter (0.2 kg /day x10days x30,000 pigs)	30,000	2	60,000	0.48	28,800.00
7	-SP1 (to 15 kg) (0.6kg /day x11days x30,000 pigs)	30,000	6.6	198,000	0.34	67,320.00
8	-SP2 (15-25kg) (1.8 kg /day x13days x30,000 pigs)	30,000	23.4	702,000	0.32	224,640.00
9	Feed to sow (4.5kg/day x46days x1,500 pigs)	1,500	207	310,500	0.28	86,940.00
10	Feeding a sow (4.5 kg/day x365days x1,500 pigs)	1,500	1,642.5	2,463,750	0.26	640,575.00
11	Feeding a boar (4 kg/day x365days x25 pigs)	25	1,460	36,500	0.26	9,490.00
B)	Total feed (5 to 11)		3,341.5	3,770,750		1,057,765.00
12	Loss in fattening piglets 2%		-	-		36,000.00
13	Under vacuum	30,000			1.00	30,000.00
14	Water and medicine – sow and boars	1,525	-	-	20.00	30,500.00
15	Human labor (personal someone else's)	working day		365	400.00	146,000.00
16	Depreciation of pigs (450 -150=300x20%)	1,525	-	-	60.00	91,500.00
17	Depreciation of facilities and equipment			1,449,275	3%	43,478.00
18	Total direct costs*(5 to 18)*					1,494,718.00
19	Indirect costs of the farm					93,559.00
C)	Total costs*(18 + 19)*					1,528,802.00
III	PROFIT/LOSS					
20	On a farm without incentive(A – C)					271,198.00
21	Per pig without incentive (20 : 3)					180.79
22	Price for kg (C : 2)					2.04
23	Production efficiency (A : C)					1.18
24.	Revenue profitability (20 : A) x 100					15.07%

Source: Authors' calculation based on data from Mičić, 2016

Livestock Number on farm 1,500, *Lowland region,*Racial compositionLandrace +Yorkshire, Entrance weight, Fattening weight in years (two cycles), Exiting weight 25 kg, Average 20.6 piglets/pig a year, Weight of a piglet after weaning 6.6 kg, Age of piglets after weaning 28 days, Raising piglets 34 days x 0.54 kg/day

From Table 2. it is visible that breeding sows-piglets on farm has the gain from 271,198 €, efficiency is 1.18 and revenue profitability is 15.07 %. Table 3, shows achieved economic indicators in fattened pigs on farm in 2016.

Table 3. Achieved economic indicators in fattened pigs on farm

1.	Production year: 2016	Amount	Conversion rate of feed inkg:			3.21	kg/growth
2.	Fattening period:Jan-Dec	Unit of Measure	Mortality rate of fattened:			2.0%	
3.	Number of pigs put for fattening:	30,600	livestock				
4.	Average weight of a fattene pig:	100	kg / livesto				
5.	Length of fattening:	98	Days				
I	Revenue	Unit of Measure	Unit of measure	Price	Unit of measure	Amount total	Amount€/ livestock
6.	Fattened pigs*(4 x 6)*	30,000	livestock	1,58	€/kg	4,740,000.00	158.00 €
7.	Manure	15,000	t	4,00	€/t	60,000.00	2.00 €
8.	Subventions per pig	30,000	livestock	8,70	€/ livestock	261,000.00	8,70 €
A)	Total revenue *(1 do 8)*	-				5,061,000.00	168.70 €
II	Expenses	-					
9.	Piglets (average/pig)	25.0	kg/ivesck				
10.	Piglets*(3 x 9)*	765,000	kg/ livestoco	2,04	€/kg	1,560,600.00	52.02 €
11.	Farm is has the mixture according to priceli						
12.	TS1 (from 25- 60 kg) 2.35kg/dayx46days x30,000 pigs			0,28	€/kg	908,040.00	30.27 €
13.	TS2 (from 60-100 kg) 2.55kg/dayx52days x30,000 pigs			0,26	€/kg	1,034,280.00	34.48 €
14.	Average daily per livestock	2.46	kg/EUR				
15.	Mechanical work *(6 x 15)*	-	kg/EUR	1,497	€/kg	44,901.00	1.50 €
16.	Water per livestock *(16 x 5) x 6*	10	L /day	1,15	€/m^3	33,810.00	1.12 €
17.	Veterinary services and medicine *(6 x 17)*			0,80	€/ livestock	24,000.00	0.80 €
18.	Human labor*(4x6) x 18*		kg/EUR	0,18	€/ livestock	540,000.00	18.00 €
19.	Indirect costs *(6 x 19)*		kg/EUR	1,00	€/ livestock	30,000.00	1.00 €
20.	Depreciation of facilities and equipment *(6 x 20)*			3,53	€/ livestock	105,900.00	3.53 €
B)	Total costs*(9 to 20)*					4,281,531.00	142.72 €
III	PROFIT/LOSS						
21.	On farm with incentive *(A – B)*					779,469.00	25.98 €
22.	Cost perkg*B :(4 x 6)*					1.42	
23.	Production efficiency*(A : B)*					1.18	
24.	Revenue profitability (21 : A) x 100				%	15.40	

Source: Authors' calculation based on data from Mičić, 2016

From Table 3. we can see that total achieved gain for 30,000 fattened pigs is 779,469.00 EUR, production efficiency 1.18 and revenue profitability is 15.40 %.

Productivity of pig production on fauna in 2016

In order to investigate the efficiency of production, the farm from Serbia has been taken into account because it has the necessary conditions for such production. We have been researching a farm with 35,442 cattle. The average input weight of the piglets for fattening was 25 kg and the output weight was 100 kg. At the farm, the average pig breeding time was 98 days with a daily gain of 0.76 kg / day. Our results are consistent with the results (Vidović et al., 2012) in the performance test for pure breeds of pigs, landrace and Yorkshire. Income calculation includes only the proceeds from the sale of pigs, while the potential income from pork is not taken into account (Table 4).

From the data presented, it can be seen that the price of pork on the farm is 1.94 EUR / kg and that this production has an efficiency of 1.45 and a profit profit of 31.16%. Furthermore, it can be seen that in the farm, the calculation of the costs of slaughtering, cooling and processing of pigs is 8,70 EUR per head. The calculation was carried out in accordance with the achieved yield of slaughtered pigs, the value of live pigs of 100 kg. After the research, we answered a few very important questions in the work: the price level is not such as to stimulate pig breeders and prices affect the level of production. One of the reasons is the reduction and stopping of the slaughter of large industries in the Republic of Serbia. At the same time, the expansion of large private slaughterhouses, which are far more flexible industries, makes their production far more efficient.

Table 4. Economic indicators of pigmeat production - at the farm in 2016

I	Indicator	Unit of measure	Farm
A.	Fresh pork meatsides	livestock	30,000.00
B.	Livestock weight of live pig weight	kg	100.00
1.	Total weight, pig(AxB)	kg	3,000,000.00
2.	Pork sides/livestock	%	78.00
3.	Total pork/sidekg (1 x 2) : 100	kg	2,340,000.00
4.	Price of pork sides	€ /kg	2.82
V.	Total revenue (3 x 4)	€	6,598,800.00
II	EXPENSES		
5.	Price of the slaughter service	€/livestock	8.70
6.	Direct costs of live pig weight	€	4,281,531.00
7.	Total pig slaughter service (Ax 5)	€	261,000.00
G.	Total expenses(6 + 7)	€	4,542,531.00
III	PROFIT/LOSS	€	
8.	Pork sides from farms (V - G)	€	2,056,269.00
9.	Pork side livestock/EUR (8 : A)	€	68.54
10.	Pork side pricekg (G : 3)	€	1.94
11.	Meat production efficiency (V : G)		1.45
12.	Revenue profitability (8 : V) x 100	%	31.16

Source: Authors' calculation based on data from Mičić, 2016

Conclusions

Another argument in the request for determining the price of fattened pigs on the line of slaughter is to give quality according to meat share, which can be seen in the research on the a pig farm, that it is best to close the whole production.

-The calculation was made on the farm in accordance with the yield of slaughtered pigs, and the value of live pigs weighting 100 kg is 142 euros + slaughter costs of 8,7 euros, which amounts to 150,70 euros, and given that the chilled side of the pork meat is 78 kg at the price of € 2.82 per kg, value of livestock (side) is 219.96 €.

-Slaughter slaughterers received pig meat with uniform weight, on average 78 kg per livestock. Farm realized profit in the amount of EUR 2,056,047.

-It can easily be concluded that the price of the cooled party is 45.96% higher than the price of the pig. We have come up with new scientific discoveries in the paper on the practical application of quality nutrition in fattening pigs.

-The advantages of this method of pig breeding and the scientific contribution to the promotion of the development of pork meat production have been examined, for which Serbia with the tradition of pig breeding has great geographical and ecological potential, especially in its agricultural and livestock production.

-As a final conclusion of the survey, farmers can be recommended for breeding pigs to organize production groups, cooperatives, clusters and franchises.

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DEVELOPMENT OF TOBACCO ECONOMY IN THE REPUBLIC OF MACEDONIA

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Abstract
Tobacco production is an important part of the Macedonian tradition, the Macedonian agriculture and economy in general. The aim of this work was to provide a clear picture of tobacco production and processing in Macedonia for a past period of twenty five years; for that purpose there were mainly used published statistical data by the State Statistical Office of the Republic of Macedonia, Analysis of the Ministry of Agriculture, Forestry and Water Economy. During data processing, many methods common for such research were used, mainly the comparative-analytical method. The production of tobacco takes place on an area of above 16.000 hectares, where farmers mostly use relatively poor, low productivity class soil. Today, the whole process of tobacco production includes more than 30.000 households and large number of family members. Tobacco industry in Macedonia has great importance for the overall economy of the state. The tobacco industry is also important as primary production, although less than 50% of the available capacities are not utilized. The production of cigarettes since independence of the country has a major reduction because of declining demand, which previously consisted of consumers from the ex-Yugoslavia. Today, part of the tobacco industry is transformed into private enterprises. The industry employs about 3.500 workers per year, has a relatively high share in the creation of domestic GDP and exports tobacco and cigarettes whose value exceeds the value of imported tobacco and cigarettes for domestic factories and direct customers with over 130 million US dollars annually. Tobacco is the most widely cultivated cash crop and, it seems that in Macedonia, tobacco will remain to be an interesting and profitable crop for many generations further.

Keywords: tobacco production, industry, cigarettes.

Introduction

Tobacco production and tobacco industry are especially important for the Macedonian economy. Both businesses have a long tradition, thanks to the favorable natural conditions for growing tobacco, the most important and the most widespread industrial culture. In addition to the economic significance, tobacco and its finalization have social significance, due to the relatively labor-intensive character of the technology of production. Annually about 30,000 families or approximately 100,000 people are involved in tobacco production. Tobacco is important for the Macedonian agriculture, because it uses relatively poorer soils, for which no one-year culture could contribute so much. For example, the realized yield of 1501 kg/ha with the achieved price in redemption of 162.0 mkd/kg gives an income of 243000 mkd/ha. Although today the tobacco industry of Macedonia is not what it represented prior to the independence of the state, it is important because with the processing of tobacco raw material and the modest amount of high-end production (cigarettes). It enables the engagement of over 5,000 workers and the export of tobacco and refined products to the world market in the amount of 150 million US dollars (2011). The independence of Macedonia and the complete or partial abandonment of economic relations with the other republics of the former Yugoslavia imposed the need for serious changes in the Macedonian economy. Although relatively small shocks in the tobacco industry have occurred, we consider it important to see what changes have happened since independence, both in the primary

production and in the industry, that is, the overall tobacco economy: what is the level of development achieved in the period from 1991 to 2015.

Material and methods

The main data are official statistical publications, published in the annual statistics and annual bulletins of the Republic of Macedonia for the analyzed years. The research period began in 1991, in which the Republic of Macedonia officially declared its independence from the former federation. The survey follows the data of changes and development with their analysis every five years, that is, comparisons refer to data for: 1991, 1996, 2001, and 2015. Comparative and analytical methods are complemented by computing relative relationships by using base and chain indexes. The survey refers to primary production, industry, exports, labor productivity.

Results and discussion

Primary production

The data for the movement of the primary production through the used area, the achieved yields per unit area (ha), as well as the total production of the tobacco, show a relative stagnation in the past period (1991- 2015). Namely, when observing the movement of the surfaces, it is noticeable that after 1991 they are moving up to 20 000 hectares (2001) and then decreasing, so in the last year of the survey there is the lowest volume of engaged surfaces (Table). A similar conclusion is derived from the tobacco yield indicator, however, in 2015, it is the highest, which can be assumed to have progress in the production technology itself. The total production of tobacco ranges from 15.4 thousand tons to 26.5 thousand tons of tobacco. In the last year, the production realized was less than in 1991, by about 4%, and the chain indices show an increase, and a decrease in the volume of manufactured tobacco.

Table 1. Indicators of primary tobacco production

Year	Area/ha	Yieldkg/ha	Total Production/t	Chain index
1991	18,32	1375	25,20	100
1996	17,51	1313	15,41	61,1
2001	20,07	1157	23,22	150,7
2006	17,51	1436	25,04	107,8
2011	19,68	1350	26,54	106,0
2015	16,13	1501	24,24	91,3

The natural, traditional and other important conditions for tobacco production in Macedonia are not sufficiently used. Some projections of the future development of tobacco production predict a realistic possible tobacco production at an annual level of over 36 000 tonnes, if the surfaces increase to 25 000 hectares, and the yield per unit area increases by 56 kg (Anakiev & Kabranova, 2010). It is known that for the engagement of producers in increasing production, the purchase price is especially important. Although tobacco - production, redemption and industry are subject to a special rules (Law on Tobacco and Tobacco Products - Official Gazette 24/2006, 88/2008, 31/2010, 36/2011 and 53/2011), purchase prices for domestic production depend not only on the movement of quantities of tobacco produced, but also on the supply and price of the World market, whose policy is carried out by the purchasers on behalf of the world's tobacco processing companies. The domestic tobacco industry can finalize only 5-10% of domestic tobacco production. The analysis of the movement of the purchase prices in the investigated period shows that they are moving mainly in a relatively high increase (Table 2), in line with the stagnation of the supply of primary production. According to the base index, the purchase price in 2015 is higher than in 1991, by 67%. Positive trends in tobacco production are in increased productivity, which is reflected in the volume of production of tobacco per producer (Table 3). Increased productivity is the result of an increased degree of mechanization of tobacco production, especially in planting and lowering tobacco (funds from the IPARD program).

Table 2. Purchase prices for tobacco

Year	Purchase price mkd/kg	Chain index
1991	96,8	100
1996	125,4	129,5
2001	116,7	93,1
2006	181,1	155,2
2011	150,0	82,8
2015	162,0	108,0

Table 3. Tobacco production by producer

Year	Production 000, tons	Number of producers	Production per producer/kg	Chain index
1991	25,20	38809	649	100
1996	15,41	27110	568	87,5
2001	23,22	35442	655	115,3
2006	25,04	29230	857	130,8
2011	26,54	33234	759	88,6
2015	24,24	28545	843	111,1

It is well-known that in Macedonia today, exclusively oriental type tobacco is grown, where a large part of the workforce is engaged in pre-harvest and post-production processes, which requires the engagement of a larger number of members in the family. From the data on the total quantity of tobacco (Table 3), it's clear that in the analyzed period production of tobacco in Macedonia has fluctuated over the years.

Tobacco industry

Today, compared to 25 years ago, the tobacco industry has a relatively small and limited volume, reduced to 5-6 000 tonnes per year. From the built capacities in the last century (for about 20 000 tons of cigarettes), only 20% are used in comparison with the time before, when production was placed in the territory of the former Yugoslavia. After independence, the production of cigarettes in Macedonia was limited only to the domestic market (Table 4). The production of cigarettes in Macedonia, although in recent years declines, it still has special significance for the tobacco industry (Miceski & Smokvoski, 2005).

Table 4. Fermented tobacco and production of cigarettes

Year	Fermented tobacco / 000 tons	Cigarettes, 000 tons	Chain index
1991	16,6	17,3	100
1996	14,0	7,9	45,7
2001	19,0	7,8	98.7
2006	20,6	5,1	65,4
2011	25,1	5,8	113,7
2015	23,9	6,7	115,5

Fermented tobacco is mainly exported, because a relatively small volume for the production of cigarettes is used (the types of domestic cigarettes use types for which Macedonia has no conditions for cost-effective production). The data for the production of fermented tobacco, which is a semi-finished product for the tobacco industry, show a steady increase, from 1991 to 2015, when production increased by 44%. Unfortunately, in the production of cigarettes, the situation is reversed, and the volume of manufactured cigarettes from 2015 compared to 1991 is 37%. There are reasons why measures are not taken to stimulate the production of cigarettes by state institutions, but once the state that is not released from the largest capacity is not guilty (not fully privatized), and second, the well-known relationship on the tobacco market in the world. Here, of

course, we take into account the recommendations and obligations of the WHO to reduce tobacco production, as well as the EU regulations on the volume of production in one country.

Export of tobacco and cigarettes

For the small and underdeveloped economy of Macedonia, as important as the development of the tobacco industry, the growth of the tobacco and cigarette exports on the world market is so important. Of course, export depends on the volume of production, both the primary and the production of fermented tobacco and cigarettes (Table 5).

Table 5. Export of tobacco and cigarettes

Year	Tobacco	Cigarettes	Total	Chain index
1991	60,8	9,8	70,6	100
1996	58,7	52,5	111,2	157,5
2001	43,4	27,7	71,1	63,6
2006	92,3	19,4	111,7	157,1
2011	118,2	35,3	153,5	137,4
2015	104,6	11,1	115,7	75,4

The data show that the value of manufactured products, especially fermented tobacco, has a positive trend as shown in Table 5, with export of fermented tobacco in 2011 and 2015 exceeding US $ 100 million, and a more serious increase after 2001. As for the export value of cigarettes, the increase is not such, and it is relatively modest, so in 2015 the increased increase in 1991 was 1.3 million US dollars.

Conclusions

From the research on the development of the Macedonian tobacco business, the following can be noted: Capacity in the area for tobacco production has not increased. There is a relatively small increase in yield, while the total production of tobacco is appropriate with the movement of the tobacco area. It is certain that the opportunities of Macedonian farmers - tobacco growers are not realized. Despite the relative increase in purchase prices, the limitations of purchasing companies in terms of volume and quality of tobacco raw material do not allow for a more serious increase in primary production. According to how much it is produced per tobacco-producer, the production has a trend of growth. Fermented tobacco has increased production, which is important for exports, while cigarette production is stagnating. As a result of the relatively limited growth and development of tobacco production, the export value of the tobacco industry increased, which shows greater engagement of all the most important factors in the country for the promotion of the tobacco industry, because we expect the EU norms that need to be re-examined with the approach of Macedonia, especially the volume of primary production, which will reflect the entire tobacco industry.

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NEW CONCEPTS IN THE TECHNOLOGICAL DEVELOPMENT OF AGRICULTURE

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Abstract

Agriculture in the Republic of Macedonia is in a constant development crisis, based on structural agri-policy origin. Agricultural holdings occur in several structures, such as: very small individual holdings (farms) that use about 80% of the agricultural land; agricultural companies; and several cooperatives that use about 20% of the best quality agricultural land in the country. The industrial labor organization in the some of the agricultural corporations: disrupts the natural cycle of the plant and animal production, increases the input, decreases the production capacity of the land and creates environmental issues. The phases that include reproduction and milk production, as phases of the farming process, are especially expensive and require individual treatment of animals. The trend of development of village structure which can encompass the principles of agricultural production is negative. The small land property structure, which is worsening each year, cause de-professionalization, especially in the hilly and mountain regions. Therefore, strategy for technological development in agriculture is proposed in this paper. The strategy is expected to contribute in the development and strengthening of agriculture in the villages in accordance to the west European examples based on cooperative investment and ownership.

Keywords: agricultural corporations, environment, production potential, production phases, R. Macedonia, structure, technological development.

Introduction

In the last decades of the 20th century and the first decades of the 21st century there has been an extraordinary development of biotechnology and agricultural technologies, particularly in the western industrial countries. It seems there is no end to the biological and technical innovations, as basis of the technological revolutions of the such scale. The development of new scientific disciplines is promising opportunity for further rationalization and increase of agricultural production. The development strategies of these countries led by the hyper production in the future, will likely be directed towards a rational limitation of agricultural production, improving product quality and quality of life, as well as the long-term preservation of natural resources, especially the fertility of agricultural land, genetic resources and solving environmental problems. Despite this, the Republic of Macedonia did not solve the problem of sufficient food production. The agriculture was in deep development crisis with social and environmental problems. In some mountainous areas the abandoning of farming is so emphasized to endanger the population and economic vitality of the regions, so the revitalization is questionable. This crisis is not a consequence of underdeveloped biotechnical sciences, or lack of technological knowledge, as in Macedonia has enough educated professional personnel and agricultural research institutions with good results in the last twenty years. It is a structural crisis in the development, which is of a systematic nature. Biotechnical sciences cannot solve the most vital problems of the agricultural crisis in Macedonia. Their successful work can only facilitate the exit from the crisis. The most vital problems of technological development of agriculture are of agricultural policy origin, and in the same time they are dependent on the modernization of the entire society.

Material and methods

The methodology included linear method, comparative analysis, method of indices, induction and deduction, as well as the method of analysis and synthesis. As a material for the preparation of this paper we used various literature, archival and statistical sources. Secondary sources are the main source of data used for the description and analysis of this paper. Secondary sources are widely used in the social sciences, especially with regard to economic sciences. In the case of economic, and especially macroeconomic aspects and data, the secondary ones are usually the only available data. At the same time, such data provide an opportunity to analyze time series and the possibility of comparative analysis, as is the case with this paper.

Results and discussion

The basic principle of effectiveness of natural bio-systems is the principle of minimum entropy that is: more life with less use of energy and matter. It is generally determined at both the individual level and ecological systems. At the level of individuals, that basic biological law means minimal loss or maximum use of energy and matter to the effective functioning of biological functions. The minimum entropy in a healthy balanced ecosystem means minimal loss of energy and matter from the system in the process of natural circulation, recycling. Moreover, the living conditions in a healthy ecosystem are stable and improving. The farming (farm household) is artificially biotic system. The human is maintaining it for the production of food and industrial raw materials. His/hers goal is with less inputs to produce the maximum benefit while also maintains and increases its production potential. Efficiency and rationality of that artificial biosystem is only possible with maximum respect of the fundamental law, the law of entropy. This means practicilng the maximum possible recycling, while taking from the system only the things for which it is maintained i.e. the agricultural products. Such definition of farm household may serve as a template for agriculture, unlike industrial type of agricultural production, which normally interrupts the circulation of matter in the system, increase input, reduces the production potential of the land and creates environmental problems. The most important subsystems in agriculture are crop production and the production of fodder plants on one hand, and livestock on the other. In developed European countries, the share of livestock is more than two thirds of the total value of agricultural production. About 85% of plant production is used as animal feed. The animals utilize only 10-20% of the total matter of the feed, 10-20% nitrogen (N), about 20% phosphorus (P), 2-5% potassium (K) and 5-15% calcium (Ca). The rest of these inorganic materials, which are the most important food for plants, some microelements and 20 to 40% organic matter, are in the manure and urine. Following the principle of recycling, this whole matter should be returned to agricultural land, or to upgrade with fertilizer and other sources of organic matter to maintain the level of humus and microbial activities of the land. Because of the low concentration of feed ingredients and large mass, the transport manure that is greater than 1 km has questionable economic viability, while the transport of more than 3 km is quite unjustified (Leskoshek, 2016). This is why the large fattening farms for pigs and cattle release the manure into watercourses, which is environmentally unacceptable. There is no cheap technological solution to that problem and is not very likely to have in the future. Nutrients are lost, which should be complemented with a huge amounts of artificial fertilizers per ha of agricultural land. On the other hand, the mass of feed, especially the bulk feed for ruminants is even greater and requires adequate transportation costs from the soil to large industrial livestock facilities. We are talking about 50 more tons of mass per ha in the production of silage or about 15 more tons per head of cattle per year. Because of limited energy resources, expensive vehicles and rise in living labor, the cost of transport in the future will grow, not shrink. First of all, because of those limitations, as a rational size of livestock facilities in Germany the following limits are recommended (Becker, 2015). Optimization within those borders have not achieved yet by any country, although some are closer to it (the Netherlands). It should be mentioned that these are the sizes facilities that can be run by a family with modern techniques. They are not industrial facilities with industrial organization of labor.

Table 1. Optimal size of livestock farm in Germany

Farm type	Size (number of animals)	
	Lower limit	Upper limit
Broilers	25.000	50.000
Hans	10.000	30.000
Pigs total	600	1.000
Fattening pigs	400	1.000
Breeding sows	75	100

Source: Seuster, H.: Ekonomik der Bauernbetriebe in der B. R. D. unter besonderer Berucksichtigung der investionsfinanzierung. 2016.

The second type that can be taken in consideration for the rational organization of livestock production is assessing the nature of biological innovations. The most important biological innovations in animal husbandry are the results of modern genetic selections. The development of population genetics, the theory of selection and electronic data processing, enable extraordinary genetic changes in the population of livestock. In the near future, the new genetic reproduction techniques will provide even better results. The results are highly developed living beings with outstanding manufacturing skills: dairy cows with 10 and more tons of milk per lactation, sows with 30 piglets per year, sheep with more than 5 lambs a year etc. They are not industrial machines for factories. They require optimal microenvironment conditions as well as optimal social environment including the breeder. It is a real relationship of symbiosis between the farmer and his animals. The quality of breeding and care of the livestock in developed countries is more and more ethical and moral problem, in addition to the production problem. Increasing labor productivity, i.e. increasing the number of livestock per worker is a result of technical innovation. The technique reduces the scope of routine, physical work, and increases the value of knowledge and professional awareness of farmers. The actual production depends mostly on quality of labor, but also on genetic characteristics of highly productive animals. Farmers with the same educational background can achieve 5,200 liters to 6,500 liters per milking cow, which means that in equal conditions of work one produces 5,200 liters, and another 6,500 liters of milk per cow (Sambraus, 2016). The difference in their labor is in their different attitude with animals. In this sense the interest of farmers for their profession is more than just earning interest. Just for earning, one can choose countless other professions. From partial aspect, efficiency of the organization of work within the livestock operation is possible via the Industrial Labor Organization, but only in relatively simple stages of reproduction, such as fattening, egg production and reproduction in poultry. More complex stages of production, such as mammalian reproduction and milking, require individual (personal) treatment, and no mechanical relationship with livestock. Therefore, these stages are most problematic in the large livestock production. Surely there are complex reasons for not executing capitalist concentration of capital and land in primary agriculture in capitalist countries. The exception is some crop production, mostly in the former colonial countries. Besides the already determined importance of the quality of labor, especially in modern animal husbandry, and the extraordinary progress in technology, which allows an increase in family businesses to the borders of rational transport opportunities, reasons may be even the following: expensive labor in industrialized countries; seasonal uneven distribution of working hours; 7-day workweek in livestock production; divided daily working hours; dependent on climatic conditions and the need for quick decisions, etc. These are sacrifices that can be taken primarily by family farms, which will choose the agricultural profession. This is also done because of other advantages, such as: relative autonomy and security work at home, diversity, work in nature, etc. The labor productivity In developed countries, primary in agriculture, grew that far, so one worker farmer produces food for 70 or more people, and agriculture employs even less than 4% of the workforce (UK, USA, Netherlands). In such conditions, where the increase of productivity in agriculture e 100%, the reduction of the workforce by 4 to 2% in terms of social productivity of labor is insignificant. In modern societies of cyber era more important than maximum productivity will be: production quality, aesthetics of the cultural environment, the ethics of livestock production,

environmental aspects, sustainable conservation of natural resources, quality of life in the countryside, minimum use of chemicals, energy, etc. However, this type of agriculture is still not a better solution than optimal rural agrarian structure with vital economic agrarian regions, developed social and physical infrastructure which provides quality of life, development of tourism, recreation of urban people, etc.

Agrarian structure in developed Western countries

There is no single country in the world that has optimal agrarian structure. The western industrialized countries experience very rapid changes, especially in the last three decades (Peters, 2015). These changes are the result of adaptation to technological development. More or less controlled, guided by agricultural policy and implemented without significant social problems. There are failures and criticism. The most significant criticisms are for the agricultural overproduction as a result of these changes and partial deviation from the principles of agriculture with all the shortcomings, mainly environmental (Priebe, 2015). They introduce more government regulation to reduce overproduction and environmental problems. Consideration of this development for us is interesting because that is the most efficient farming in similar natural conditions.

Agricultural structure in the USA

The US is the most liberal capitalist country, that according to the political-economic theory of XIX century should have completed the capitalist concentration in primary agriculture. By 2000 it had happened. Out of 1.2 million commercial farms in the United States 45 270 are owned by corporations. They own 12% of agricultural land, and sell on the market more than 24% of the total market production. They are limited to extensive cattle fattening farms (33%) and other plantation agriculture (37% fruit, vegetable 66%). The grain production is insignificant (8.2%), and virtually they have no other activities of primary production. The cause of a corporative approach is to increase efficiency in comparison with individual holdings of medium size, but primarily in tax policy. According to G.L. Cramer and C.W. Jensen (2015) significant growth of the corporations can not be expected, primarily because alternative opportunities for investment capital are more secure.

Table 2. Number, size and workforce on the farms in USA

Year	Number of farms 000	Average size in ha	Average workforce in 000	Part time/seasonal work force in 000
1920	6.518	59,7		
1940	6.350	67,8		
1960	5.648	86,5	7.252	2.090
1970	3.962	120,6	5.172	1.885
1980	2.924	155,5	3.348	1.175
1990	2.491	173,4	2.500	1.273
2000	2.322	182,7	2.402	1.273
2010	2.309	183,9	2.402	1.303
2015	2.434	173,8	2.236	1.094

Source: Carner & Jensen, 2015

Therefore, the family agrarian structure is prevailing, which otherwise is much divided, and employs a significant proportion of the employed labor force, mainly for seasonal work. A significant part of the employed labor force is of foreign origin, mostly from Mexico. Until 1960, the farm is considered a holding with more than 4 hectares, or it sells products worth at least $ 250per year. Right after that year, a farm represented a holding whose annual production could be at least $ 1,000. The rapid decrease in the number of farms started after 1960. In the recent years, the number of farms is constant, but stratification continues, as seen from Table 3.

Type of farm	Year	No. of farms	% of farms	Value of production (%)	Value of production by farm ($)	Net income by farm in ($)	Nonfarm activities income
A	1980	973.000	8,6	51,6	51.340	11.743	1.844
	2000	350.000	39,9	93,5	141.726	21.785	10.610
	2015	309.000	30,2	85,0	166.800	25.400	12.800
B	1980	1.774.000	44,8	42,7	8.397	3.409	1.580
	2000	953.000	39,1	6,0	9.300	4.500	18.423
	2015	845.000	30,2	7,8	10.900	4.900	20.542
C	1980	1.849.000	46,4	5,8	1.104	806	2.732
	2000	511.000	21,0	0,5	1.411	1.100	22.425
	2015	485.000	18,9	2,2	1.990	1.320	24.120

Source: Carner и Jensen, 2015. (A - farms with more than $ 20,000 in annual, sales, B - farms between 2,500 and 19,999 dollars in annual sales, C - farms with less than $ 2,500 in annual sales)

Farms of type C, are considered as hobby farms. The stratification is largest in farms of type B, which normally are mixed economies. About 94% of market production is concentrated on less than one million farms, where the most of the employed labor force is located. The average size of farms type A is approximately 400 hectares and is variable. The value of production per ha per year on average is about $ 350. The US Agriculture has a very large capacity in terms of agricultural land (1.8 ha per capita) and equipment, but the intensity of production per ha is behind agriculture in developed Western countries. Lesser intensity per ha conditions the size of commercial farms, which is far above Europe.

Agricultural structure in Western Europe

The Western Europe has a small capacity of agricultural land per capita. In the European Union area of arable land per capita averaged 0.48 ha and the total agricultural land only 0.77 ha. Very limited areas of agricultural land are the reason for very intensive use of land. Therefore the structure of the agriculture as a whole, differs greatly from US agriculture. The data in Table 4, show very variable average size of agricultural economy in the European countries, which is partly due to historical reasons, the general productivity of labor and the type of economy that depend on terrain, climate, etc. Noticeable is the dependence of labor productivity, measured by the area of agricultural land per worker and the size of the economy.

Table 4. Size of farms and labor productivity in some European countries (data from 2000 and 2015)

Country	Size of farms in ha	Full work force on 100 ha	ha/ Full work force	Employment in agriculture %
Great Britain	69,4	3,2	31,25	2,7
France	27,1	5,6	17,86	8,7
Luxemburg	29,9	7,0	14,29	5,7
Denmark	26,3	4,9	20,41	8,1
Ireland	22,5	3,6	27,08	10,2
Holland	16,1	10,0	10,0	4,1
Germany	15,8	6,6	15,5	6,0
Belgium	16,0	7,0	14,29	3,0
Italy	7,4	11,5	8,7	14,2
Austria	10,2	10,1	9,90	12,5
Check Republic	21,3	12,7	7,87	9,5
Poland	47,5	11,1	9,01	12,8

Source: Brun, A. Land ownership and farm unit, European review of agricultural economics, br. 3-4/2016.

The data in the table results in the calculated equation:

y = 4,92 + 0,53x – 0,0022x2 (r2 = 0,86),

where "y" is the number of hectares per worker, and "x" is average size of the farm. The increase in labor productivity is not growing quite linearly with the size of the economies, however with the rising of holding for 1 ha, the labor productivity increases by around 0.5 ha per worker. This fact can be interpreted like this: farms in Europe are growing in size to be able to fully employ the family labor. In the case of average conditions, the Western Europe has reached full employment of two workers on family farms, when the average size of farm is 55 ha. In that case ha productivity per worker is 27.5 ha. This claim applies to conditions of agriculture in Western countries, while accepting all variability from small horticultural farms to large agricultural holdings, terrain and climatic conditions of the Mediterranean, alpine and temperate climate of Europe (Zagozhen 2016). In this context, in comparison with other EU countries, the Czech Republic has the lowest labor productivity in agriculture, although it has a prevailing agricultural-livestock type of farming in very high concentration of land. The difference in labor productivity would be even greater if measured in the value of output per worker. In this context it is important to add this conclusion: Dutch agriculture can compete with US agriculture in labor productivity, measured in value of output per worker, although the Dutch farmer has 10 times smaller area than American farmer. The rapid stratification of rural agricultural economies of Western Europe began in the sixties of the 20th century and not completed. The annual rate of change in the number of farms in Western Europe in the years 2000 and 2015 was: Germany - 3.5%; France - 2.9%; Netherlands – 2.6%; - Belgium - 4.1%; - Great Britain - 2.6%; - Denmark - 2.2 % (Brun, 2016). The number of wage labor has even quicker changes. For example, in the Austrian Styria, the number of wage-labor from 2000 to 2015 is decreasing at an annual rate of 5.5%. The farms smaller than 200 ha total land, usually do not employ wage labor. In Western Europe, especially in the mainland, the employed labor force is very limited with some minor exceptions (Schulz-Borck, 2015). The stratification of peasants and abandonment of agriculture by peasants and engaging in other activities is gradually. A change in the type of agricultural holdings and abandonment of agriculture, as a rule, occurs with a shift of generations of agricultural holdings. Table 5 shows the process in Germany.

Table 5. Changes in the structure of agricultural Germany

Type of holding	Total number in 000		Average size in ha in 2000	Average size in ha in 2015
	2000	2015		
Agricultural holdings	466	399	25	77
Mixed holdings type 1	233	93	15	10
Mixed holdings type 2	380	316	6	13

Source: Part – time farmers, Ljubljana 2016

The mixed holdings of earn income more than 50% from non-agricultural activities, and mixed farms type 1 less than 50%. The conclusion is that farms that are not capable of its expanded reproduction, are moving into mixed farms type 1, and then rapidly into mixed farms type 2, until they cease to exist as farms and move into non-agricultural households. Agricultural land is concentrated in a reduced number of farms, which operate in a very high professional level. What does the professionalization of agriculture in Germany means, Seuster (2016), is demonstrated by the figures in Table 2. The development in Western Europe has these features: the number of farms is rapidly shrinking, agricultural land is concentrated in professional farms with a size of 20 to 60 ha, and mixed holdings are in relatively low variable rate, as a transitional group or hobby farms.

There are several structures In the Republic of Macedonia. There is a public and private land, private enterprises and agricultural cooperatives on the one hand, and individual farms or households on the other. The major private agricultural companies use about 20% of the best agricultural land, and the remaining land of about 80% belongs to very small rural farm holdings. The productivity of private agricultural companies and agricultural cooperatives, measured in hectares per worker, is somewhat better than in the Czech Republic, reaching 9.90 ha. That is equal to productivity in

Austria, where the average size of farms is 10.2 ha and is less than other countries in Western Europe (up 31.25 ha per worker in the UK). The production in private farms is relatively very expensive, especially in livestock, shown in table 7.

Table 6. University degree holders and net income of the family calculated by Full Force – FS

Professional education of the owner of the farm	Net income of the family calculated at one unit of average workforce
Low	100
Assistant	130
Master	171

Table 7. Cost of production of cow's milk of selected farms in the Republic of Macedonia in 2015

Group of holding	Number of holdings	Average number of cows	Price MKD/lit
Group (Farmers with more than 20 cows)	10	26.7	14.83
Group (Framers with 15 to 20 cows)	10	17.7	22.97
Group (Farmers with 10-15 cows)	10	13,1	24.50
Group (Framers with 5-10 cows)	10	7.9	25.59

Source: Hadzievski, 2016

The first group size is approaching the Western European average and has cheapest production. Medium-sized farms are more expensive by 50% and the smallest farms are more expensive even by 72%. The price of raw milk at the time was 18.91 MKD/litre. Model calculations show that in the present economic conditions the viability of agricultural production begins on farms larger than 10 ha, if it comes to cows or larger than 20 hectares, if it comes to other combinations of crops and livestock production (Hadzievski, 2016). In conditions of increased competition (the case of overproduction), the threshold of profitability of the economy would be greater. The rural structure (size of holdings) in the country is very small. It is smaller than before the independence in 1991, and still going. It is significant that the number of farms with more than 8 ha is rapidly decreasing, especially in economically developed areas. Mixed farms normally shrink. The expected trend of development can be seen from the social structure of agricultural holdings in the following table. Due to this trend the country loses annually about 1% of agricultural land. The average size of agricultural holdings (all agricultural areas) decreased from 3.5 ha in 1981 to 2.0 ha in 2016. Since 1960, the number of farms with over 10 hectares total land is decreasing at a rate of 1.5% per year.

Table 8. Source of income for farms in the country (population census 2002)

Source of income	Number of holdings	%
a) exclusively from agriculture	52.601	27,3
b) exclusively from non-agricultural activities	21.772	11,3
c) exclusively from its own income (pensioners)	29.864	15,5
d) from agricultural and non-agricultural activities	32.562	16,9
e) agriculture, non-agriculture, own income	10.982	5,7
f) agriculture and own income (pensioners)	8.670	4,5
g) non-agriculture and own income (pensioners)	34.296	17,8
h) no income	1.928	1,0
Total farms	192.675	100%

Source: Census of agricultural holdings in the Republic Macedonia in 2007

Without structural changes the agriculture in the country cannot be intensified and professionalized, but certainly the trend of development will be reversed, which means the agriculture will regress. The conditions for transformation in a positive sense depend entirely from agricultural policy nature, for which we need ideological unblocking. In this context, the program for subsidizing agriculture

promises significant milestone. In long term, it can even be dangerous because the primary agricultural production experienced a setback in physical volume and quality, and the country has seen a negative foreign trade balance.

Conclusions

The Republic of Macedonia should implement a patient discussion seeking answers in the direction of gradual restructuring of agriculture in the modern, professional farming from Western type in conditions of transitional society that aims to modern capitalist system. According to the climate, terrain and areas of agricultural land per capita, The Republic of Macedonia has some slight resemblance to the production potential of some Western European countries such as: Denmark, Netherlands, Belgium, Luxembour; but does not uses them optimally. The strategy for economic and technological development of agro-industry is not optimal, and in the mountainous regions is not even possible.

The following issues are a matter of debate and discussion:

- Development of modern co-operative movement based cooperative ownership, with operating features;
- Possibilities for gradual implementation of agrarian reform in favor of rural (village) agriculture;
- Regional development of agricultural activities in the non-agricultural, especially in the mountainous regions, including the development of social and physical infrastructure;
- Execution of the redistribution of fields and land consolidation of agricultural land in the country;
- Development of agricultural vocational education of farmers and villagers who plan to deal with primary agricultural production;
- Development of technical infrastructure for faster transfer of technology and biological innovation in agriculture;
- all other socio-economic measures that can speed up the process of restructuring.

The development of agriculture in the proposed direction will trigger enormous human development forces and solve some problems with smaller investments in social capital than in the development of agro-industry. The Republic of Macedonia has no short-term economic strength and hardly acceptable long-term investments in agro-industry without securing a strong primary agricultural production.

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EXAMINING THE STATUS CYTOGENETIC ON SOME AUTOCHTHONOUS VARIETIES A GRAPEVINE IN R. MACEDONIA ACCORDING O.I.V. SYSTEM

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Abstract
In R. Macedonia has many domestic (autochthonous) or domesticated varieties of vines. Many of them are similar to some varieties of from neighboring countries, and some of them are very different between them, and are also differ from the other varieties. It depends on heritable traits of their ancestors and their origins, from the centers of origin. They represent undiscovered source of many genes that are carriers of positive properties and predominantly transmitted to future generations. Many of them are unidentified and not known their exact origin. Therefore efforts are made with certain adequate methods to identify (ampelographic, ampelometric, DNA identification).In our research we covered several table and wine varieties of grapevine from different vineyards through R. Macedonia. In the trials used methods for determination of cytogenetic status according O.I.V. system of descriptors - (number of chromosomes, ploidy level, germination of pollen, meiosis, type and characteristics of the flower, etc.). We used statistical computer processing by (SPSS) program.Obtained are interesting results in terms of the structure of the flower and the cell division that indicate the similarity between them and their common origin.

Keywords: autochthonous varieties, description, cytogenetic status, meiosis.

Introduction

In this paper, 3 autochthonous (domestic) or domesticated varieties of grapevine and 1 muscat variety for comparison from the same group, different subgroup were examined. The main objective of this study is to investigate the cytogenetic status of varieties of the same center of origin. Although variability in polyploid and chromosomes (tetraploidy and aberrations) in muscat varieties, the autochthonous varieties and muscat varieties grown in the Republic of Macedonia have been shown to have stable and constant cytogenetic status. Often in tested varieties of grapevine used the term domesticated varieties of grapevine, not autochthonous or domestic, because the Balkans for many years have introduced many varieties of grapevine in the center of origin of the Middle East and they were mixed with domestic species of the genus *Vitis.* Therefore it is not known with precision their genetic origin. In these trials, cytogenetic status testing methods were used only to the level of karyotype analysis (chromosome counts and measurements) where no significant differences in the chromosomal structure in the nucleus were observed. These significant differences can be verified in the processing of the genomic structure and certain genes, and it is therefore necessary to go to the DNA analysis, which would identify the similarities between the DNA fragments that are responsible for the similarities between varieties and similar centers of origin.

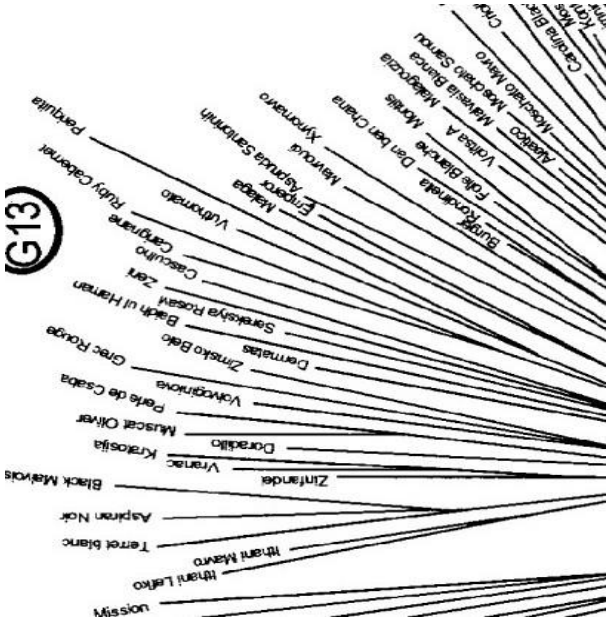
Material and methods

For examination of mitosis and meiosis in the varieties under the microscope, it is necessary prior germination of the seeds of the examined grape cultivars and the examined crossing combination, which is performed by keeping the seeds in isolated plates, slightly covered with water, alternating

6 hours on a temperature of -2°C to -3°C, in a refrigerator and on 25°C in a thermostat or a room temperature next to some heater. After the germination of the seeds they were slightly dried and planted in pots filled with garden soil and bio-fertilizer. For examination of the mitosis at the grape varieties, germinated roots 5-10 mm long were used.

- Monastery white (Klis üzum) - white table variety, with belonging to eastern varieties (convarietas orientalis, subconvarietas antasiatica), in our country found in Gevgelija-Valandovo vineyard region.
- **Stanusina** - black wine variety with belonging to Black Sea - Balkan varieties (convarietas pontica, subconvarietas balcanica), in our country found in Tikveš, Ohrid, Bitola, Štip vineyard region.
- Kratosija - black wine variety with belonging to Black Sea - Balkan varieties (convarietas pontica, subconvarietas balcanica), in our country found in Montenegro, Dalmatia, Herzegovina, Macedonia vineyard region.
- **Temjanika** - white wine variety with belonging to Black Sea - Balkan varieties (convarietas orientalis, subconvarietas caspica), in our country found in Tikveš, vineyard region

The examinations were performed in several successive years from 2006 to 2016, in Ohrid, Tikveš, Gevgelija-Valandovo and Skopje vineyard region (7). Among the results is used statistical processing according (SPSS) program. A special computer program for measuring chromosomal parameters and for the preparation of the karyotype and vine cariogram was used. A special microscope with a computer program with measuring units for measuring chromosomes in micrometers (μm) was also used. The cytogenetic status of varieties are examined according with description lists of primary and secondary OIV Code descriptors. The list was proposed by the EU-PROJECT GENRES 081 - 09/2001. Addition- ally recent edition of 2009 was used.



Dendogram 1. Aradhya, M. and col. 2013

Results and discussion

The examined varieties - monastery white (klis üzum), stanusina, kratosija and temjanika belong to the sub-genus Euvitis and they are diploid cultivars (2n = 38).

Cytological status was examined according to the pattern O.I.V.

12. Cytological characters
12.1 Chromosome number
12.2 Ploidy level; (e.g. aneuploid or structural rearrangement)
12.3 Pollen viability; Specify the method i.e. germination in a solution or grain staining
12.4 Meiosis chromosome associations; Mean of 50 microspore mother cells,

observed during metaphase
12.5 Other cytological characters; (e.g. stomata density and size)
13. Identified genes
Describe any known specific mutant present in the accession
The germination of the pollen was examined *in vitro*, with planting pollen grains in fertile base of 15% saccharose solution, in a preparation hanging drop and with keeping it in a thermostat on a temperature of 21ºC. After that the germinated pollen grains were counted and photographed under a microscope [2].
Fertilization, as part of the genetic status, was examined by determining the self - fertilization (autogamous) and cross - fertilization (ksenogamous). The observation and counting the chromosomes of the examined varieties and of the grapevines in general, is very difficult because they are tiny, their number is great and it is also very difficult to differentiate them from the cytoplasm. The cytoplasm is very thick, it blocks the dispersion of the chromosomes, so they concentrate on one place and can not be macerated during the preparation. With that, the contrast and the clarity of the sight under the microscope is lost [2], [6]. Tables 1, 2 and 3 and Chart 1 show the diploid number of chromosomes according to the standard scheme and the length of chromosomes in micrometers (μm**)** with statistical differences between individual chromosomes. Not observed any more concessions and abnormalities in metaphase chromosomes in the different cultivars [2], [6], [8]. On figures 1 and 2, chromosomes of grape varieties are shown. At the examined grape varieties – monastery white (klis üzum), stanusina, kratosija and temjanika, the metaphase is normal, there are no anomalies in the structure and the number of chromosomes, there are 38 clearly differentiated chromosomes under microscope. The dispersion of the chromosomes is slightly bigger and the cytoplasm is more porous in comparison with the wine grapes. For that reason there is better separation of the chromosomes, and they look bigger and clearer.[3], [4], [5].

Table 1. Chromosome constitutions in normally diploid organism with 2*n* = 38 chromosomes (labeled A, B, and C) in the basic set

Monastery white, Stanusina, Kratosija Temjanika	Designation	Constitution	Number of chromosomes
Monoploid	*n*	ABC	19
Diploid	2*n*	AABBCC	38
Triploid	3*n*	AAABBBCCC	57
Tetraploid	4*n*	AAAABBBBCCCC	76
Monosomic	2*n* − 1	ABBCC	37
		AABCC	37
		AABBC	37
Trisomic	2*n* + 1	AAABBCC	39
		AABBBCC	39
		AABBCCC	39

The best fertilization showed Temjanika variety, best germination of pollen showed white variety Monastery and lowest fertility slightest germination of pollen showed the variety Kratosija. [8]. Insignificant abnormalities in fertilization have been shown in the Kratosija variety, because we observed certain abnormalities in the meiotic chromosomes at the fertilization stage in the flower. So sometimes in this variety is less germination of pollen and less fertilization. According to Aradhya,

M. and col. 2013, which have prepared a map for several varieties of vines, mostly for varieties from Europe and Asia), the investigated varieties in our work are in the Ghetto 13 (along with varieties Vranec, white winter and Muscat Oliver) [1], [7].

Table 2. Length of chromosomes in tested cultivars and statistical processing

Haploid number of chromosomes N°	Vitis Vinifera subsp. Vinifera code Vvi_v 2n = 38			
	Monastery white	Stanusina	Kratosija	Temjanika
	µm	µm	µm	µm
01	1,69	1,68	1,67	1,70
02	1,57	1,58	1,56	1,63
03	1,50	1,49	1,48	1,51
04	1,41	1,39	1,37	1,42
05	1,36	1,35	1,34	1,37
06	1,33	1,30	1,27	1,30
07	1,29	1,28	1,25	1,25
08	1,26	1,25	1,22	1,22
09	1,21	1,20	1,19	1,19
10	1,18	1,18	1,16	1,17
11	1,16	1,15	1,14	1,12
12	1,13	1,12	1,11	1,11
13	1,10	1,10	1,09	1,08
14	1,08	1,07	1,05	1,04
15	1,05	1,05	1,02	1,01
16	1,03	0,99	0,97	0,98
17	0,97	0,94	0,91	0,95
18	0,89	0,89	0,88	0,89
19	0,86	0,85	0,84	0,87
Average	1,21	1,20	1,19	1,20
*sd	0,22	0,23	0,23	0,24
*CV%	18,51	18,84	19,18	19,91
*L	1,69	1,68	1,67	1,70
*S	0,86	0,85	0,84	0,87
*L-S	0,83	0,83	0,83	0,83
*L+S	2,55	2,53	2,51	2,57
*L/S	1,97	1,98	1,99	1,9

*sd - standard deviation, *CV% - coefficient of variation, *L – longest chromosome,
*S – shortest chromosome, *L-S - difference of longest and shortest chromosome,
*L+S – sum of longest and shortest chromosome, *L/S - ratio between longest and shortest chromosome

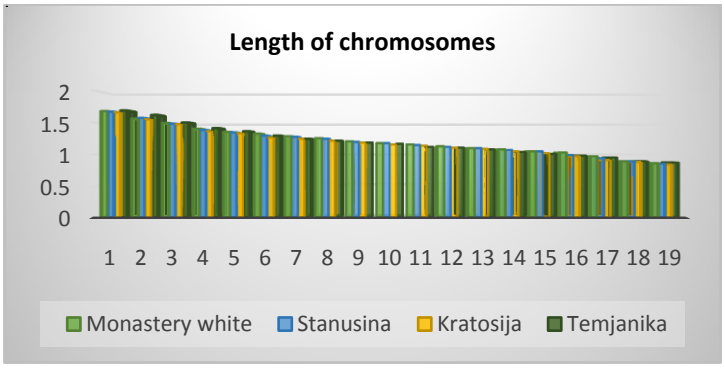


Chart 1. Graphical display of the length of the chromosome

Table 3. Percentage of fecundation in isolated conditions (self-pollination) and in normal conditions(cross-pollination), percentage of alive pollen and percentage of pollen germination

Cultivars	Isolated conditions (autogamy) %	Normal conditions (xenogamy) %	Alive pollen %	Pollen germination %
Monastery white (Klis üzum)	29,95	79,81	89,10	79,18
Stanusina	28,67	77,24	88,71	77,63
Kratosija	24,16	59,15	78,12	69,35
Temjanika	30,80	82,30	87,46	75,40

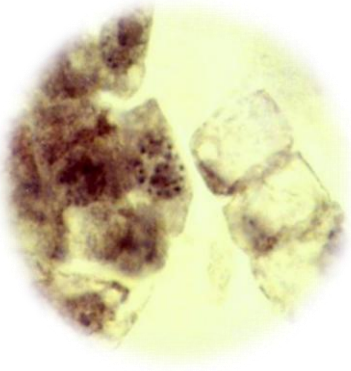


Fig.1 Metaphase chromosomes of grape varieties

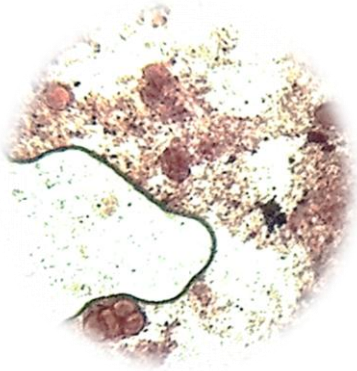


Fig. 2 Meiotic chromosomes of grape varieties

Fig. 3 Monastery white (Klis üzum)

Fig. 4 Temjanika

Fig. 5 Stanusina

Fig. 6 Kratosija

Conclusions

At the examined grape varieties - monastery white (klis üzum), stanusina, kratosija and temjanika according to the cariotype it is stated 2n = 38, that is typical for these cultivars. The chromosomes are very small and they are difficult to be found and observed. The best fertilization showed Temjanika variety, best germination of pollen showed white variety Monastery and lowest fertility slightest germination of pollen showed the variety Kratosija. In the observed phenotype of the examined varieties, that sometimes may drastically reflect the cariotype and the polyploidia, no differences of that kind are noticed. The cell division is regular and the metaphase is normal. According to the existing limited possibilities for examination, abnormalities of the chromosomes

are not noticed (aberrations, divisions etc.). Insignificant abnormalities in fertilization have been shown in the Kratosija variety, because we observed certain abnormalities in the meiotic chromosomes at the fertilization stage in the flower. So sometimes in this variety is less germination of pollen and less fertilization. The smallest length of the chromosome was measured in the Kratosija variety 0.84 µm, and the highest in the Temjanika variety 1.70 µm. Examination of cytogenetic status in varieties contributes to determining the similarity between varieties and belonging to a particular group or subgroup. Also, the cytogenetic status contributes to determining the centers of origin.

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CONTRIBUTION OF ALTERNATIVE CROPS TO ORGANIC AGRICULTURE IN THE FUNCTION OF BIODIVERSITY CONSERVATION

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Abstract
In this paper the following alternative crops interesting to be cultivated in Balcan cuntries in order to enlarge the biodiversity are discussed: broomcom, grain sorghum, proso millet,smail and iarge headed italian millet, canarygraas, buckwheat,oil pumpkin,hemp,flax,tobacco,medicinal, aromatic and spice species as well as amaranth.Alternative crops occupy a relatively small acreage but their contribution to the diversification of field crops production is considerable. Natural biodiversity is of high relevance considering the ecosystem stability and productivity.A high level of agro-biodiversity is very important because of wider crop rotations, growing leguminous crops for the nitrogen input, and the need for specific site and system adapted species and cultivars, also when considering special marketing strategies. For the further improvement of the production of alternative crops expanded literature, selected cultivars and innovative production andprocesing technologies are neccesary. It works best if covering and integrating the whole value chain including wholesalers, retailers, and consumer.

Key words: organic agriculture, agrobiodiversity, alternative crops, conservation.

Introduction

Conservation genetics is an interdisciplinary science that studies the possibilities of applying genetic methods in the protection and restoration of biodiversity. Research in conservation genetics includes various areas, such as population genetics, molecular ecology, molecular biology, evolutionary biology and biosystematics. Genetic variability is one of the three basic postulates of biodiversity, so it is directly important in conserving biodiversity, although genetic factors are also important in preserving species (species diversity) and the diversity of ecosystems (ecological diversity). Preserving genetic variability is important for the overall health of the population, as reduced genetic variability leads to an increased inbreeding effect and a reduction in the adaptation value of phenotypes (Robert W. Morin P., 2004). If genetic variability weakens in many genes of one species, it becomes more and more at risk of biological vulnerability and even extinction. Then it has only one possible choice of genetic information on all or almost all of its genes; In other words, all the individuals are almost identical. If there is a new selection pressure (such as ecological catastrophes), populations with high genetic variability have a greater chance that at least some individuals have a genetic constitution that allows them to survive. If genetic diversity is very low, none of the individuals in the population can have the characteristics needed to deal with new unfavorable conditions. Such a population may suddenly disappear. Genetic variability of species is always open to change. No matter how many genetic variants present in today's population, only those varieties that survive in the next generation can contribute to the future variety of species. When certain gene variants are lost once, they can not be recovered in the same form. For the assessment of the genome status of one species, specific genetic techniques are applied in relation to specific conservation issues as well as the genotype structure of the population (Vučinić M.and Pešić V., 1997). These analyzes can be done in two ways: by analyzing the DNA of today's individuals and / or fossil DNA (Woodworth, L., Montgomery, M., Briscoe, D., Frankham, R., 2002) . In order to

stop the still present loss of biodiversity and the degradation of ecosystems, EU published an EU Strategy for the Preservation of Biodiversity by 2020, on 03.06.2011 aimed at "restoring lost biodiversity and accelerating EU transition to a resource efficient and green economy". By formulating the aim of this new strategy, it is indirectly acknowledged that all previous activities and measures were more or less unsuccessful.

Material and methods

Focusing on agro-biodiversity, the European Commission has adopted two directives aimed at addressing a wide range of issues pertaining to this area:
Directive 2008/62 / EC of June 2008 on the acceptance of agricultural local populations and varieties naturally adapted to local and regional conditions and endangered by genetic erosion and the placing on the market of seeds and seed potatoes of these local populations and varieties.
Directive 2009/145 / EC of 26 November 2009 on the acceptance of local populations and varieties of vegetables traditionally cultivated in certain sites and regions and varieties without essential value for commercial crop production but are under special conditions for seed placing on the market. Some of the initiatives in the field of organic agriculture and nature conservation could make good use of both of these directives when they are transposed into the national legislative framework and adapted to it. The main activities are the identification of registrations and the return to the use of local populations and old varieties. In this paper, agriculture is shown as one of the important factors with a great impact on biodiversity and the environment. The aim of the paper is to point out the importance of agro-biodiversity of crops in organic agriculture from various aspects of agricultural policy and to the comparison of relations between other areas with biodiversity. In order to provide adaptable varieties to the ambient environmental conditions, some long-term initiatives for organic breeding and reproduction of seeds have been successfully launched.

Results and discussion

Biodiversity and Sustainability of Agricultural Production

Ecological factors of agricultural sustainability understand environmental protection and biodiversity. Namely, since the goal of agriculture is to produce sufficient quantities of quality food for human population, food production must be organized so as not to affect the quality of air, soil, surface and ground waters, and not to disturb the existing equilibrium in the biosphere, i.e. natural diversity of plant and animal genotypes and phenotypes and their natural heritability. Therefore, it is said that agricultural production is sustainable only if it is organized as to concurrently provide the biosphere sustainability under conditions of ever-increasing population growth (Heitschmidt et al., 1996). Biodiversity means the total of the existing plant and animal genotypes and phenotypes, i.e. natural heritability, thereby sustainability of plant and animal genome variability. Within all the existing ecosystems, biodiversity sustains their steady stands thus enabling them to function, i.e. survive as well as to interact with surrounding ecosystems. In the same way agri-ecosystems, i.e. agricultural ecosystems influence their environment and vice versa. From the standpoint of agriculture, biodiversity preservation means production that does not affect equilibrium in the biosphere, i.e. enabling the survival of plant and animal genetic resources (bioresources) and contributing to their adaptability and future use in food production. Irrespective of highly productive breeds in animal production, cultivars and strains in field crop production, fruit- and vinegrowing. efforts and investments are made to preserve traditional biotops and rare local races, strains and cultivars. Although an agri-ecosystem is only a small portion of the entire biological diversity, it is of crucial importance for human population survival. This means that in the context of agriculture biodiversity must enable continuing food production for people living in a variety of environments but not affect the evolutionary course, i.e. biodiversity of other ecosystems. In other words, agricultural production must not cause the reduction in the number of existing natural varieties within the genome of plant and animal species belonging to other mini-ecosystems that a particular agri-ecosystem interacts witii (Haila, 1995). Concurrently, agricultural production must be organized

in such a way as to preserve and protect all existing genetic varieties within an agri-ecosystem, particularly favoring the survival of plant and animal species, races, strains and cultivars adaptable to all growing conditions, resistant to diseases characteristic for certain locations, not susceptible to agrotechopathies, i.e. those productive and yielding in different ecogeographical locations. Since genetic variability is conditioned by the intensity of selection, heritability, size of population and breeding program, this means that biological diversity sustainability within an agri-ecosystem is dependent right upon these factors.

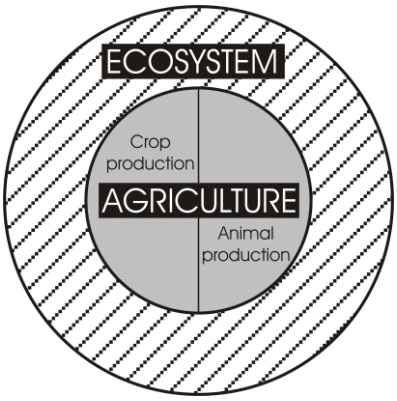

Figure 1. Aspect of ecosystems and agriculture

Of the listed factors, the size of the existing populations of plant and animal species is most important for biodiversity preservation. The reduction of size of a certain population inevitably leads to the status of homozygosity which contributes to genetic variability reduction. By favoring the growing of only highly productive plant and animal species, all cultivars, strains, races and even species that are low productive but disease resistant and sustainable in all living conditions may disappear from an agri-ecosystem. If this occurs, the disrupted biodiversity within an agri-ecosystem would label agriculture as an unsustainable activity and would soon endanger the preservation of natural genetic variability and heritability in all other ecosystems that agriculture interacts with. We can simply say that the goal of agriculture is to close food chain in which man is the final link. If there were no agricultural production, this link would exist. However, by unplanned and short-term selection measures, breeding methods and growing of beneficial species, agricultural production may affect the genetic variability reduction, extinction of some genetic, i.e. biological varieties. Their extinction always results in the loss of one link in a food chain, the chain is broken, and man suffers, he who has organized this activity. To avoid the consequences, the Ministry of Agriculture and Forestry in many countries enacts long-term development programs, considering specific demands in lowland, hilly and mountainous ecogeographical locations (Atkinson and Watson, 1996). It was found that unorganized favoring of pasture grazing with increasing number of herbivore population, in a certain ecogeographical location, leads to fast biodiversity degradation within plant species on a pasture susceptible to defoliation. To avoid this, it is necessary to know apical meristem position in the species grown on pasture. Extinction of some plant species from the pasture further effects full extinction or reduction, i.e. rise in population numbers, of invertebrate and vertebrate beneficial for agriculture (earthworms, birds, insects, rodents, etc). When such a condition follows, biodiversity in a pasture is disrupted, and the pasture itself has no longer its function. In situations like this, utilization of a pasture being a degraded agri-ecosystem is left without undertaking any cultural practices to improve the state. Since the instances of biodegradation accumulated from year to year coupled with other factors affecting adversely global biodiversity, it was necessary to undertake measures for its preservation. Genetically variable populations are much more adaptable to new living conditions compared with genetic populations grown exclusively for one production purpose like high productivity (Pesic et all, 1997). Therefore, it is a requirement to assess genetic diversity at both national and global levels. The goals of growing must be organized so as to consider all

genotypic and phenotypic characters of a particular species, race, cultivar, strain, both morphological and functional characters like reproductiveness, disease resistance and stress susceptibility. The key question to the issue of sustainable agriculture and biodiversity relates to cost-effectiveness of growing rare, low-productive biological sources within certain agri-ecosystems.

Biodiversity in Organic Agriculture

From the very beginning of the development of the organic farming system, biodiversity has been considered one of the key issues, which is as important as the fertility of the land. With the language of modern terminology, biodiversity in organic agriculture focuses on two issues. One is the impact of agriculture on process quality and considers the issue of welfare for nature as stated (Pesic et all, 2009), and the second relates to the biodiversity and beauty of natural or wild species, habitat and biotope, to the level of appearance of natural areas. High biodiversity is considered to be the result of processing agro ecosystems by methods of organic agriculture. Many studies that deal with the impact of different agricultural systems have clearly demonstrated the positive impact of organic agriculture on biodiversity parameters such as: more diversified taxa, greater wealth, higher abundance (Bengtsson, 2005; Frieben & Koepke, 1996; Fuller et al., 2005; Wetterich & Haas, 2000). Stability of agro ecosystems as resources in agriculture leads to indirect pest control, which ensures and increases productivity. In a recent study (Krauss et al., 2011), when comparing the conventional and organic fields, it has been concluded that organic agriculture increases biodiversity, including important functional groups such as plants, polinators and predators that improve natural pest control. Preventive insecticide application in conventional fields has only short-term consequences for the number of populations of leaf lice, and long-term negative consequences for biological control of pests.

Breeding and selection for the needs of agro-biodiversity

In the 1980s, in Germany, after years of discussion, it became clear that organic agriculture needed special varieties to meet its specific needs. The first research findings based on the definition of ideologies have been published (Haas & Friedt, 1990; Drews et al., 2009). Research networks exchanged ideas, discussed approaches and limitations in organic breeding. One of the key initiatives was the EU-COST Act 860: "Sustainable Low-Input Grain Production: Required Characteristics of Varieties and Biodiversity Crops". The networks were further divided into working groups: "genetics and breeding", "biostatistics", "plant-land interaction", "plant-plant interaction", "plant-disease-complexes" and "testing and certification of varieties". Publications, reports, manuals and contact partners are still available:

• www.cost860.dk, www.cost860.dk/doc/Action860Brochure.pdf

•http://w3.cost.eu/fileadmin/domain_files/ABFS/Action_860/ final_report /final_report-860.pdf

Today, as in all other sectors, the EUCARPIA breeder association covers both the field of organic farming and one of the activities carried out is the EUCARPIA Conference held in Paris, 1-3 December 2010, with the theme "Breeding Resistance: One of the Strategies for Organic and Low-Input AgriculturalSystems"(https://colloque.inra.fr/eucarpia2010organicli/Proceedings). It is highly probable that Serbia and the countries of the Western Balkans will intensify their efforts to reach the level of agricultural production in Northwestern Europe with significant loss of biodiversity and agro-biodiversity. However, on the other hand, Serbia and the Balkan countries, and especially its southern parts, they always have very high and rich biodiversity and agro-biodiversity. Every individual remains to preserve the agro-biodiversity of rich flora and fauna, regardless of whether he is a politician, scientist, breeder, farmer, processor, trader or consumer. Therefore, within the framework of I.S.L.E. network, we propose the initiative and we propose the establishment of the Balkan Center for Organic Agriculture Breeding with all the regional centers in the countries of the Western Balkans, because they can have the maximum possible potential of biodiversity and agro-biodiversity in Europe.

Conclusions

The interconnection between organic farming and biodiversity lies in the fact that this type of production entails the application of ecological principles and agro-ecological measures in order to revive natural biological cycles, while respecting the interconnection between living organisms. Natural biodiversity is of high relevance considering the ecosystem stability and productivity. Alternative crops occupy a relatively small acreage but their contribution to the diversification of field crops production is considerable. At the same time, multi-functional organic farming contributes to the conservation of genetic resources and ecosystem diversity, and its job-opening and profit increasing potential creates the foundation for a better quality of life in rural areas. In this paper the following alternative crops interesting to be cultivated in Balcan cuntries in order to enlarge the biodiversity are discussed: broomcom, grain sorghum, proso millet, smail and iarge headed italian millet, canarygraas, buckwheat, oil pumpkin, hemp, flax, tobacco, medicinal, aromatic and spice species as well as amaranth.

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EFFECTS OF NEW ORGANIC PREPARATIONS BASED ON ZEOLITE AND DOLOMIT OVER SOME CHARACTERISTICS OF THE GRAPE IN R. MACEDONIA

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Abstract

In our research are covered the results of applying new organic products of mineral origin based on zeolite and dolomite. The specific substances processed at our paper represent minerals geographic origin of the mining localities in R. Serbia and the same are protected by intellectual property. In R. Macedonia are implemented on several agricultural crops including the grapevine. According to the method of application to plants can be as improvers of soil features which are applied on the soil of planted place, as well as their other formulations that are applied as fertilizer on the foliage (leaves). Way of their influence is based on improving the health and conditions and capacity of plant organisms and strengthening the entire immune system of the plant. Usually affect an increase in foliage and Equating the flowering and fertilization. Thereby receive yields that have improved quantity and quality. They represent formulations which are allowed to apply organic production of grapevine.In this examination are presented results of treating many varieties of grapevine on several localities in R. Macedonia. They are chosen at plantations with low condition and individual plantings for periods of two years. Were obtained visible results in increasing the useful leaf mass and in a timely and evenly flowering. Also, this year, these preparations improve the situation with the frozen vineyards.

Keywords: organic, mineral, zeolite, dolomite, grapevine.

Introduction

In organic agricultural production in the R. Macedonia, for the improvement of the properties of the soil and for the nourishment of plants, preparations with natural mineral origin are increasingly used. The manner of their action refers to the improvement of certain soil characteristics and the improvement of certain physiological processes in plants. They do not act biocidally, but act in the direction of improving the overall conditional ability and plant health and improving the physico-chemical properties of the soil so that they can respond to the attack of diseases and pests (based on inducing defense reactions in the treated plants) [3]. This paper deals with the use of natural preparations based on minerals zeolite and dolomite (raw materials) having a geographical origin from the R. Serbia and are protected with intellectual property rights. These are the preparation - Terra Foster and its improved formula (gel variant) - Terra Powder. These innovative solutions were applied in two vegetations and several phenophases in the grapevine. From the application of the preparations, certain improvements in the properties and visible positive results were obtained [3], [7]. The raw materials - zeolite and dolomite and their preparations applied in our examination are analyzed in an accredited laboratory in the R. Macedonia. Macedonia, where a positive expert opinion on the physical and chemical components of the raw materials was obtained. Also, positive expert opinion was obtained for samples of preparations originally produced in R. Macedonia, in order to produce in the future larger quantities for broader markets [6], [8], [12].

Material and methods

The research in this paper was carried out on several varieties of grapevine in the Skopje vineyards, most of the varieties of which were examined in the Collection Plantation at the Institute of Agriculture, and several investigations were conducted in individual plantations. Studies in the collection plant at the Institute of Agriculture have yielded visible results in terms of treating the investigated preparations [4], [5]. Specifically studied varieties are Flem seedless (seedless variety), Chasselas (table white variety), Vranec (variety producing red wines), Ohrid white (variety for producing white wines). The preparations examined in this paper are obtained from the natural minerals zeolite and dolomite and represent new organic preparations - Terra Foster and Terra Powder. They are currently produced in the Czech company, GAIA LIFERESOURCES S.R.O. PRAGUE, CZECH REPUBLIC In a perspective with permission, they will be produced in the R. Macedonia. Treatment was performed in the period 2016 - 2017. Treatment with Terra Foster is done after the vegetation in November 2016. Treatment with Terra Powder is done during vegetation 2017. with 4 treatments on the vine. The first treatment is when the shoots have a length of 10 cm, the second treatment is before blossoming, the third treatment is prior to the formation of the grains and the fourth treatment is during the maturation of the grapes. Eventually the fifth treatment would be after the completion of the vegetation. The first treatment with Terra Foster is directly in the soil, the other 4 treatments are foliar feeding [4], [5], [8]. The method of applying the gel Terra Powder depends on the quantities of minerals and macro and micro nutrient elements currently found in the soil (it is necessary to analyze the soil). Quantities of 1 to 3 tons per hectare are commonly practiced. But in our case since individual vines are treated, the need for these raw materials (zeolite and dolomite) is about 0,100 to 0,400 kg in a plow place. Hereinafter, the composition of the mineral raw materials from which the preparations Terra Foster and Terra Powder are obtained are presented.

RESULTS FROM PROPERTIES IMPROVEMENT - GAIA - TERRA POWDER

Item no.	Parameter	Method	Received value	Declared value	Unit measure
Physical parameters					
1.	Moisture	MKCISO8190:1992	1,12	/	%
2.	Mechanical composition (size in granules)	MKC ISO8397:2009	1 mm 98 min 0,25 mm 80 min	1 mm 98 min 0,25 mm 80 min	%
3.	*Shape	Organoleptic	powder form	Powder form	/
4.	*Color	Organoleptic	white	white	/
5.	*Smell	Organoleptic	no	no	/
6.	*Solubility in water	Organoleptic	Very poorly soluble	Poorly soluble	%
Chemical parameters					
7.	pH	MKC ISO13037:2011	10,78	/	/
8.	*CaCO3	Volumetric ISO10693	83,31	/	%
9.	* Total CaO	Rulebook on inorganic fertilizers R.M. no. 96 from 31.06.2009	35,80	35±3	%
10.	* Total MgO	Rulebook on inorganic…	5,08	5±1,25	%

* Unaccredited method

Raw materials:
Zeolite and Dolomite: Water - H_2O, Calcium - $CaCO_3$ (total Ca), Magnesium - MgO (total Mg), Silicon - SiO_2, Aluminum - Al_2O_3, etc.
Small additions of elements: Phosphorus - total Phosphorus P_2O_5, Potassium - total Potassium K_2O, Zinc - total Zn, Sodium – NaO, etc.
According to the method of action, it can be said that the preparation Terra Powder due to the high content of Ca and Mg can be used as an enhancer of the properties of soils for fertilizing soils that have acidic pH reaction on the soil and in plants that require alkaline reaction [6], [7]. Terra Powder positively affects the physico-chemical properties and the water regime in the soil by affecting the water retention and making it available on the root of the plants. Terra Powder best shows results in light (sandy) soils, but also improves the structure of heavier (clayey) soils. Terra Powder has the capacity to bond heavy metals to keep them in and makes them unavailable for plants. It also has prolonged action and encompasses all phenophases in a single culture [1], [2], [11].
Precautions.
Protection of workers according to the prescribed rules in the package leaflet (washing, washing and changing, procedure for irritation of the skin and eyes, major irritant reactions where doctor advice is needed.
Environmental Protection.
Do not contaminate the water and other water courses, the way of safe storage of the packaging and the manner of safe removal of the packaging. When selecting raw materials for Terra Powder, be careful not to choose a zeolite that has already done decontamination of the land in a particular area because it has heavy metals bound in it and can react poisonily or even carcinogenic.
The data in this paper are statistically processed with mean value, coefficient of variation and standard deviation. Also in the following table are presented the results of the laboratory analysis of GAIA Terra Powder.

Results and discussion

The examination of the effect of the preparations was done on three groups of characteristics in individual units from the tested varieties of grapevine - Flem seedless, Chasselas, Vranec and Ohrid white. For the most part, the experiment was carried out in the collection plant of the Institute of Agriculture, but there were also treatments for individual vines in individual plantations and house yards [3], [4]. The period of examination (November-December 2016 and 2017) was unfavorable for the vegetation of the grapevine. During the winter period there was a great freezing, late spring frosts, and in the summer period there was a mild disease and certain pests (spiders). The application of the Terra Foster and Terra Powder preparations was welcomed in order to improve several important properties of the vines from the tested varieties in the investigated "problematic - bad" period. The overall health and resistance (preparedness) for obtaining solid yields was also improved [4] Based on the action of the investigated preparations that indirectly acted on the physico-chemical properties of the soil, the water regime in the soil and in the plant and the physiological processes in the plant habitat improved the resistance (response of the immunity) of the plant to unfavorable external conditions, diseases and pests. The investigated preparations are improving the properties and do not act biocidally. From the obtained results in the attached tables it can be seen that in the individual treated vines there is a difference with the untreated vines - the phenophases from beginning to end of vegetation are several days earlier which is significant for achieving full maturity and favorable chemical composition (sugars and acids). At the earliest it reaches full maturity variety Flem seedless (treated) - 08.08, and at the latest the Ohrid white (treated) variety 30.09. Also, in the investigated varieties, the yield per vine is higher in the treated vines and ranges from 2,414 kg / vine in Ohrid white to 4,105 kg / vine in Flem seedless. The photos can be seen that there is an increase in foliage and growth of shoots in treated individuals grapevine.

Table. 1 Phenological phases in treated and untreated vines from the investigated varieties

Varieties of grapevine	*T and *U	Branching of branches	Flowering			Beginning in maturing	Full maturity
			Beginning of flowering	Full flowering	End of flowering		
Flame seedless	U	13.04.	31.05.	03.06.	07.06.	14.07.	10.08.
	T	11.04.	29.05.	02.06.	05.06.	10.07.	08.08.
Chasselas	U	14.04.	31.05.	03.06.	06.06.	12.07.	16.08.
	T	11.04.	29.05.	01.06.	05.06.	08.07.	12.08.
Vranec	U	18.04	02.06.	05.06.	07.06.	30.07.	09.09.
	T	12.04	01.06.	04.06.	06.06.	22.07.	05.09.
Ohrid white	U	23.04	03.06.	06.06.	08.06.	09.08.	02.10.
	T	18.04	01.06.	04.06.	07.06.	07.08.	30.09.

*T = Treated, *U = Untreated

Treated individuals give uniformized grains and clusters in color and fertilization, a beautifully colored and fresh leaf mass and a uniform almond color. In the treated varieties, the percentage of sugar is also higher, which is very significant in the case of seedless seed varieties and wine processing varieties to improve the properties of the wine obtained. Most important is that the treated vines of the variety to produce red wines Vranec, sugar full maturity reached 225 g/dm3. It should be noted that the varieties tested in all treatments retain the variety characteristics.

Tab. 2 Quantity of harvested grapes (yield) in *T and *U vines from the investigated varieties

Varieties of grapevine	*T And *U	Yield grape kg/vine
Flame seedless	U	3,376
	T	4,105
	Average	3,741
	sd	0,515
	CV%	13,781
Chasselas	U	2,185
	T	2,895
	Average	2,540
	sd	0,502
	CV%	19,766
Vranec	U	3,360
	T	3,750
	Average	3,555
	sd	0,276
	CV%	7,757
Ohrid white	U	1,900
	T	2,414
	Average	2,157
	sd	0,363
	CV%	16,850

*T = Treated, *U = Untreated

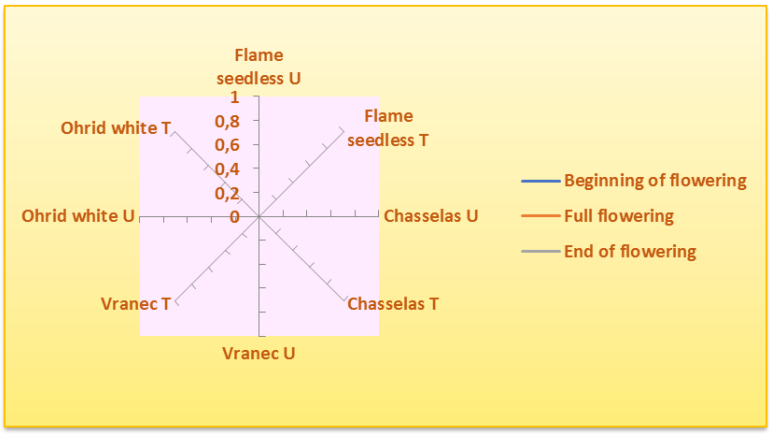

Chart 1. Diagram for displaying the phenophases of flowering inthe investigated grape varieties

Tab. 3 Chemical composition of the grapes in treated and untreated vines from the investigated varieties

Varieties of grapevine	*T and *U	Sugar g/dm^3	Index	Total acids g/dm^3	Index
Flame seedless	U	167	104	4,4	94
	T	172		4,2	
	average	170		4,3	
Chasselas	U	186	98	6,4	121
	T	202		5,9	
	average	194		6,2	
Vranec	U	196	106	5,6	105
	T	225		5,2	
	average	211		5,4	
Ohrid white	U	180	96	4,0	94
	T	199		5,6	
	average	190		4,8	

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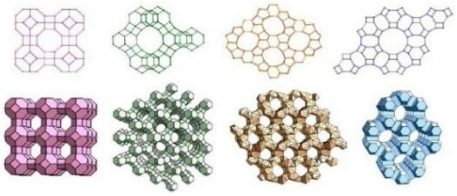

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Fig. 1, 2, 3, 4, 5 and 6 Structural formulas of the Zeolite mineral and its modifications

Fig. 7 Untreated

Fig. 8 Treated

Fig. 9 Untreated

Fig. 10 Treated

Fig. 11 Treated vines in the plantation

Fig. 12 Examined preparations in packaging

Conclusions

On the basis of the performed examinations and the achieved results the following can be concluded:

The tested preparations - Terra Foster and Terra Powder showed favorable physical and chemical composition and in the viticulture of plants there was a positive reaction from their application

The tested varieties of the grapevine - Flem seedless, Chasselas, Vranec and Ohrid white which were treated with the preparations phenophases were several days earlier than the untreated vines, which is significant for the vegetation and the full maturity of the grapes and the grains.

treated individuals have a higher yield and quality of untreated individuals.

The treated units have higher sugar content, which is significant for processing in wine, drying and consumption.

In the treated varieties there is improvement of other properties - quantity of leaf mass, color and size of tendrils, uniform fertilization

The raw materials for preparation - Terra Foster and Terra Powder are zeolite and dolomite. When choosing their ore deposit, care must be taken of the origin - not to originate from contaminated areas already decontaminated under their influence (zeolite binds heavy metals and cleans the soil.It is also possible for the investigated preparations, if necessary by processing, to correct the size of the grains (the mechanical composition) of the raw material and the preparation according to the requirements of the consumers.

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12. Muazzez Çelik Karakaya, Necati Karakaya, Fuat Yavuz. DOI: 10.1346/CCMN.2015.0630202 Published on April 2015, First Published on October 26, 2015 GEOLOGY AND CONDITIONS OF FORMATION OF THE ZEOLITE-BEARING DEPOSITS SOUTHEAST OF ANKARA (CENTRAL TURKEY)

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DESCRIPTION OF THE MORPHOLOGICAL AND TECHNOLOGICAL CHARACTERISTICS OF THE PLANT GOJI BERRY

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Abstract

Goji berry is relatively a new plant introduced in the Republic Macedonia. It is prevalent on limited small plantations to a controlled breeding conditions and providing a yield which is immediately placing on the market and awakens interest in further expansion of its production.This plant (Lycium barbarum or Lycium chinense), belongs to the family Solanacea and characterized by very favorable chemical composition of the fruit with high nutritional, energy and antioxidant value. Therefore, this plant is a large application in dietary recommendations for the prevention of many diseases and as a natural organic product for general strengthening of the human organism. From another aspect, goji berry requires minimal growing conditions aimed at irrigation and treatment with pesticides and it belongs in adaptable resistant plants for organic production. Also, this plant has good genetic predispositions, easily reproduced and has favorable characteristics; cytogenetic status, germination of seeds, regenerative ability, ability to clonal selection and in vitro - propagation. Its morphological construction is easy for examination of scientific purposes. Considering that in the fruit of this plant has similar chemical substances as it has in the grape, but enormously more, in our research experience made by fermentation (actually vinification) of the two types of Goji berries - sweet and bitter. The goal was to get fermented products similar to wine, but with improved chemical composition and strong antioxidant power.But after analyzing the obtained product, it can be concluded that by increasing the quantity of antioxidant substances during the vinification, however sensory evaluation of the final product is low. Goji berry should be consumed in fresh or dried form or may be a supplement of some special wines (with high sensory evaluation and strong antioxidant substances).

Key words: Goji, cytogenetic, antioxidant, germination, fermentation.

Introduction

The purpose of this paper is to examine in detail the cytogenetic status, the number of chromosomes, the properties of the seed material, the fertilization and reproduction of the goji berry plant as the genetic basis for its future selection and the utilization of its positive properties [8]. According to our examination in this paper, which is one of the initial studies of this type for this culture, it can be said that from the cytogenetic aspect, this plant has a diploid number of chromosomes with 2n = 24 and with few chromosomal irregularities, stable cell (mythological) divisions properly formed a partial spindle in the meiosis of the flowers, and thus a good fertilization of the flower [4]. The seeds have good germination and easily observed many correct mitotic divisions. The chromosome lengths are also measured and statistically processed. There is no frequent occurrence of triploidy and tetraploidy [2], [3]. The variation (division) of sweet and bitter fruits from the goji is not at the level of cell divisions and variations in chromosomes, but is due within the gene and part of the genomic structure. It could be the goal of future research on genomes and the germline dispersion according to NCBI matrices genomic maps for more families of plants worldwide [7], [9]. The fruit of goji can be used in fresh form, to dry, to get various drinks, juices, marmalades and fermented products, and from the seeds to extract oils and other types of nutrients. According to the fact that in the processing and fermentation of grains from some fruit

crops and from grapevines, juices or fermented products that are richer with nutrients and antioxidants and fresh fruits are obtained, we decided in this paper to process goji berry in a fermented product – wine.

Material and methods

For germination of goji berries we used a method used to germinate grapevine seeds. For obtaining material for observation under a microscope, it is necessary prior germination of the seeds of the examined godji berry which is performed by keeping the seeds in isolated plates, slightly covered with water, alternating 6 hours on a temperature of -2^{o}C to -3^{o}C, in a refrigerator and on 25^{o}C in a thermostat or a room temperature next to some heater. After the germination of the seeds they were slightly dried and planted in pots filled with garden soil and bio-fertilizer. For examination of the mitosis at the godji berry, germinated roots 5-10 mm long were used [9], [7]. For the examination of pollen and cell division of meiosis, methods used were applied in the flowers of the grapevine, by seeding and germination of pollen in a 15% solution of sucrose and treatment with orthocene. For the processing of goji berry in wine, standard fermentation was used which was used to obtain red wines. In the obtained goji berry wines we measured the content of alcohol, total extract, density were measured by picnometry. The amound of residual sugar, total acids, volatile acids, free and total SO_2 were analysed by titrimetry and pH with pH-meter. All of this methods were performed in the oenological laboratory of Agricultural Institute - Skopje, according to OIV methods. The obtained results for analysis of total polyphenols were expressed in mg/l EGA (Equivalente Galic Acid). Statistical processing according (SPSS) program. The tests were conducted in 2016/2017 year.

Results and discussion

The Goji plant, in the health food program, is increasingly being imported and grown in R. Macedonia. Goji's fruits have a high health and nutritional role in human nutrition. The fruits contain carbohydrates and carotenoids. Carotene pigments are represented by beta-carotene, zeaxanthin, lutein, lycopene, cryptosanthin. It also contains proteins, minerals (calcium, phosphorus, magnesium, iron, zinc and selenium) and vitamins (C, riboflavin, nicotinic acid and thiamine). *Lycium Barbarum* (Goji Berry) plants are native to the Himalayas. They also are referred to as wolf berries. Goji berries are called "super fruits" because of their antioxidant, amino-acid, essential mineral and protein content. The species of Wolfberry are deciduous woody plants growing 1-3 m. *L. Chinense* is cultivated in southern China and tends to be somewhat shorter, while L. barbarum is cultivated in the north, primarily in the autonomous region of Ningxia Hui, and tends to be slightly higher. Flowers grow in groups of one to three in the leaf axes [1]. The calyx (eventually interrupted by thegrowing berry) consists of bell-shaped or tubular separators forming short, triangular lobes [9]. The flowers are hermaphrodite, with pale purple and pale pink color, the pestle is straight, and the anteries are folded, which sometimes has the possibility of fertilization. In the northern hemisphere it can bloom from July to September and is fertilized, and the fruits ripen from July to October. The fruit is elliptical with a diameter of 1-2 cm and has an orange-red color in technological maturity. They are filled with small seeds (10 - 60 yellow seeds) [8], [11]. Synonyms for goji are „Wolfberry“, „Marriage grapevine“, „Chinese desert thorn“ etc. Goggi berry plant is suitable for growing in organic production, because it requires a maximum of 2-3 pesticide treatments throughout the year [5]. According to the observation and counting of metaphase chromosomes in the mitosis of cells from the examined material, only the diploid number of chromosomes AABBCC 2n = 24 was found [2], [3]. The chromosome length ranges from 3.50 µm to 5.65 µm in sweet goji berry and 3.49 µm to 5.64 in the bitter gobbies, which is a completely insignificant difference. (Fig. 1- 12, Chart 1). From the chemical composition it can be seen that the fermented product - wine from goji berry in relation to the red wine Vranec has the following differences; much higher content of total extracts, slight increase in phenolic substances and pH value, increased specific weight, while alcohols and CO2 are similar. In bitter goji berry has a very low residual sugar. (Table 3). As can be noted, according to the content of the rest of the sugar, the fermentation of wine in the current year is

completed, but the specific weight is still high. According to past data regarding this type of fruit, we assumed that the higher value of specific weight is due to the greater presence of pectin in the grains of this plant [1], [10]. According to the sensory analysis, the wine obtained from a slimy Goji berry and has a bitter taste with a typical characteristic flavor of the family Solanaceae. Our recommendation is that this alcoholic beverage could be used as an additive in the production of special wines to improve their antioxidant power or special type liqueur drinks [10], [1].

Table 1. Chromosome constitutions in a normally diploid organism with *2n* = 24 chromosomes - Goji berry (labeled A, B, and C) in the basic set

Name Goji berry / sweet, Goji berry / bitter	Designation	Constitution	Number of chromosomes
Monoploid	*n*	ABC	12
Diploid	2*n*	AABBCC	24
Triploid	3*n*	AAABBBCCC	36
Tetraploid	4*n*	AAAABBBBCCCC	48
Monosomic	2*n* – 1	ABBCC	23
		AABCC	23
		AABBC	23
Trisomic	2*n* + 1	AAABBCC	25
		AABBBCC	25
		AABBCCC	25

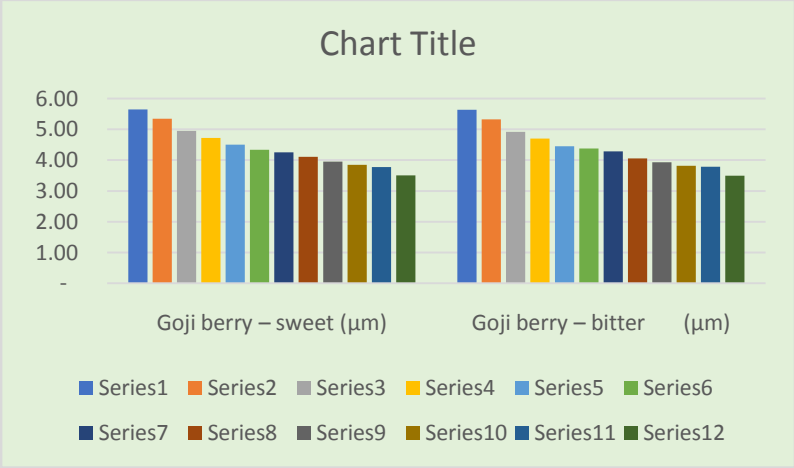

Chart 1. Graphical display of the length of the chromosomes

Table 2. Length of chromosomes in tested Goji berry and statistical processing

Haploid number of chromosomes N°	Goji berry – sweet (µm)	Goji berry – bitter (µm)
01	5,65	5,64
02	5,35	5,32
03	4,95	4,92
04	4,72	4,70
05	4,50	4,45
06	4,34	4,38
07	4,25	4,28
08	4,11	4,06
09	3,95	3,93
10	3,85	3,82
11	3,77	3,79
12	3,50	3,49
Average	4,41	4,40
*sd	0,65	0,65
*CV%	14,82	14,76
*L	5,65	5,64
*S	3,50	3,49
*L-S	2,15	2,15
*L+S	9,15	9,13
*L/S	1,61	1,62

*sd - standard deviation, *CV% - coefficient of variation, *L – longest chromosome,
*S – shortest chromosome, *L-S - difference of longest and shortest chromosome,
*L+S – sum of longest and shortest chromosome, *L/S - ratio between longest and shortest chromosome

Table 3. Chemical composition of fermented product - wine from goji berry and comparison with red wine Vranec

Parameters	Goji berry / sweet	Goji berry / bitter	Wine / Vranec
Specific weight 20/20	1,0137	1,0131	0,9983
Alcohol vol%	12,42	11,30	12,60
Total extract g/l	77,40	72,80	38,20
Residual sugar g/l	8,40	1,90	10,00
Total acids g/l	6,00	5,30	4,90
pH	4,63	4,91	3,45
Volatile acids lg/l	0,95	1,10	0,75
Free SO2 mg/l	15,36	12,80	26,88
Total SO2 mg/l	62,87	82,68	84,48
Total polyphenols mg/l	2569,60	2663,36	2400,00

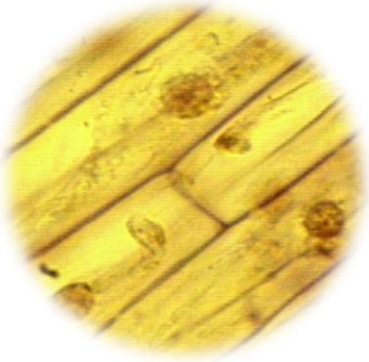

Fig. 1 Chromosomes of Goji berry – sweet

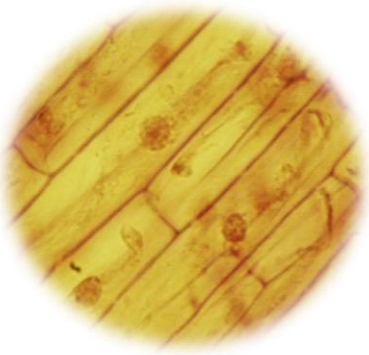

Fig. 2 Chromosomes of Goji berry – bitter

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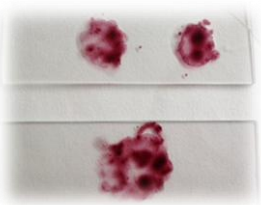

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Fig. 3 - 13 Grains, seeds of goji berry and processing of goji berry

Conclusions

Examined two types of goji berry - sweet and bitter showed to have uniformity regarding the number of chromosomes. The length of the chromosomes is within the cytogenetic properties of

the family Solanaceae and no major differences between the two variations sweet and bitter goji berry. In examined two types of goji berry, that sometimes may drastically reflect the cariotype and the polyploidia, no differences of that kind are noticedThe cell division is regular and the metaphase is normal. According to the existing limited possibilities for examination, abnormalities of the chromosomes are not noticed (aberrations, divisions etc.). According to chemical composition it is positive that the fermented product of the Goji berry - wine has a higher content of polyphenols that have a positive impact as nutritional components in food and beverages. After the sensory analysis and tasting, the final fermented product - Goji Beri wine was not rated with high marks. Therefore, this fermented product can be used as an addition to certain wines and some liqueur drinks to improve nutrition and health, ie. antioxidant value.

Acknowledgments
The processing material in this paper was procured from a distributor of goji berry in Macedonia – BIOPLANT.

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OIL CONTENT IN THE SEEDS OF WINE GRAPE VARIETIES IN THE REPUBLIC OF MACEDONIA

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Abstract
Modern studies worldwide suggest a high nutritional and medicinal value of the grape seeds. Oil for human consumption produced from the grape seed is already in everyday use in the diet in the economically developed countries. Seeds are also characterized by a rich composition of phenolic substances from which supplements recommended for cardiovascular system improvement are produced. Recent studies indicate the possibility of their use in the treatment of cancer. Grape seeds are not used for these purposes in the Republic of Macedonia. We tested two varieties that are most widely cultivated in the Republic of Macedonia, the red wine variety, Vranec and the white wine variety, Smederevka. Grapes were collected from two regions, Kavadarci and Valandovo, regions that are most important for the production of these two varieties. All tests were carried out in three repetitions. The mechanical and chemical composition of the grapes were analysed following the OIV (International Organisation of Vine and Wine) methods. We used statistical analysis of the completely randomized design. We detected rich chemical composition in the seeds, which indicates the great seed use value of the tested varieties.

Keywords: wine grape varieties, Vranec, Smederevka, grape seeds, oil.

Introduction

Vranec and Smederevka are the most common wine varieties of the Republic of Macedonia, predominantly cultivated in the regions surrounding the cities of Tikveš wine-growing region. Vranec takes up 75% of the areas of the red wine varieties. Smederevka takes up 70% of the total white wines varieties. The two varieties together cover 70% of the areas of all the wine varieties. They determine the type of Macedonian red and white wines (Bozinovik 2010). These two varieties yield the largest amount of manufactured dry pomace in the production of red and white wines. For these reasons, we used Vranec and Smederevka varieties in our research on the grape seed oil production possibilities.

Material and methods

Grape samples were collected from the Vranec and Smederevka varieties from two locations, Valandovo and Kavadarci, which are locations with ecological conditions that widely differ from each other. The samples were collected at the time of full maturity of the grapes, using a fully randomised design without setting the exact location. The chemical composition of the must was determined by analysing of the sugar and total acid content and pH following the standard OIV methods. As for the mechanical properties of the grapes, we analysed the cluster and berry weight, the number of the berries, and the mechanical composition of the berry. The moisture content of the grape seed was determined by drying the seed at 105°C to a constant mass, using the method No. 925.10 of AOAC (2006). The oil content was determined by Soxhlet method No. 920.85 (AOAC, 2006). A 10 g grinded seed sample (0.0001 g accurately weighed) was extracted in the presence of 10 boiling glass regulators with 300 mL *n*-hexane. After 6 h extraction, the *n*-hexane was removed from the extract using a rotary vacuum evaporator (40 °C, 200 mPa). The traces of *n*-hexane were removed by drying

at 40 °C and 105 mPa, followed by cooling in a desiccator and weighing. The steps of drying, cooling and weighing were repeated until the difference between two consecutive weights was less than 2 mg. The yield of oil was calculated based on the dry matter (DM) weight of the seeds. The statistical analysis was done by determining the basic indicators, mean values of standard deviation, and variance quotient.

Results and discussion

Table 1 shows the cluster and berry features of the Vranec and Smederevka varieties from two locations, Kavadarci and Valandovo. The Vranec variety is characterized by an average cluster weight of 336 g with the number of berries of 140, and an average berry weight of 2.24 g. The Smederevka variety has an average cluster weight of 358 g, the number of berries is 104, and an average berry weight of 3.28 g. The Smederevka variety cluster is 22 g heavier, has a berry larger for 1.04 g and 36 berries less in the cluster compared to the Vranec variety. The location has the greatest influence on the berry size in both varieties.

Table 1. Characheristics of cluster and berry

Variety	Vranec				Smederevka			
Parameter	Kav.	Val.	Aver.	CV%	Kav.	Val.	Aver.	CV%
Weight of grape	325	347	336	3,3	400	316	358	11,7
Weight of rachis	7.9	7.6	7.75	1,9	7.6	6.7	7.15	6,3
% of rachis	2.43	2.19	2.31	5,2	1.90	2.12	2,01	5,5
Number of berries	147	132	140	5,4	106	103	104	1,4
Weight of one berry	2.11	2.37	2.24	5,8	3.71	2.85	3.28	13,1

Table 2 shows the mechanical composition of the berry of the Vranec and Smederevka varieties from two locations, Kavadarci and Valandovo. The Vranec variety berry has an average flesh content of 89%, an average seed content of 3.6%, and an average skin content of 7.4%. The Smederevka variety berry has an average flesh content of 91%, an average seed content of 2.1%, and an average skin content of 6.9%. The Smederevka variety berry has a higher flesh and lower seed and skin content compared to the Vranec variety. The location has greatly influenced the skin content of the berries of the two varieties.

Table 2. Mechanical composition of berry

Variety	Vranec				Smederevka			
Parameter	Kav.	Val.	Aver.	CV%	Kav.	Val.	Aver.	CV%
Flesh (%)	86,4	91,6	89,0	4,1	91,2	90,8	91,0	0,3
Seeds (%)	4,5	2,8	3,6	33,4	1,7	2,6	2,1	30,3
Skin (%)	9,2	5,6	7,4	34,4	7,1	6,7	6,9	4,1

Table 3 shows the chemical composition of the must of the Vranec and Smedervka varieties from the two locations, Kavadarci and Valandovo. The Vranec variety must has an average sugar content of 240 g/l, an average total acids of 5.2 g/l. and an average pH of 3.58. The Smederevka variety must has an average sugar content of 200 g/l, an average total acid content of 4.3 g/l, and an average pH of 3.67. The Vranec variety must has a higher sugar and total acid content, but lower pH. The location has greatly influenced the total acid content of the must in the two varieties.

The quantity of dry matter and oil in seeds of the Smederevka and Vranec grape variety is shown in Table 4. The highest content of dry matter (92.02%) and oil (13.51% DM) was determined in the seeds of the Vranec variety collected in the region of Kavadarci. The oil content significantly depends on the region of collection. The lower values of oil content were determined in the grape seed of the Smederevka and Vranec varieties from Valandovo.

Table 3. Chemical composition of must

Variety	Vranec				Smederevka			
Parameter	Kav.	Val.	Aver.	CV%	Kav.	Val.	Aver.	CV%
Sugar (g/L)	235	244	240	2,7	210	190	200	7,1
Total acids (g/L)	5,5	4,9	5,2	8,2	4,5	4,1	4,3	6,6
pH	3,46	3,69	3,58	4,5	3,64	3,70	3,67	1,2

Table 4. Content of oil in seeds

Grape variety	Region	Dry matter (%)[1]	Oil (%)[1]	Oil (%)[1,2]
Smederevka	K	90.37 ± 0.06	11.00 ± 0.29	12.18 ± 0.30
	V	89.90 ± 0.25	8.87 ± 0.54	9.87 ± 0.61
Vranec	K	92.02 ± 0.05	12.43 ± 0.20	13.51 ± 0.21
	V	89.96 ± 0.21	9.25 ± 0.21	10.28 ± 0.26

K-Kavadarci; V-Valandovo; [1]Data are expressed as mean ± standard deviation (n = 3); [2]Calculated according to the corresponding dry matter (DM).

The values of oil content specified in Table 4 are comparable with the published data in the literature. Lachman *et al*. (2015) determined the average oil content of 11.60 ± 0.33 g in 100 g seed dry matter.

Conclusions

We examined the oil content from the grapes of the Vranec and Smederevka varieties from two locations, Kavadarci and Valandovo. The seed, skin, and oil content is higher in the Vranec variety compared to the Smederevka variety. The location has a significant influence on the oil content. The two varieties have a higher oil content in Kavadarci compared to Valandovo.

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DYNAMICS OF RIPENING OF AFUS-ALI TABLE GRAPE VARIETY

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Abstract
The afus-ali variety, together with the muscat italia, cardinal, victoria, ribier, and palieri, is the most important table grape variety in the Republic of Macedonia. We studied the dynamics of ripening of the afus-ali table grape variety from two locations Kavadarci and Valandovo where this variety is most commonly cultivated in the Republic of Macedonia. To determine the timing of ripening, we examined the dynamics of ripening by randomised sampling in the period from early August to the ripening of the grapes in early September. Four samples with three repetitions for each sample were taken every 10 days. We analysed the mechanical and chemical composition and mechanical properties of the cluster and berries following the OIV (International Organisation of Vine and Wine) methods. We used statistical analysis of the completely randomised design. The changes that occur during ripening of the afus-ali variety are the indicator of its technological ripeness. The results can be applied in the planning of the vintage depending on the market placement and duration of refrigerator storage of grapes.

Keywords: table grape variety, afus-ali, dynamics, ripening.

Introduction

The afus-ali variety is the most common table grape variety in the Republic of Macedonia, mostly grown in the vicinity of Kavadarci, Valandovo, Gevgelija, and Strumica. Its maturation starts by the end of August and has prolonged harvesting period up to the end of October (Božinović 2010). After harvesting, it is most often placed on the markets in the region, mainly in Serbia and Kosovo. Storing in refrigerators, with the intention to be placed on the markets later in the period October – December, is not a very common practice. This variety yields high-quality table grapes. In the ecological conditions of Veles, the control, in relation to the applied variants, varied in the average cluster mass (387 and 445 g), cluster weight (4.92 – 5.96 g), sugar contents (4.7 – 5.1 g/dm^3), skin firmness (1.81 – 2.23 kg/cm^2) and pedicel detachment force (416 – 475 g) (Jevtimova 2000). The purpose of our investigation is to detect the mechanical composition, mechanical properties, and chemical composition of the grapes in the period from veraison to full maturity and to use the obtained results to determine the harvesting and the refrigerator storage time following the markets' needs.

Material and methods

Samples were collected in 4 periods from two locations, Valandovo and Kavadarci, which are the most important locations for table grape production in the Republic of Macedonia,. The first sampling period started on August 3 followed by the next three periods on every 10 days each. The sampling was completely randomised, without predetermination of the exact location and certain vines at that location. The must chemical composition was studied from the grapes of all groups by analyzing the content of sugars, total acids and pH following the standard methods of the OIV. Three groups of clusters, the largest, medium size, and the smallest, were analysed for their mechanical

properties. Each of the groups were analysed in three repetitions. Weight of the grapes, number of berries, participation of normal and small berries in a cluster, mechanical composition and mechanical properties of the berries were studied. We analysed the correlation coefficient between the days of maturation and each of the examined indicators.

Results and discussion

Table 1 shows the afus-ali variety cluster weight. The average weight of the afus-ali cluster increased gradually from 517 g to 900 g and from 553 g to 783 g in Kavadarci and Valandovo respectively in the period from August 3 to September 4.

Table 1. Cluster weight (g)

	3 August		14 August		25 August		4 September	
Cluster size	Kav.	Val.	Kav.	Val.	Kav.	Val.	Kav.	Val.
Largest	766	695	860	740	816	948	1477	1105
Medium	508	586	535	620	542	779	753	825
Smallest	278	377	369	398	277	394	471	419
Average	517	553	588	586	545	707	900	783

Table 2 shows the grape weight of the afus-ali variety. The average weight increased gradually from 3.2 g to 6.2 g and from 3.3 g to 5.2 g in Kavadarci and Valandovo respectively between August 3 and September 3.

Table 2. Berry weight (g)

	3 August		14 August		25 August		4 September	
Berry size	Kav.	Val.	Kav.	Val.	Kav.	Val.	Kav.	Val.
Largest	3,6	3,2	4,5	5,1	5,0	4,9	6,0	5,6
Medium	3,8	2,9	3,7	4,1	4,4	4,9	5,7	5,1
Smallest	2,3	3,8	5,1	2,8	3,6	4,3	6,9	4,9
Average	3,2	3,3	4,4	4,0	4,3	4,7	6,2	5,2

Table 3 shows the reactive berry skin firmness of the afus-ali variety. The average skin firmness decreased gradually from 9,2 kg/cm^2 to 6,7 kg/cm^2 and from 5,6 kg/cm^2 to 5,3 kg/cm^2 in Kavadarci and Valandovo respectively between August 14 and September 3.

Table 3. Skin firmness (kg/cm^2)

	14 August		25 August		4 September	
Berry size	Kav.	Val.	Kav.	Val.	Kav.	Val.
Largest	10,2	6,0	7,1	6,4	7,8	5,3
Medium	8,5	5,3	6,7	4,9	5,6	5,6
Smallest	8,5	5,3	7,8	4,6	7,1	5,3
Average	9,2	5,6	7,1	5,3	6,7	5,3

Table 4. Pedicel detachment force (g)

	14 August		25 August		4 September	
Berry size	Kav.	Val.	Kav.	Val.	Kav.	Val.
Largest	314	354	180	358	406	402
Medium	126	178	142	124	270	158
Smallest	100	74	106	68	124	73
Average	180	202	143	183	267	211

Table 4 shows the pedicel detachment force of the afus-ali variety. The average pedicel detachment force increased gradually from 180 g to 267 g, and from 202 g to 211 g in Kavadarci and Valandovo respectively between August 14 and September 3.

Table 5 shows the chemical composition of the must of the afus-ali variety. The average sugar content in the must increased gradually from 128 g/dm^3 to 233 g/dm^3 and from 129 g/dm^3 to 204 g/dm^3 in Kavadarci and Valandovo respectively in the period from August 3 to September 4. Total acids decreased from 5.1 g/dm^3 to 3.0 g/dm^3 and from 7.7 g/dm^3 to 2.7 g/dm^3, while pH increased from 3.47 to 3.97 and from 3.27 to 3.94 in Kavadarci and Valandovo respectively.

Table 5. Chemical composition of must

	3 August		14 August		25 August		4 September	
Must properties	Kav.	Val.	Kav.	Val.	Kav.	Val.	Kav.	Val.
Sugar g/dm^3	128	129	135	126	174	182	233	204
Tot.acids g/dm^3	5,1	7,7	3,4	3,2	3,2	2,8	3,0	2,7
pH	3,47	3,27	3,53	3,52	3,60	3,61	3,97	3,94

Table 6 shows the mechanical composition of the must of the afus-ali variety. The average contents of the flesh did not change significantly in Kavadarci (91.4% – 91.7%) but it increased in Valandovo (89.6% – 90.5%). The percentage of skin increased from 6.6% to 8.3% and from 7.7% to 8.3% in Kavadarci and Valandovo respectively. The percentage of seeds decreased from 2.0% to 1.4% in Kavadarci and from 2.8% to 1.1% in Valandovo.

Table 6. Mechanical composition of berry

Berry components	3 August		14 August		25 August		4 September	
	Kav.	Val.	Kav.	Val.	Kav.	Val.	Kav.	Val.
Flash %	91,4	89,6	93,0	92,9	92,8	91,6	91,7	90,5
Skin %	6,6	7,7	5,1	5,0	5,1	6,5	8,9	8,3
Seeds %	2,0	2,8	1,8	2,1	2,1	1,9	1,4	1,1

Table 7 shows the correlation coefficients (r) between the dynamics of ripening of the afus-ali variety, expressed in days, and the grape characteristics. The dynamics of ripening of the grapes has a positive correlation with a high coefficient (r) pertaining to the cluster weight, r=0.91; grape weight, r=0.97; sugar content and pH, r=-0.9; and total acids, r=-0.85. The dynamics of ripening is not correlated with the percentage of flesh and skin of the berry.

Table 7. Coefficient of correlation (r)

	Cluster weight	Berry weight	Skin firmness	Pedicel detachment force	Sugar	Total acids	pH	Flesh %	Skin %	Seeds %
Days	0,91	0,97	-0,92	0,62	0,95	-0,85	0,95	0,14	0,40	-0,91

Conclusions

The mechanical composition, mechanical properties, and chemical composition of the grapes of the afus-li variety change in the period from veraison to full maturity. In both locations, Kavadarci and Valandovo, the average cluster and berry weight, pedicel detachment force, sugar contents and pH in the must increased significantly. At the same time, the skin firmness and total acid content decreased. Regarding the mechanical composition of the berry, the skin content increased while the seed content decreased. The value of these indicators will determine the use value of the grapes – whether to sell it on the market or store it in refrigerators.

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TECHNOLOGICAL CHARACTERISTICS OF SOME NEW PROKUPAC CLONES

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Abstract
The research carried out in experimental vineyard-collection at Faculty of Agriculture experimental field Radmilovac, which is located at GPS coordinates N 44º 45' 21" and E 20º 34' 53". Experimental vineyard is located at southeast part of Belgrade, at an altitude of 130 m and covers southern exposure. It belongs to Šumadijsko-velikomoravski vineyard area, Belgrade sub-region and Grocka vineyard region. Rows were extending in southeast-northwest direction with line spacing of 3 m and 1 m between vines in row. In experiment tested clones were under codes 40/2, 42/1, 43/1 and 43/3. From technological characteristics in paper is presented data related to weight of biomas discarded in pruning, yield, mechanical composition of berries and cluster, structural indicators of berries and bunches and qualitative parameters-sugar and acid content. The biggest mass of pruning shoots was determiner at clone 40/2 (1.008 kg/vine). The highest yield is recorded at clone 42/1 (7.1 kg/grapevine) and the smallest for clone 43/1 (3.6 kg/vine). Maximum cluster mass was recorded at clone 43/1 (276 g), whereas for clone 40/2 was determined the largest weight of berries meat (254 g) and the biggest seeds number per 100 berries (208). Clones 42/1 and 43/1 are characterized with the highest recorded skin weight of 100 berries (10 and 23 g/100 berry). Same trend was recorded for percent of stem, skin and seed in cluster. Clone 42/1 had the lowest percent of meat in berry (88.21%). According to sugar content were founded the highest level for clones 42/1 (24.1%) and 40/2 (22.4%). Same trend of variation is determined for acid content in grape juice.

Keywords: technological characteristics, berry, grape, clone, Prokupac.

Introduction

In recent years, great attention has been give to cultivation and conservation of autochtonous varieties. Prokupac is an Serbian autochtonous red wine variety. Vineyards raised with the Prokupac variety, which is also known as Rskavac, Kameničarka, Crnka and Niševka, is mostly spread throughout southern and central parts of Serbia, also in Macedonia (Skopsko crno) and Bulgaria (Zarcin). Prokupac it is characterized with big yielding capacity. Bunch could be classified as medium large, cylindrical or conical in shape, medium compact, berries are round or slightly oval with dark blue epidermis. Prokupac wine is refreshing and nicely red colored (Avramov and Zunic 2001, Zunic, 2010). First information about Prokupac breeding date from the fourteenth century (Zirojević, 1964). By clonal selection were separate 42 clones with different morphological and technological characteristics, 11 were recognized by Ministry of Agriculture as a technologically better clones compared to the standard variety and they are expanding into further production. (Markovic et al. 2013a). Clonal selection is important tool for grapevine genetic selection. In grape clonal selection main aims of selection are bigger cluster, excellent yield, bigger percent of berry skin, better grape quality express through sugar and acid content, stronger wine aroma and coloration, as well as genetic resistance to main pests and diseases. Clones from one grape variety can produce wines with different organoleptic characteristics, aromatic profile and phenolic content. Content of phenolic acids, stilbenes, flavonols, dihydroflavonols, anthocyanins, flavanol monomers (catechins) and flavanol polymers-proanthocyanidins can be affected directly by mechanical grape composition (Zivkovic et al. 2016). The objective of this study was to represent the yield, morphological and quality variability among clones of the autochthonous variety Prokupac.

Material and methods

The research carried out in experimental vineyard-collection at Faculty of Agriculture experimental field Radmilovac, which is located at GPS coordinates N 44º 45' 21" and E 20º 34' 53". Experimental vineyard is located at southeast part of Belgrade, at an altitude of 130 m and covers southern exposure. It belongs to Šumadijsko-velikomoravski vineyard area, Belgrade sub-region and Grocka vineyard region. Rows were extending in southeast-northwest direction with line spacing of 3 m and 1 m between vines in row. In experiment tested clones were under codes 40/2, 42/1, 43/1 and 43/3. From technological characteristics in paper is presented data related to weight of biomass discarded in pruning, yield, mechanical composition of berries and cluster, structural indicators of berries and bunches and qualitative parameters-sugar and acid content. Vegetative potential was determined by measuring of shoot mass during pruning. The obtained results give a clearer picture of real vegetative potential of vine. Ravaz's index is derived from ratio of grape yield to grape weight. For the *Vitis vinifera* L. Ravaz index can have values in range from 4-15, and this range is large but necessary because there is a different vine balance depending on training system and number of buds left during pruning. When is index values less than optimal, it indicates a small yield with a higher mass, if the value is above the upper, then is reverse. The yield per trunk is determined in technological grapes maturity by measuring of total clusters mass on scale type CAS-SHOLEX SHRE-122. The mechanical composition of the grapes and berries represents a varietal characteristic. The elements of the mechanical composition are subject to deviations under influence of ecological factors under which variety is cultivated. The mechanical composition of clusters and berries is characterized by the weight-ratio of certain elements, where elements of cluster composition are: cluster stem and berries, and elements of composition of berries are: berries skin, mezocarp and seeds. By values of mechanical composition of clusters and berries it is shown quality of grapes which has a special scientific and practical relationship. Practical significance is reflected in determination of percent of individual berries components, in particular berries skin and the mezzogarpa, which are main elements of quality of future wine. For purposes of testing mechanical composition of berries and clusters were selected five vines from which was harvested five representative clusters which are subjected. After clusters selecting it was measured their individual weight, length and width after which was carefully separate each berry from cluster stem without meat rest. With measuring on analytical balance was determined cluster mass, mass of all beres on cluster and cluster stem weight. Berries number was determined by counting. After that was selected 100 berries from which was separated epidermis and seeds. The seeds and epidermis mass was measured on an analytical balance. Seeds number was determined by counting. Other parameters were obtained by computation. The grapes quality was expressed through sugar content in grape which was examined by Oeshle mostwage and values were determined using Dujardin-Salleron tables. Total acid content was determined by titration method with n/4 NaOH.

Results and discussion

On basis of results obtained by measuring of cutting shoot mass it can be concluded that the largest average mass was recorded at clone 40/2 (1.008 kg/ vine), while the lowest value was observed at clone 43/1 (0.335 kg/vine). The higher average shoot mass for clone 40/2 indicates strong vigor versus clone 43/1, which had a smaller shoot mass, consequently, a lese vigor. The results are shown in table 1.

Table 1. Shoot mass removed by pruning

Clon	Shoot mass				
	Vine 1	Vine 2	Vine 3	Vine 4	Average
40/2	0.840	1.135	1.130	0.930	1.008
42/1	0.370	0.795	0.715	0.565	0.611
43/1	0.250	0.400	0.285	0.322	0.335
43/3	0.265	0.400	0.505	0.910	0.520

Ratio between yield and average shoot mass was calculated as Ravaz index. The highest index value was recorded for clone 43/1 (10.74), and the lowest for clone 40/2 (4.86). Other two clones were with approximately same values (10.19 and 10.74). High index values can be explained through lower yield and high values of the average shot weight. Shoot mass and vigor also can be affected to different rootstock (Markovic et al. 2012). The results are shown in table 2.

Table 2. Ravaz index

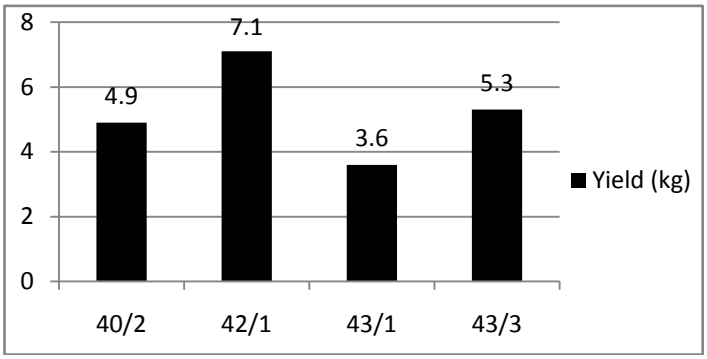
Clon	Yield per vine (kg)	Average shoot mass per vine (kg)	Ravaz index
40/2	4.9	1.008	4.86
42/1	7.1	0.611	11.62
43/1	3.6	0.335	10.74
43/3	5.3	0.520	10.19

Grapes yield depending of clone varied from 3.6 to 7.1 kg/vine. The highest yield, i.e. the highest grape mass per vine, was determined for clone 42/1, while average yield per hectare at planting density of 3333 vine per hectare for this clone was 23664 kg. Clon 43/1 had the lowest average grape weight per vine, which was 3.6 kg, ratio of average yield per hectare was 11998 kg. Clones 40/2 and 43/3 had approximately same yield values-4.9 and 5.3 kg, or 16331 and 17664 kg/hectare. Results are according to Markovic and Atanackovic (2013a).

Table 3. Grape yield of Prokupac clones

Clon	Yield per vine (kg)	Yield per ha (kg)
40/2	4.9	16331
42/1	7.1	23664
43/1	3.6	11998
43/3	5.3	17664

Existing differences between clones by yield/vine are shown in graph 1.



Graph 1. Yield per vine

The average clusters and berries mass of tested Prokupac clones varied from clones to clones. By study is founded that the largest cluster mass had a clone 43/1 (276 g), while the lowest was recorded for clone 43/3 (223 g). Clones 42/1 and 43/1 had same berries number in cluster (115), while the smallest number of berries were found for clone 43/3 (103). The results of measurements showed that clone 43/1 had the biggest berries mass (266 g) and the smallest 43/3 (213 g).
On the other hand, analysis of indicators of the mechanical composition and structure of berry resulted following results. The maximum weight of 100 berries was determined for clone 40/2 and was 269 g. The smallest mass was determined for clone 43/3 and was 231 g. By study was found that the largest mass of berries skin of 100 berry had clone 42/1 (23 g), while the smallest mass was

recorded for clones 40/2 and 43/3 (9 g). The weight of seeds in 100 berries varied in range from 6-7 g, so the highest mass was determined for clones 42/1 and 43/1 with 7 g, while a slightly smaller mass was recorded for clones 40/2 and 43/3 and it was 6 g. Clone 40/2 had the highest seeds number (208), while clone 43/3 had the smallest seeds number (159). Other two clones had approximately same seeds number (190 and 197). Relationship between seeds and berries skin is important parameter that can define quality of future wine, however, their given aromatic and color matter, as well as most tannins which are concentrated in these berries parts (Zivkovic et al. 2016). The results of mechanical composition of berries are shown in table 5.

Table 4. Indicators of mechanical composition and cluster structure

Clon	Cluste structure				Indicator of weight composition
	Cluster mass (g)	Berries number in cluster	Berries mass (g)	Cluster stem mass (g)	
40/2	243	106	233	10	23.3
42/1	254	115	247	7	35.2
43/1	276	115	266	10	26.6
43/3	223	103	213	10	21.3

Table 5. Mechanical composition and berries structure

Clon	Berries structure				
	100 berries mass (g)	Skin mass of 100 berries (g)	Seed mass of 100 berries (g)	Mesocarp mass of 100 berries (g)	Seed number in 100 berries
40/2	269	9	6	254	208
42/1	252	23	7	222	197
43/1	240	10	7	223	190
43/3	231	9	6	216	176

Clone 43/3 (4.48%) was allocated according to percent of stem in cluster. The highest value for percent of berries in cluster was determined for clone 42/1 and was 97.24%. For same parameter the lowest value was recorded for two clones 40/2 and 43/3-95.51% and 95.88%. Percent of berry skin is important parameter and indicator of oenological potential of variety, especially considering that many phenolic compounds are concentrated in berry skin. Clone which has the largest percent of berry skin in cluster is 42/1 (10.5%), which is significantly higher than other clones. The lowest participation berry skin in cluster was determined for clone 43/10 (4.10%). Based on study of seeds participation in cluster it can be concluded that value of seed content was approximately same for all examined clones. Clone with the largest mesocarp content in cluster was 43/1 with 89.45%, while clone with the lowest mesocarp content in cluster 42/1 was 83.78%. By study was found that the highest percent of solid residue was found for clone 42/1 and amounted to 16.22% and clones 40/2 and 43/1 had approximately similar values of solid residual (10.55% and 10.80%). By detailed study, clone with the highest values of structural indicator was 43/1 (8.47), and the lowest value of structural indicator is determined for clone 42/1 (5.16). Results of mechanical composition and cluster structure indicators are shown in table 6.

Table 6. Indicator of mechanical composition and cluster structure

Clon	Cluster structure						
	% of cluster stem	% of berries in cluster	% of berries skin in cluster	% of seed in cluster	% of mesocarp in cluster	% of solid residue	Structure indicator
40/2	4.11	95.88	3.94	2.74	89.19	10.80	8.25
42/1	2.75	97.24	10.50	2.96	83.78	16.22	5.16
43/1	3.62	96.37	4.10	2.82	89.45	10.55	8.47
43/3	4.48	95.51	4.30	2.55	88.65	11.34	7.81

By testing of mechanical composition and berry structure following results were obtained. Clone 42/1 was allocated on basis of the largest percent of berries skin (9.20%), but also the smallest mesocarp percent in berry (8.21%) and values for indicator of berry weight. Clone 43/1 was caracterised by the highest percent of seeds in berry (2.82%) and the minimum value for berry indicator (41.66). Clone 43/3 characterized itself with the smallest percent of berries skin (4.04%) and percent of seeds in berry (2.39%), but also the highest values for participation of mesocarp in berry (93.57%), berries indicator (46.18) and indicator of berry weight (23.17). Markovic et al. (2013 b) and Markovic and Atanackovic (2013 c) in research founded same results. The results are shown in table 7.

Table 7. Indicator of mechanical composition and berries structure

Clon	*Berries structure*				
	% of berries skin	*% of seed*	*% of mesocarp*	*Berries indicator*	*Indicator of berry weight*
40/2	*4.29*	*2.68*	*93.03*	*43.62*	*21.64*
42/1	*9.20*	*2.59*	*88.21*	*45.27*	*13.26*
43/1	*4.11*	*2.82*	*93.07*	*41.66*	*22.67*
43/3	*4.04*	*2.39*	*93.57*	*46.18*	*23.17*

Fact is that Prokupac as vine variety with strong oenological potential which is important parameter that can be monitored through sugar and total acids content in the grapes and through their relationship via glycoacidometric index. During alcoholic fermentation, biochemical processes take place, there is a series of physical and chemical changes which resulting wine production. Wine contains a large number of compounds that together contribute to overall quality, depending on the percentage of sugar and acid in the berry. Matthews et al. (2005) refers that grape and wine quality can be affected by berries size and yield. In table 8 are showed sugar content expressed in percent and total acid content expressed in g/l and values of glycoacidometric index are also shown.

Table 8. Sugar and total acid content and glycoacidometric index

Clon	Sugar content (%)	Total acid content (g/l)	Glycoacidometric index
40/2	22.4	6.7	3.34
42/1	24.1	6.9	3.49
43/1	20.0	6.7	2.98
43/3	17.6	6.0	2.93

The highest sugar percent was recorded for clone 42/1 (24.1%), while the lowest value for same parameter was recorded for 43/3 (17.6%). The highest total acid content was found for clone 42/1 (6.9 g/l), which is correlated with extremely low sugar content for this clone. The smallest total acid content was recorded for clone 43/3 (6.0 g/l). While the clones 40/2 and 43/1 had same total acid content in must (6.7 g/l). Values for glycoacidometric index varied in the range from 2.93-3.49. The lowest value is determined for clone 43/3 and the highest is determined for clone 42/1. Results was according to Markovic et al. (2013 b).

Conclusions

After research following conclusions can be made: the highest average shoot mass recorded for clone 40/2 which indicat strong vigor of this clone, whereas clone 43/1 had the lowest value for this parameter; the highest yield was recorded for clone 42/1, while the lowest yield was recorded for clone 43/1. Clones 40/2 and 43/3 did not differ significantly in for yield values; Based on analysis of mechanical composition of clusters and berries and calculated parameters can concluded: the maximum 100 berries weight was recorded for clone 40/2 and the smallest berries mass was determined for clone 43/3. The largest skin mass of 100 berries, mass of seeds in 100 berries and the

largest percent of skin in cluster had clone 42/1. Slightly smaller seed mass in 100 berries was recorded for clones 40/2 and 43/3. Clone 40/2 had the highest seed number, while clone 43/3 had the smallest number of seeds. According to percent of cluster stem clone 43/3 was singled out. Clone 43/1 had the highest percent of mesocarp in the cluster. According to qualitative parameters expressed through sugar content in grape juice clones 40/2 and 42/1 were singled out. The highest acid content was founded for clone 42/1, which is correlated with low sugar content of this clone. Values of glycoacidometric index varied in the range of 2.93-3.49.

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FRAJLA AND DIONIS, NEW GRAPE VARIETIES FOR ECOLOGIAL GROWING

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Abstract

Reducing pesticide use in vineyard production in order to preserve the environment and human health is possible by growing cultivars tolerant or resistant to fungal diseases. At the experimental field of University of Novi Sad, Faculty of Agriculture in Sremski Karlovci, during last four decades, several cycles of interspecies crossings were made, putting emphases on quality improvement and resistance maintenance. The research results of the last generation of new wine grape varieties Frajla and Dionis are presented. Using molecular markers, it was found that Frajla variety carries Rpv3 and Ren3 genes, while the variety Dionis carries Rpv3 and Rpv 12 genes. The presence of the genes Rpv3 and Rpv 12, (downy mildew resistance) and Ren3 (powdery mildew resistance), were confirmed in the field conditions. Biological and production characteristics of new varieties were observed during the period 2012-2016. Frajla (Vertes csillaga x Petra) is an early ripening variety (30. 08.), solid yield, with high sugar content in the must, and enough acids to produce high quality white wine, with discreet muscat aroma. Variety Dionis (Cabernet franc E11 x Panonia), is a late ripening (01. 10.), with solid productivity, accumulates high content of sugar in the must. Dionis demonstrated a high degree of tolerance to fungal diseases, resistance to frost and excellent quality of red wines. New varieties are recommended for ecological viticulture and winemaking.

Keywords: wine quality, resistance, frost, fungal diseases.

Introduction

Ecological production of grapes promotes production systems that respect the environment and protect the human health. In the last few decades, it has been more and more recognized. A decision which variety to grow is of paramount importance for successful and economical production of quality grapes. For more than 100 years, breeders all around the world have been working on making new varieties with resistance to biotic and abiotic stress factors and high grape quality. As a result, a huge number of resistant table and wine varieties was released. These interspecific hybrids, also known as pilzwiderstandsfähing (PWI), have resistance to main fungal diseases and have the grape quality as high as remarkable *Vitis vinifera* varieties (Alleweldt, Posingham, 1988; Csepregi, Zilai, 1989; Guzun i sar. 1990; Korać, Cindrić 1995; Bleich, 1998; Eibach, 2000;, Korać, Cindrić, 2004). Many of these varieties are successfully grown in ecological production systems (Korać et al, 2011). Since 1947, at the experimental field of Faculty of Agriculture, University of Novi Sad situated in Sremski Karlovci, several succesive grapevine breeding programs have been performed. In the last four decades, the priority is on making new fungus resistant varieties. The aim is the combination of resistant traits found in Asian or American *Vitis* species and quality traits found in the cultivated *Vitis Vinifera*. Using traditional breeding concepts 15 interspecies varieties were released and several genotypes are in the progress (Cindrić, Korać, 1990; Cindrić, 1995; Korać, Cindrić, 1995; Cindrić i sar., 1997; Korać, 1989; Korać i sar 2011). In the paper we presented biological and productive characteristics of new grapevine varieties Frajla and Dionis, which could be successfully grown in ecological production of grapes and wine.

Material and methods

The experiment was conducted in Sremski Karlovci (wine region Vojvodina, Serbia) at the experimental field of the Faculty of Agriculture, University of Novi Sad (45º10´ N, 20º10´ E, 130

Altitude) during 2012-2016. Planted at 2.8 x 1 m inter and intra row spacing the vines were trained to modified Guyot training system (a cane with 12 buds and a spur with 2 buds). New varieties Frajla and Dionis were investigated under ecological conditions, while the control varieties Neoplanta and Cabernet franc E11 were trained conventionally. There were 6 wines in the replication per variety. Frajla (Vertes csillaga x Petra) is a white skin variety released in 2015. The authors are P. Cindrić, N. Korać and V. Kovač. This mid-vigour, early ripening variety accumulates high sugar content in themust and is suitable for the production of dessert wines. The wines made from the Frajla have a slightly muscat aroma. In the field the variety has high frost-tolerance and resistance to the main fungal diseases and could be successfully grown with a reduced use of pesticides. Dionis (Cabernet franc E11 x Panonia) is a red skin variety released in 2017. The authors are: P. Cindrić, N. Korać and D. Ivanišević. It has many of the characteristics of its Cabernet franc parent and the wine of Dionis is high quality with fine phenolic structure. The berries are small without touching each other in the bunch. It is a late ripening variety resistant to low winter temperatures and also has resistance to the main fungal diseases. Neoplanta (Smederevka x Traminer) was control variety for Frajla during the process of approval. Neoplanta is *Vitis vinifera* variety with high quality aromatic wines. The variety is high vigour, mid-ripening with a satisfied yield. In the field Neoplanta is susceptibile to fungal diseases and low-winter temperatures. Cabernet franc is parent of Dionis, and therefore was selected during the process of approval.

Following analyses were performed:Three key phenological stages of grapevine were observed: BBCH-07- the beginning of budburst i.e. the date when green shoot tips became visible; BBCH-60- the beginning of flowering i.e. the date when first flower hoods were detached from the receptacle; and BBCH-80-the beginning of veraison i.e. the date when berries begun to develop variety-specific colour.The resistance to *Plasmopara viticola* and *Oidium tuckeri* was tested using IBPGR »Descriptors for grape«. 8.2.3 and 8.2.4. codes were applied for leaf and bunch resistance. The mark 1 presents high resistance while the mark 9 presents high susceptibility. For the *Oidium tuckeri* examination 8.2.5. (leaf resistance) and 8.2.6 codes (bunch resistance) were used. The mark 1 also presents high resistance while the mark 9 presents high susceptibility. The analysis for susceptibility to bunch rot was performed at the time of harvest and expressed in %. Wine sensory analysis were applied using a scale up to 20 and experienced tasters participated in the sessions. Productive characteristics (grape yield, sugar content and acidity in the must, bunch weight) were examined using standard methods (Cindrić 2000). DNA analyses of leaf samples were performed at the University of Udine in Italy. Genomic DNA was extracted using a CTAB-based method. CR reactions were carried out like Ivanišević et. al. 2014 published. The following markers was used to determine the presence genes: For Rpv3 gene was used markers UDV305 and UDV373, and interval marker UDV374 (Di Gaspero et al. 2012). For Rpv12 was used markers sc36_7 and UDV350 (sc81_9.1) (Venuti et al. 2013). For Ren3 was used markers VMC4D9-2 and VVIV67 (Welter et al. 2007). During the research period climate conditions were highly variable among the years. 2012 was hot and dry, with only 268 mm of rainfall. 2013, 2015 and 2016 were moderate with enough rainfall. On the other hand, 2014 was cold and rainy which negatively affected wine quality.

Results and discussion

Phenological observations

There were no big differences in the beginning of budburst (5 days), as well in the beginning of flowering (3 days). The difference in the beginning of the veraison was higher (9 days) compared to beginning of budburst and flowering. However, the biggest difference was observed in completation of grapes maturity (31 days). Frajla is an early ripening variety, while Dionis has a long ripening period.

Table 1. Phenological observations (Sremski Karlovci, Mean: 2012-2016.)

Variety	Date of the begining			Harwest date
	Budbreak BBCH-07	Flowering BBCH-60	Veraison BBCH-80	
Frajla	05.04.	21.05.	13.07.	30.08.
Neoplanta	07.04.	23.05.	17.07.	04.09.
Dionis	09.04.	21.05.	21.07.	01.10.
Cabernet franc	10.04.	23.05.	22.07.	01.10.

Resistance to the fungal diseases

Frajla and Dionis are highly torelant to booth fungal diseases (the marks 1, 3 and 5) and could be successfully grown without using of pesticides, or at least with less number of spraying against *Plasmopara viticola* and *Oidium tuckeri* (Table 2). These results are in agreement with previous research (Korać et al, 2011 and Ivanišević et al, 2012).

Table 2. Susceptibility to fungal diseases (Sremski Karlovci, Mean 2012-2016.)

Variety	*Plasmopara viticola*		*Oidium tuckeri*	
	Leaf	Bunch	Leaf	Bunch
Frajla	5	3	3	3
Neoplanta	7	7	7	7
Dionis	3	1	3	3
Cabernet franc E11	7	7	7	7

Productive characteristics

In the ecological production system, booth varieties had a medium yield but without significant differences compared to control varieties. The Frajla had significantly lower bunch weight than Neoplanta as well as Dionis compared to Cabernet franc E 11. Results showed that Frajla has high potential for sugar accumulation, significantly higher compared to control variety Neoplanta (Table 3). Frajla also had higher must acidity compared to the control. On the other hand, Dionis had sugar and acids content as high as Cabernet franc E11. Susceptibility to bunch rot was at the acceptable levels for booth varieties. Varieties Frajla and Dionis produce high quality wines.

Figure 1. Heritage basis of the variety Frajla

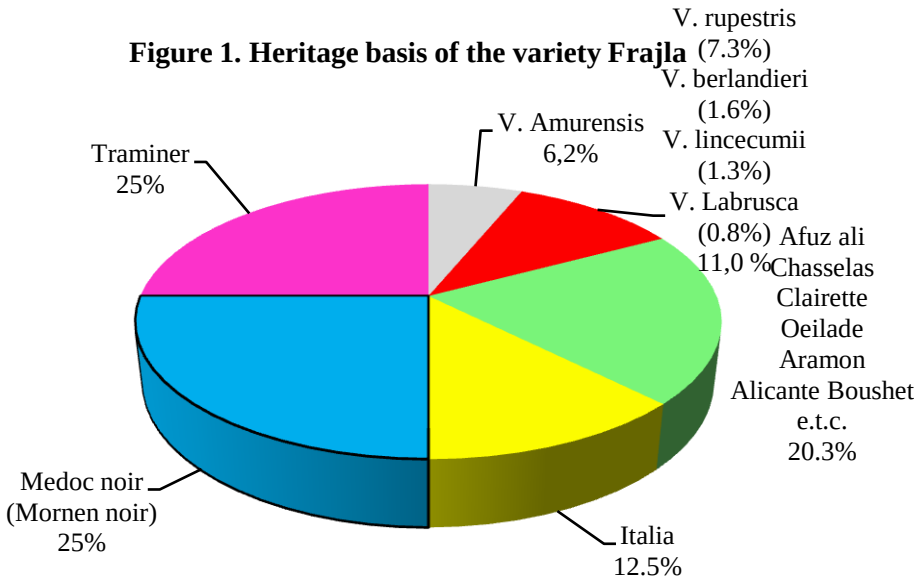

Table 3. Grape yield and quality (Sremski Karlovci, Mean: 2012.-2016.)

Cultivar	Year	Grape yield (kg/m^2)	Bunch weight (g)	Sugar in must (%)	Acidity in must (g/l)	Botrytis (%)	Wine sensory analysis (up to 20)
FRAJLA	2012	0.97	80	27.4	7.9	0	18.7
	2013	0.87	140	25.7	8.1	0	18.5
	2014	1.02	177	20.5	8.7	13	18.3
	2015	0.90	80	26.7	8.7	0	17.9
	2016	0.83	140	27.4	9.1	0	18.7
	Average	0.92 ± 0.1 [a]	123 ± 42 [b]	25.5 ± 2.9 [a]	8.5 ± 0.5 [a]	2.6 ± 5.8 [b]	18.4 ± 0.3 [a]
NEOPLANTA (control)	2012	0.71	154	22.9	3.8	0	17.8
	2013	1.18	203	18.9	4.9	13	18.3
	2014	1.04	227	17.7	6.9	23	17.7
	2015	1.19	177	17.6	4.8	0	16.7
	2016	1.73	283	18.6	6.9	5	17.8
	Average	1.17 ± 0.4 [a]	209 ± 50 [a]	19.1 ± 2.2 [b]	5.5 ± 1.4 [b]	8.2 ± 19.8 [a]	17.7 ± 0.6 [b]
DIONIS	2012	0.83	150	26.5	6.4	0	18.4
	2013	1.48	170	24.7	5.3	3	18.2
	2014	1.01	160	23.3	4.7	20	-
	2015	1.02	160	21.7	4.7	1	17.8
	2016	1.24	183	24.7	6.9	15	18.9
	Average	1.12 ± 0.2 [a]	165 ± 12 [ab]	24.2 ± 1.8 [a]	5.6 ± 1.0 [b]	7.8 ± 9.1 [a]	18.3 ± 0.5 [a]
CABERNET FRANC E11 (control)	2012	1.21	220	24.3	6.0	0	18.5
	2013	1.30	240	20.8	5.6	0	18.0
	2014	1.28	135	19.3	7.3	3	-
	2015	0.70	225	23.8	4.2	3	17.8
	2016	1.30	133	24.5	5.9	15	18.4
	Average	1.16 ± 0.3 [a]	191 ± 52 [a]	22.5 ± 2.3 [a]	5.8 ± 1.1 [b]	4.2 ± 6.2 [a]	18.2 ± 0.3[ab]

[a,b] The values marked with different lower-case letters are statistically significantly different for the significance treshold of 0.05 (LSD test)

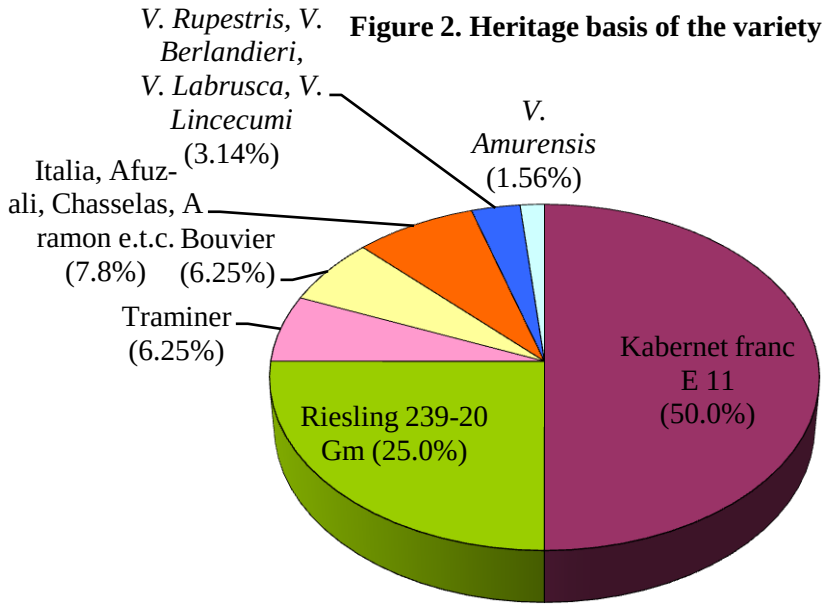

Figure 2. Heritage basis of the variety Dionis

Genetic background and DNA profiles of the varieties Frajla and Dionis

Frajla has 82.8 % genes that originated from several Vitis vinifera varieties, 11 % belong to the American species while 6.2 % of the genes are related to *Vitis amurensis*.

The portions of *Vitis vinifera* genes and those originated from wild ancestors are presented in the Figure 1. In the heritage basis of Dionis wild genes account with only 4,7%, while 95.3 % of the genes originated from several *Vitis vinifera* varieties (Figure 2).

Detection of the genes related to the resistance to *Plasmopara viticola* and *Oidium tuckeri* confirm their resistance in the field (Table 4).

Table 4. Present genes

Genotype	Gene
Frajla	Rpv3, Ren3
Dionis	Rpv 3, Rpv12

Conclusions

The results showed that new grapevine varieties Frajla and Dionis in the ecological production system are mid-yield varieties with high quality grapes. White skin variety Frajla is an early ripening, with high potential for sugar accumulation and high quality wine. Red grapevine variety Dionis is late-ripening with satisfied yield with the wine quality at the level of Cabernet franc. Booth varieties could be successfully grown with reduced use of pesticides and it is confirmed with the presence of the genes related to the fungal resistance. Therefore, these varieties constitute a valuable genetic material and would be included in further breeding programs.

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THE INFLUENCE OF VARIETY AND VINTAGE ON THE CHEMICAL COMPOSITION AND SENSORY PROPERTIES OF RED WINES IN PODGORICA SUBREGION (MONTENEGRO)

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Abstract

This paper presents the results of investigation of the influence of variety and vintage on the chemical composition and sensory properties of Vranac, Kratosija and Cabernet Sauvignon wines in Podgorica subregion (Montenegro) in vintages 2012 and 2013. The varietal wines were produced from the grapes grown at four different localities, according to a uniform manner (traditional method) in the winery of the Biotechnical Faculty, located at the experimental farm in Podgorica, at the vineyard location of Ljeskopolje. The analysis of basic chemical parameters of wines and sensorial testing of wines were carried out. The research findings show that variety and vintage (climatic conditions) significantly affected the chemical composition of wine. The higher content of alcohol and extract was measured in 2012 vintage, while the total acid content in wine was higher in 2013, as a result of frequent rainfall during the growing season, especially in August and September. The highest content of alcohol, extracts and total acids was found in Kratosija wine, then in Cabernet Sauvignon, while the lowest content was found in Vranac wine in both vintages. According to sensory properties and average testing score for the two years of research, all wines fall into the category of superior wines.

Keywords*:* red wine, Vranac, Kratosija, Cabernet Sauvignon, locality.

Introduction

Chemical composition and organoleptic or sensory properties of wine determine its quality. The chemical composition of wine, as well as the chemical composition of grapes and must is very complex and rich. The quantity of individual ingredients and the ingredients ratio affect significantly the quality of the future wine. The main quality indicators of the must and future wine quality are the concentration of sugar and total acidity in grapes. (Pajovic et al. 2013, Raicevic et al. 2015). The sensory properties of wine are important wine quality indicators. Using the sense of sight, the sense of smell (olfactory evaluation) and the sense of taste (gustatory evaluation), we assess wine clarity and color, as well as its smell and taste, i.e. we determine wine sensory profile. (Raicevic et al. 2012, Pajovic et al. 2013). There are several factors, including grape variety, that influence wine chemical composition and sensory profile. Vranac is the leading variety of grape in Montenegro (Ulicevic, 1966, Pejovic, 1987, Bozinovic, 2005, Popovic et al. 2013). In Montenegro, red wines are produced predominantly, and Vranac accounts for nearly 80% of these wines, followed by Kratosija and Cabernet Sauvignon. Vranac is the dominant grape among red grapes, whereas Kratosija is decreasing and Cabernet Sauvignon is increasing (Pajovic et al. 2014). Vranac variety is characterized by a high good phenolic content, as previous published for Vranac grape and wines grown and produced in Montenegro and R. Macedonia, (Pajovic et al. 2014, Raicevic et al. 2014, Ivanova-Petropulos et al. 2015). Vranac variety is characterized by a high alcohol and extract content and a low total acids content, while Kratosija wine has a high content of all these parameters (Pajovic et al. 2016). Climatic conditions and soil are also important factors that affect the yield and quality of grapes, and therefore the chemical and polyphenol composition of wine (Ribereau- Gayon, 1982, Lee et al.2009, Chira et al. 2011, Roullier-Gall et al. 2014, Popovic et al. 2016). The average atmospheric temperature decrease means low sugar level and increased total acids content in grapes, and later in wine. (Fregoni, 1973, Ranković - Vasić et al. 2011).

This study examined the effects of variety, harvest and climate as crucial *terroir* elements on chemical composition and the sensory properties of Vranac, Cabernet Sauvignon and Kratosija wines (in the period 2012-2013) produced from grapes grown at four representative localities in the Podgorica subregion.

Materials and methods

Meteorological data processing

The monthly mean minimum and maximum temperature (° C), the average monthly rainfall (L/ m²), the average monthly relative humidity (%) and number of rainy days (rainfalls ≥ 01 mm) in the vegetative stage (from 1 April until harvest time) were analysed.Hydro-meteorological data are taken over from the Hydro-meteorological Institute of Montenegro while monitoring, recording and collection of these data have been carried out by hydro- meteorological stations (MONSTAT 2013 and 2014).

Samples and winemaking process

The tested wines were produced from the grape varieties Vranac (n = 3), Kratosija (n = 3), and Cabernet Sauvignon (n = 3). The harvest was done at the time of technological maturity (21–23 Brix), between 5 and 20 September in 2012 and 2013. Grape was (20 kg) sampled in vinayaerd from 4 localites (Sipcanik (L1), Rogami (L2), Ljeskopolje (L3), Kokoti (L4). The localities belong to Podgorica subregion and lie in the range from 25 and 50 m above sea level. Vineyard characteristics are presented in Table 1.

Table 1. The characteristics of the vineyards from which grapes were sampled

Locality	Rootstock	Planting year	Plant density	Training system	Row
Vranac					
L1	Kober 5BB	1978	4 274 (2.6 x 0.9 m)	Double Guyot	north –
L2	Teleki SO4	2006	6 211 (2.3 x 0.7m)	Single Guyot	north - south
L3	Kober 5BB	2005	4 000 (2.5 x 1.0 m)	Double Guyot	north - south
	Kratosija				
L1	1103 Paulsen	2006	5 495 (2.6 x 0.7 m)	Single Guyot	north - south
L2	Teleki SO4	2006	6 211 (2.3 x 0.7m)	Single Guyot	north - south
L3	Kober 5BB	2005	4 000 (2.5 x 1.0 m)	Double Guyot	north - south
	Cabernet Sauvignon				
L1	1103 Paulsen	2006	5 495 (2.6 x 0.7 m)	Single Guyot	north - south
L2	Teleki SO4	2006	6 211 (2.3 x 0.7m)	Single Guyot	north - south
L4	Kober 5BB	2008	5 714 (2.5 x 0.7 m)	Single Guyot	north - south

The same vinification conditions were provided for the all tested varieties. The vinification was conducted by applying the classical technique (spontaneous fermentation). After destemming and crushing the grapes, the pomace was put in plastic fermentation tanks. The potassium metabisulfite was added to pomace (5g of SO2 to 100 kg of grapes). The cap was punched down manually. The fermentation lasted an average of seven days at a temperature between 25 and 28°C. After fermentation, the wine decantation into the vessels for wine aging was performed. After the spontaneous malolactic fermentation, the wine was decanted again and necessary amount of SO2 was added. The wines are produced in three repetitions of each variety and each locality. The analysis of wine was performed four months after fermentation.

Proximate chemical composition of wines

The following parameters: alcohol, total acidity, volatile acidity, total and free SO2, dry extract and pH, were analyzed according to the official methods of analysis of wines (OIV. 2011)

Sensorial analysis

The wines from the 20012 and 2013 harvest season were subjected to sensory evaluation by the method of 100-point O.I.V. / U.I.O.E. method: max. 15 points for clarity, max. 30 points for bouquet, max. 44 points for flavor and max. 11 points for harmony (OIV, 2009). The OIV point scoring method comprises the following wine categories: table wine without geographical indication score 60 to 64.99; table wines with controlled geographical indication score 65 to 74.99; quality wines with controlled geographical origin score 75 to 84.99; superior wine scoring more than 85. Organoleptic evaluation was carried by a tasting committee consisting of 6 members.

Statistical analysis

Data was processed by ANOVA (p indicated) and, when significant, the means were separated using Tukey's honest significant difference (HSD) test ($p < 0.05$). Statistical analysis was performed using the StatSoft, Inc. (2003) Statistica.

Results and discussion

Meteorological data during the research period

The average vegetation temperature in the Podgorica district in the basin of Lake Skadar was 24.3 °C and 23.4°C, whereas the precipitation in the same vegetation period (from 1 April until harvest time) was 102.6 L/m^2 and 112.5 L/m^2, relative humidity was 51.2 and 53.3 % and number of rainy days was 7.5 and 9.3 in 2012 and 2013, respectively (MONSTAT 2013, 2014). Meteorological data for Podgorica sub region during the growing season (April-September) are given in Table 2.

Table 2. Meteorological data for Podgorica, during the growing season (April-September)

	AVERAGE MONTHLY AIR VAZDUHA (º C), TEMPERATURE (º C)						
	April	May	June	July	August	September	average
2012	14,5	19,9	27,3	30,4	29,7	23,9	24.3
2013	17,1	20,1	24,5	28,5	28,8	21.3	23.4
	MONTHLY TEMPERATURE (absolute max.) (º C)						
2012	31,1	33,5	38,3	40,7	44	36.1.	37.3
2013	32,6	34,1	38,4	39,4	41,3	31.9	36.3
	MONTHLY TEMPERATURE(absolute min) (º C)						
2012	0,4	10,7	14,9	19,6	17,7	10.9	13.4
2013	8,6	10	11,3	16,9	18,5	11.1	12.4
	MONTHLY PRECIPITATIONS (L / m²)						
2012	351,2	132	33,7	11,3	0,5	86.6	102.6
2013	101.2	211.2	51	10,3	123,1	178,4	112.5
	AVERAGE MONTHLY RELATIVE AIR HUMIDITY (%)						
2012	70	59	48	41	36	53	51.2
2013	60	62	54	40	44	60	53.3
	NUMBER OF RAINY DAYS (rainfalls ≥ 0,1 mm)						
2012	21	12	2	2	2	6	7.5
2013	10	15	9	6	7	9	9.3

If we compare the years of research, it may be concluded that during the growing season (from 1 April until the harvest time), the year 2012 was warmer than 2013. At the same time, the mean annual minimum and maximum temperature as well as the mean temperature during the 2012 growing season was higher. The average precipitation during the 2013 growing season was 9.9 L/m^2 higher than in 2012, while in August and September it was even 214.4 L/m^2 higher than in the previous year. The average monthly humidity was 2.1% higher. There were more rainy days during the 2013 growing season than during 2012, and even twice more during August and September.

The impact of the vintage year on chemical composition of wine
The analyzed parameters of chemical composition of Vranac, Kratosija and Cabernet Sauvignon are shown in Table 3.

By observing the vintage years, the higher alcohol, total extract and reducing sugar content as well as the higher pH value, a decrease in total acid contents is recorded in 2012, when compared to the year 2013. The lower content was observed in all cultivars from all localities and that was the result of higher average air temperature and low precipitation in the growing season of the research year, which is consistent with previous studies conducted by Fregoni, 1973, Ranković - Vasić *et al.* 2011, Popovic et al.2016. The vintage year has a statistically significant influence on all parameters in wine, except on reducing sugar.

The impact of grape variety on chemical composition of wine
Based on tabular overview of chemical composition of the investigated wines, it can be seen that Kratosija wine has the highest average alcohol content in 2012 and 2013 respectively, but also on average for both years of research (13.7% vol) and the highest total extract content (30.6 g / L). It is followed by Cabernet Sauvignon (13.2 vol% and 29.9 g / L), while the lowest content of alcohol (13% vol) and total extract (29.7 g / L) was found in Vranac wine. The obtained alcohol and extract values confirmed the values recorded by Pajović et al. 2016, who analysed the wines of small private producers. In the research period from 2007 to 2013, the average value of the alcohol and extract in wines were as follows: in Vranac wine (14.0 vol% and 28.0 g/l), in Kratosija (14.6 vol% and 32.2 g/l), while in Cabernet Sauvignon (13.9 vol% and 27.5 g/l). In the research period from 2008 to 2010, Raičević et al. 2012 obtained the average value of the alcohol in Vranac (14.2 vol%), and the value of extract (30.5g / l). However, the values obtained in this study are different, i.e. higher than the values obtained by Pejović, 1987. The values of alcohol (12.5vol%) and extract (23.87g/l) in Vranac wine and values of alcohol in Kratosija (11.50 to 13:00 vol%) (Pejovic,1988) and in Cabernet Sauvignon (10.9 vol%) (Pejovic et al.1996). The average amount of total acids in wines varies from 5.1 gr/l in Vranac and 5.8 g/L in Cabernet Sauvignon to 6.9 g/L in Kratosija. The values of total acids are within the limits stated by Pajović et al (2016) and range from 5.2 g/l in Vranac and Cabernet Sauvignon to 6.2 g/l in Kratošija. Similar values of total acids in Vranac were obtained by Pejović, 1987 (5.1 g/l) and Raičević et al. 2012 (6.2 g/l). In regard to the amount of reducing sugar, all wines belong to the category of dry wines (up to 4 g/l). The volatile acidity showed an overall average value of 0.46 to 0.65 g/L with no influence on the quality of wines that was protected from further oxidation and microbial contamination by the free SO2 present in a sufficient level in the wines (24.2 to 26.9 mg/L). The average total acidity content and pH values were significantly different ($p \leq 0.001$) in wines from all the 3 grape varieties. Based on the determined parameters of the chemical composition of the investigated wines, it may be concluded that all wines are typical for the investigated grape varieties and for the Podgorica region climate, and they are all characterized by a high alcohol and extract content (Ivanova et al. 2012, Raicevic et al. 2012, Kosmerl et al. 2013, Pajovic et al. 2013).

Table 3. Chemical characteristics in four-month-old wines from Vranac, Kratosija and Cabernet Sauvignon from the 2012 and 2013 vintages

	2012							2013						
Locality	Alcohol (%vol)	Total extract (g/l)	Reducing sugar (g/l)	Titratable Acidity (g/l)	Volatile acidity (g/l)	Free SO_2 (mg/l)	pH	Alcohol (% vol)	Total extract (g/l)	Reducing sugar (g/l)	Titratable Acidity (g/l)	Volatile acidity (g/l)	Free SO_2 (mg/l)	pH
Vranac														
L1	13.5	31	2.3	4.8	0.5	25.3	3.49	12.9	29	2.03	5.2	0.61	26.2	3.37
L2	13	29.9	3	5.1	0.55	25.6	3.45	12.1	27.7	2.1	5.6	0.65	26.7	3.33
L3	13.7	32	2.5	4.6	0.56	25	3.5	12.8	28.6	2.3	5.4	0.6	25.8	3.36
Mean	**13.4**±0.29^{A}	**30.97**±1.14^{A}	**2.6**±0.23^{A}	**4.8**±0.21^{A}	**0.54**±0.03^{A}	**25.3**±0.93^{A}	**3.48**±0.03^{A}	**12.6**±0.4^{B}	**28.4**±0.62^{B}	**2.14**±0.07^{B}	**5.4**±0.17^{B}	**0.62**±0.04^{B}	**26.2**±0.40^{B}	**3.35**±0.02^{B}
Kratosija														
L1	13.3	29.6	3.2	7.1	0.53	25.1	3.23	12.8	28.6	2.2	7.5	0.62	25.8	3.25
L2	14.5	32.8	3.15	6.7	0.46	25	3.31	13	29.5	2.25	7	0.59	24.9	3.29
L3	14.8	33.9	3.4	6.3	0.49	24.3	3.35	13.5	30.9	2.34	6.8	0.55	25.8	3.29
Mean	**14.2**±0.31^{A}	**32.1**±1.15^{A}	**3.25**±0.31^{A}	**6.7**±0.33^{A}	**0.49**±0.02^{A}	**24.8**±0.91^{A}	**3.30**±0.021^{A}	**13.1**±0.31^{B}	**29.7**±0.67^{B}	**2.26**±0.09^{B}	**7.1**±0.25^{B}	**0.59**±0.03^{B}	**25.5**±0.35^{B}	**3.28**±0.013^{B}
Cabernet Sauvignon														
L1	13.5	31.6	2.32	5.4	0.53	24.5	3.44	12.7	28.7	2.21	6.1	0.63	26.7	3.31
L2	13.4	29.7	2.17	6	0.47	25	3.37	12.4	27.5	2.25	6.3	0.57	26.9	3.32
L4	13.9	32	2.42	5.2	0.49	24.2	3.45	13	29.8	2.4	5.9	0.61	25.9	3.32
Mean	**13.6**±0.30^{A}	**31.1**±1.10^{A}	**2.30**±0.21	**5.5**±0.30^{A}	**0.50**±0.03^{A}	**24.6**±0.90^{A}	**3.42**±0.02^{A}	**12.7**±0.4^{B}	**28.7**±0.62^{B}	**2.29**±0.09^{B}	**6.1**±0.25^{B}	**0.60**±0.04^{B}	**26.5**±0.41^{B}	**3.32**±0.02^{B}

ANOVA was used to compare data (n.s. not significant, a,b, $p \leq 0.05$, A,B $P \leq 0.001$). Different lower-case letters indicate significant differences of means between varieties using Tukey's HSD test ($p \leq 0.05$).

Table 4. The average chemical composition of Vranac, Cabernet Sauvignon and Kratosija wine for the year 2012/2013

The average for 2012/2013	Alcohol (% vol)	Total extract (g/l)	Reducing sugar (g/l)	Titratable Acidity (g/l)	Volatile acidity (g/l)	Free SO_2 (mg/l)	pH
Vranac	13.0 ±0.29^{A}	29.7±1.11^{A}	2.37±0.31^{A}	5.1±0.27^{A}	0.58±0.04	25.8±0.44	3.42 ±0.05^{A}
Kratosija	13.65±0.44$^{A\ B}$	30.9± 1.46^{B}	2.76±0.43^{B}	6.9±0.43^{B}	0.54±0.03	25.2±0.28	3.29 ±0.04^{B}
Cabernet Sauvignon	13.15±0.34^{A}	29.9± 1.62^{A}	2.30±0.36^{A}	5.8±0.31^{C}	0.55±0.03	25.5±0.52	3.37±0.03^{C}

ANOVA was used to compare data (n.s. not significant, a,b,c $p \leq 0.05$, A,B,C $P \leq 0.001$). Different lower-case letters indicate significant differences of means between varieties using Tukey's HSD test ($p \leq 0.05$).

Considering the results obtained, it may be concluded that, statistically, the grape variety has the most significant influence ($p \leq 0.001$) on total acid content and pH value, while it has no statistically significant effect on volatile acids and free SO2 content. The average content of alcohol, extract and reducing sugar is significantly higher in Kratosija wine than in the other two varieties, while there is no statistically significant difference between these parameters values in Vranac and Cabernet Sauvignon. The results obtained in this research confirm the high impact of the grape variety on the investigated parameters, as was ascertained by previous research (Pajović et al. 2014, Ivanova-Petropulos et al. 2015, Raičević et al. 2015) on these varieties in Montenegrin and Macedonian region.

Sensory evaluation of wines

The average tasting score of wine for the two years of research is given in Table 5.

Table 5. The sensory properties of Vranac, Kratosija and Cabernet Sauvignon wine

	APPEARANCE (max 15)	BOUQUET (max 30)	FLAVOUR (max 44)	Harmony/ Overall evaluation (max 11)	TOTAL (max 100)
Vranac					
2012	12.6	25.7	37.8	8.8	84.9
2013	13	26	38.2	9.4	86.6
Mean	12.8	25.9	38	9.1	85.8 ±0.89^{A}
Kratosija					
2012	12.5	25.4	37.6	8.7	84.2
2013	12.8	25.8	38	9.3	85.9
Mean	12.7	25.6	37.8	9	85.1 ±0.74$^{A\ B}$
Cabernet Sauvignon					
2012	12.7	25.9	37.8	8.9	85.25
2013	13.1	26.1	38.3	9.4	86.8
Mean	12.9	26	38.0	9.2	86.0 ±0.99^{A}

ANOVA was used to compare data (n.s. not significant, a,b,c $p \leq 0.05$, A,B,C $P \leq 0.001$). Different lower-case letters indicate significant differences of means between varieties using Tukey's HSD test ($p \leq 0.05$).

When it comes to appearance of the tested wines, there was no statistically significant difference between the average testing scores during the two years of research. The results ranged from 12.7 to 12.9. However, if we look at each year respectively, Cabernet Sauvignon produced in 2013 got the highest average score (13.1). Bouquet and flavour got the similar testing scores. The average scores for both years of research range from 25.6 to 26 for bouquet and from 37 to 38 for flavour. Cabernet Sauvignon produced in 2013 was the best ranked wine with the score (26.1 and 38.3). The average sensory score for harmony, for the two researched years, range from 9 to 9.2, with the highest score (9.4) achieved by Vranac and Cabernet Sauvignon in 2013. Cabernet Sauvignon got highest average sensory score (86 points). It is followed by Vranac wine (85.8), while Kratosija wine got the lowest

average score (85.1 points). Based on the evaluation of sensory properties, the influence of the vintage is obvious. The wines produced 2013 got a better average score (86.4) in relation to the wines produced in 2012 (84.7). The best ranked wine was Cabernet Sauvignon in 2013 (86.8). According to sensory properties and average testing score for the two years of research, all wines fall into the category of superior wines. Previous research on Vranac wine conducted by Pajović et al.2013 also proved that the vintage year significantly affected the quality of wine and most of the Vranac wines were categorized as superior wines, with the total sensory scores ranged from 85.1 to 88.7.

Conclusions

This paper presents the results of the investigated wines - Vranac, Kratosija and Cabernet Sauvignon. The study results of chemical composition and sensory evaluation of wine sampled from four localities in Podgorica subregion were analyzed.Based on the results obtained during the course of two years, it can be concluded that:

- There are favorable environmental conditions for wine grapes growing and winemaking in Podgorica subregion.
- The influence of the vintage year, i.e. the influence of climatic conditions has statistically significant effect on the total acid content and pH value, but it has no statistically significant effect on volatile acids and free SO2. The average content of alcohol, extract and reducing sugar is significantly higher in Kratosija wine than in the other two varieties, while there is no statistically significant difference between these parameters values in Vranac and Cabernet Sauvignon.
- The higher alcohol and total extract content was recorded in investigated wines in 2012 which can be associated with a higher mean annual air temperature and mean air temperature in the growing season. The total acid content in the year 2012 was lower than in 2013 because of the higher rainfall in August and September 2013.
- The highest average content of alcohol, extract, reducing sugars and total acidity was found in Kratosija wine, then in Cabernet Sauvignon, while the lowest content was registered in Vranac wine. Kratosija wine has a lower pH value compared to Vranac and Cabernet Sauvignon.
- The grape variety has a high statistical influence on all investigated parameters, except on the content of volatile acids and free SO2.
- All investigated wines belong to the category of superior wines. Sensory evaluation has shown that Cabernet Sauvignon and Vranac wine were the highest ranked (no significant difference), while the Kratosija was the lowest ranked wine.

While differences were observed, similar trends were apparent that could be further examined and validated in other wine varietals.

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IMPACT OF THE NUMBER OF CLUSTERS ON CARDINAL VARIETY PRODUCTION RESULTS

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Abstract
The Cardinal variety is a leading very early ripening table grape variety in the Republic of Macedonia. The grape quality largely depends on the applied production technology. The aim of our research is to determine the impact of the number of retained clusters per m^2 on the production results of the Cardinal variety, grown on pergola tendon trellis (odrina) system in the Gevgelija - Valandovo wine region. The load of 3, 4, and 5 clusters/m^2 respectively was noted. Based on the results, we found a significant impact of the number of clusters on the yield, dynamics of ripening, and quality of grapes. By increasing the number of clusters, the weight of the cluster decreased from 489 g in the 3 clusters/m^2 variant to 446 g in the 5 clusters/m^2 variant. The weight of the berry ranged from 7,6 g in the 5 clusters/m^2 variant to 8,4 g in the 3 clusters/m^2 variant. Total weight of packaged grapes ranged from 1,4 kg/m^2 for the 3 clusters/m^2 variant to 1,9 kg/m^2 for the 5 clusters/m^2 variant. There was a significant difference in the dynamics of ripening, i.e., the quantity of packaged grapes in the first harvest. The highest weight of 1,55 kg/m^2 of packaged grape in the first harvest was obtained from the variant with 4 clusters/m^2, and the lowest of 1,29 kg/m^2 from the 3 clusters/m^2 variant. The best quality of 9.6 points was observed in the variant with 3 clusters/m^2 and the lowest of 7.9 points in the grapes of the variant with 5 clusters/m^2. From these results, it can be concluded that the best results for the Cardinal variety are obtained by leaving 4 clusters per m^2.

Keywords: Table grape, production tehnology, yield, dinamics of rippening, organoleptic evaluation.

Introduction

The production of table grapes in R. Macedonia has a long tradition. Our country has suitable soil and climate conditions, infrastructure, human resources etc. Within the past few years, new knowledge in this area is followed and implemented, especially the assortment, the growing systems, technology of production etc. As a result, nowadays in our country there are modern plantations of table grape, equipped with irrigation systems, protective nets, grape packaging and storage premises etc. Cardinal variety is a leading, very early table variety in R. Macedonia. It characterizes with high fruiting potential and average yields. As a variety, it features many particulars in the production itself and it requires application of ample-technical measures in order timely and equal ripening, as well as reaching high yield and quality. As of the very competitive market, which mostly arises from the customer's demands, only by following and application of the newest production methods we will remain the leading country in the production of table grape in the region.

Material and methods

The examinations have been performed in viable plantations in Gevgelija- Valandovo wine-growing region, at the Chaparica locality. The Cardinal variety has been examined, on a plantation which is fully fruitful, 10 years old and has an irrigation-system-pergola. 4 variants have been examined: St, I, II and III, which differed in the number of left bunches per vine (or m^2). Reduction of bunches of grapes has not been made at the variant St, i.e. all bunches of grapes that had grown were left on it. 3 bunches of grapes were left per m^2 at the variant I, at the variant II 4 bunches of grapes per m^2, i.e.

5 bunches of grapes per m^2 at the variant III. Despite the Standard, ample-technical measures have been implemented at the other variants: removal of double rods, leaving of two bunches of grapes per rod at the most, pinching out, defoliation etc.
The following examinations have been performed at each variant: average weight of bunch and berry, average mass of grape, yield (packaged grape and waste), dynamics of harvest, and degustation rate. Examination of technological characteristics has been performed according to an elaborated scheme by Prof. Dr. Zvonimir Bozhinovikj (Ampelography, 2010). The quantity of harvested grape is established per vine and per hectare. Thereto, there are two categories: packaged grape and waste. The dynamics of harvest has been established from the quantity of harvested grape within the I and II harvest, given in kg/$m^{2.}$ Degustation rating has been made with application of a ten-point system whereto with the sense of sight, smell and taste the following elements have been rated: external appearance, consistence, taste and originality. On basis of the degustation rating a classification of the grape in categories (classes) has been made.

Results and discussion
The obtained results for the impact of the implemented ample-technical measures on the mass of the bunch of grape at the Cardinal variety are presented in table 1.

Table1. Average mass of a bunch of grape at Cardinal variety in g

Year	Variant			
	St	I	II	III
2015	484	536	528	485
2016	392	442,5	439,3	406,9
2015/16	438	489,3	483,7	446
Index	100	111,7	110,4	101,8

The average mass of a bunch of grape for the examined years ranges from 438 g at the ST variety to 489, 3 g at the I variety.
On basis of the obtained data, it has been concluded that the influence of the reduction of the number of bunches of grapes per vine reflects on the average mass of the bunch of grape. Variant I characterizes itself with the largest average mass of the bunch of grape where an increase of 11,7 % in relation to the standard has been recorded, whereas there is slight increase of 1,8 % compared to the standard recorded at the III variant.
Table 2 shows the impact of the applied ample-technical measures on the mass of the berry at the Cardinal variety.

Table 2. Average mass of a berry at the examined varieties in g

Year	Variant			
	St	I	II	III
2015	8,9	9,2	8,8	8,4
2016	6,58	7,67	7,17	6,83
2015/16	7,74	8,44	7,99	7,62
Index	100	109,0	103,2	98,4

The average mass of the berry of grape ranges from 7,62 g at the III variant to 8, 44 g at I variant. On basis of the obtained data we can conclude that there is impact on the clogging of the vine with bunches of grapes upon the average mass of the grape. An increase of the average mass of the gerry has been noted at I and II variants in relation to the standard of 9,0, i.e. 3, 2 %, whereas there is a decrease of 1, 6 % at III variant compared to the Standard.
Table 3 shows the impact of the applied ample-technical measures on the yield of the examined varieties.

Table 3. Total yield at the examined varieties (kg/m^2)

Year	Variant							
	St		I		II		III	
	Packaged kg/m^2	Waste kg/m^2	Packaged kg/m^2	Waste kg/m^2	Packaged kg/m^2	Waste kg/m^2	Packaged kg/m^2	Waste kg/m^2
2015	1,74	0,13	1,50	0,01	1,95	0,01	2,06	0,26
2016	1,55	0,21	1,29	0,01	1,63	0,05	1,73	0,32
2015/16	1,65	0,17	1,40	0,01	1,79	0,03	1,90	0,29
Index	100	100	84,8	5,9	108,5	17,6	115,2	170,6

On basis of the obtained results presented in Table 3, it can be concluded that the left number of bunches of grape per m^2 has an impact in the quantity of packaged grape. The quantity of packaged grape ranges from 1,40 kg/m^2 at I variant to 1,90 kg/m^2 at III variant. The quantity waste ranges from 0, 01 kg/m^2 at I variant to 0, 29 kg/m^2 at III variant.

Table 4. Dynamic of harvest at the Cardinal variety

Year	Variety							
	St		I		II		III	
	I harvest kg/m^2	II harvest kg/m^2	I harvest kg/m^2	II harvest kg/m^2	I harvest kg/m^2	II harvest kg/m^2	I harvest kg/m^2	II harvest kg/m^2
2015	1,48	0,26	1,34	0,16	1,65	0,30	1,33	0,73
2016	1,35	0,20	1,24	0,05	1,44	0,19	1,27	0,46
2015/16	1,42	0,23	1,29	0,11	1,55	0,25	1,30	0,60
Index	100	100	90,8	47,8	109,2	108,7	91,5	260,7

The quantity of harvested grapes in I harvest ranges from 1, 29 kg/m^2 at I variant to 1,55 km/m^2 at II variant. The quantity of harvested grapes in the second harvest ranges from 0,11 kg/m^2 at I variant to 0,60 kg/m^2 at III variant.
The leaving of number of bunches of grapes per m^2 has an impact on the dynamic of harvest, too. The largest quantity of packaged grape in the first harvest from 1,55 kg/m^2 or 9,2 % more compared to the standard has been noted at II variant, whereas the smallest quantity of packaged grape in the first harvest from 1,29 kg/m^2 i.e. 9,2 % less compared to the standard is noted at I variant.
Degustation rating of variants at the examined varieties is presented in Table 5.

Table 5. Impact on the application of ample-technical measures on the degustation rating of the grape berry at the examined varieties

Year	St	I	II	III
	Total rate	Class	Total rate	Class
2015	8,1	Excellent quality	9,5	Extra quality
2016	8,1	Excellent quality	9,7	Extra quality
2015/16	8,1	Excellent quality	9,6	Extra quality

Degustation rating at the Cardinal variety ranges from 7, 95 points at III variant to 9, 6 points at I variant. A significant impact from the application of the ample-technical measures on the total degustation rate of grapes can be concluded from the table. I variant is characterized with the

highest degustation rate at the examined varieties and III variant with the lowest. I and II variants characterize with the category of extra quality.

Conclusions

On basis of the obtained results and their analyses we concluded the following:

Ample-technical measures have a great impact on the production results and the quality of grapes at the Cardinal variety.

The left number of bunches of grape per m^2 has a significant impact on the mass of the bunch of grape and the grape berry, the ripening dynamic, the quantity of packaged grape and the quality of the grape.

The mass of the bunch of grape and the grape berry at all variants is within the range of the variety's characteristics. The bigger the number of bunches of grape is, the lower their mass is. The largest mass of the bunch of grape that measures 489 g and the mass of grape 8,4 g has the variant with 3 bunches of grape per m^2.

The quality of the total packaged grape at the applied variants ranges from 1,4 kg/m^2 at the variant with 3 bunches of grape per m^2 to 1,9 kg/m^2 at the variant with 5 bunches of grape per m^2.

The variant with 4 bunches of grape per m^2 characterizes with the largest quantity of packaged grape in the first harvest of 1,55 kg/m^2 and the variant with 3 bunches of grape per m^2 characterizes with the lowest quantity of packaged grape in the first harvest of 1,29 kg/m^2.

The quality of the grapes presented through degustation rating depends on the number of bunches of grape per m^2. Variants with 3 and 4 bunches of grape per m^2 characterize with the category extra quality. The standard variant characterizes with excellent quality and the variant with 5 bunches of grape per m^2 characterizes with very good quality.

The obtained results should also be used for production purposes. We strongly recommend the producers of Cardinal variety to apply vine clogging with 4 bunches of grape per m^2 which will result in early harvest, high percentage of packaged grape and obtaining grape with extra quality.

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AGROBIOLOGICAL AND TECHNOLOGICAL CHARACTERISTICS OF VINE CULTIVARS CHARDONNAY AND RHEIN RIESLING IN TIKVESH WINE REGION

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Abstract

Chardonnay and Rhein Riesling are white grape varieties that are used in producing high quality white wines. In Macedonia the production of wine grape is more than 2/3 from the whole grape production. With specific vine training we can plan the yield, make the shape and also to produce the desired quality of the wine grape. All the unnecessary shoots that are developed are removed until the start of the vegetation. The research is focused on the possibility of using different ways of pruning to achieve the best results in the yield and quality of the grape and also for introduction of machine pruning and machine harvest. The research is conducted on the wine grape varieties: Chardonnay and Rhein Riesling. On the two researched grape varieties there are 4 variants of vine training from which one is Control. For the researched variants and grape varieties, the percentage of developed shoots is calculated, potential fertility, number of clusters per vine and shoot, cluster mass per bud and variant, grape yield per vine and hectare, total sugars and total acids. Results from the research in 2016 for the grape yield per vine and per bud, yield per vine, chemical analysis for sugar content and total acids show that the best variant from the Chardonnay is Variant 3 and the Rhein Riesling is Variant 2.

Keywords: wine grape, Chardonnay, Rhein Riesling, vine training, yield, machine pruning, machine harvest.

Introduction

Viticulture takes important economic part in the agriculture production in Republic of Macedonia because there are also favorable conditions for growing white grape varieties for production of high quality white wine. The white grape varieties in Macedonia take lower percentage in the whole wine production in favor of varieties for red wine production. With the knowledge of the agrobiological and technological characteristics of the white grape varieties it enables us to take advantage of the full potential that these varieties offer.Bud break, shoot development and it's fertility (number of clusters per developed and fertile shoot) are important elements and characteristics of one grape variety. The different ways of pruning enables us to achieve the different results in the yield and quality of the grape whether is short spur, half long (short canes),or cane pruning. The results obtained from the different lengths in pruning will enable us to make a conclusion that will enable us to make high quality and superior quality white wines.

Material and methods

The subject of the research are two wine grape varieties Chardonnay and Rheine Riesling purposed for production of high quality white wines. On the two researched grape varieties there are 4 variants with different vine training from which one is a Standard (Control). The Variants differentiate each other by the length of the cane. The Standard in the both Chardonnay and Rheine Riesling is with Double Guyot pruning system with two canes with 10 fertile buds and 2 spurs with 2 fertile buds with total of 24 buds per vine. In both researched vines the Variant 1 is consisted of 8 spurs with 3 buds with total 24 buds per vine. The Variant 2 is consisted of 6 long spurs with 4 buds or total of 24 buds per vine. Variant 3 is consisted of 6 long spurs with 5 buds or total of 30 buds per vine. On both grape varieties with their variants, the percentage of developed and fertile shoots is

calculated, number of clusters per shoot (relative coefficient of fertility) and number of clusters per fertile shoot (the absolute coefficient of fertility). At every grape variety and variant it's calculated the average mass of grape per bud, average mass of cluster in the researched varieties and average mass of berry for all variants. The yield that is calculated from each variant is showed as grape yield per vine and grape yield per hectare. The chemical composition of the must is showed with the contents of total sugars in g/l and the contents of total acids in g/l for every variant and grape variety. Uvologic researches are conducted by the specifications of prof, d-r Zvonimir Bozinovic (Ampelografija 2010). Total sugars are measured with Oechsle Must meter and read on Saleron - Dijardin table. The total acids are calculated by the method of the neutralisation of all acids and their salts with solution of 0,1 m - NaOH. On the base of the spent solution the quantity of total acids is calculated.

Results and discussion

The results for the percentage of developed shoots for grape variety Chardonnay and Rheine Riesling are shown in Table 1.

Table 1. Developed shoots in percent

Variant	Variety	Chardonnay	Rheine Riesling
	bud	Developed shoots in %	
Standard	1	95,0	90,0
	2	90,0	100,0
	3	80,0	95,0
	4	85,0	95,0
	5	80,0	95,0
	6	85,0	95,0
	7	90,0	100,0
	8	85,0	100,0
	9	100,0	95,0
	10	95,0	100,0
Average		88,50	96,50
Variant 1	1	85,0	95,0
	2	100,0	100,0
	3	100,0	100,0
Average		95,0	98,33
Variant 2	1	90,0	100,0
	2	95,0	90,0
	3	100,0	100,0
	4	100,0	100,0
Average		96,25	97,50
Variant 3	1	90,0	90,0
	2	95,0	95,0
	3	85,0	95,0
	4	95,0	95,0
	5	100,0	100,0
Average		93,0	95,0

For the Chardonnay grape variety the percentages in all Variants are high with 93,00% in Variant 3, Variant 1 with 95,00% and Variant 2 with 96,25%. The results for the Rheine Riesling are higher compared with the Chardonnay with 95,00% in Variant 3, 97,50% for Variant 2 and 98,33 for Variant 1. The number of shoots per vine is important agrobiological characteristics because the shoot is carrier of the leaf and other organs of the vine (leaf, bud, tendril).The results for the fertile shoots are shown in Table 2.

The percentage varies between the Variants of the Chardonnay and it is 76,00% in Variant 3, in Variant 2 is 83,75% and the highest is in Variant 1 with 86,66%. In the Riesling variety the percentage of the fertile shoots is little higher compared with the previous variety. In Variant 3 is 88,00%, in

Variant 2 is 90,00% and in Variant 1 is 95,00% of fertile shoots. The relative coefficient of fertility (number of clusters per developed shoot) and absolute coefficient of fertility (number of clusters per fertile shoot) are shown in Table 3.

Table 2. Fertile Shoots in percent

Variant	Variety	Chardonnay	Rheine Riesling
	bud	Developed shoots in %	
Standard	1	55,0	65,0
	2	90,0	90,0
	3	85,0	85,0
	4	95,0	95,0
	5	85,0	85,0
	6	90,0	90,0
	7	90,0	90,0
	8	90,0	90,0
	9	90,0	90,0
	10	100,0	100,0
Average		87,0	88,0
Variant 1	1	75,0	85,0
	2	90,0	100,0
	3	95,0	100,0
Average		86,66	95,0
Variant 2	1	70,0	80,0
	2	80,0	85,0
	3	90,0	95,0
	4	95,0	100,0
Average		83,75	90,0
Variant 3	1	50,0	65,0
	2	65,0	90,0
	3	85,0	95,0
	4	85,0	90,0
	5	95,0	100,0
Average		76,0	88,0

The relative coefficient of fertility in the wine grape variety Chardonnay is 1,34 in Variant 3, 1,54 in Variant 2 and 1,57 in Variant 1. The relative coefficient of the fertility in the Rheine Riesling has higher values compared with the Chardonnay and its from 1,66 in Variant 2, 1,76 in Variant 3 until 2,01 in Variant 1. The absolute coefficient of fertility in the Chardonnay is varying from 1,65 in Variant 3, 1,73 in Variant 2 and 1,74 in Variant 1. In the Riesling grape variety the results are somewhat higher. The Variant 3 has 1,82, Variant 2 is with 1,87 and 2,08 clusters in Variant 1 per fertile shoot**.**

In Table 4 the average mass of grape per fertile bud is shown with the results shown for the Chardonnay are 295 g for Variant 3, 296 g for Variant 2 and 330 g for the Variant 1. The Riesling has shown lower results such as 268 g in Variant 2, 273 g in Variant 3 and 295 g in Variant 1. The values of the average mass of cluster of the two researched grape varieties are shown in Table 5.

The lowest value of 164 g of average mass is measured in Variant 2 in the Chardonnay, 171 g in Variant 3 and 175 g in Variant 1. Lowest values are measured in Riesling grape variety compared with the Chardonnay and are varying from 146 g in Variant 1, 153 g in Variant 3 and 157 g for Variant 2. In the table there are also indexes that are comparable with the Standard.

Table 3. Number of clusters per developed shoot and per fertile shoot

Variant	Variety	Chardonnay	Rheine Riesling	Chardonnay	Rheine Riesling
	bud	Clusters per developed shoot		Clusters per fertile shoot	
Standard	1	0,94	0,88	1,53	1,50
	2	1,55	1,00	1,72	1,46
	3	1,63	1,43	1,72	1,62
	4	1,85	1,54	2,05	1,68
	5	1,68	1,52	1,88	1,70
	6	1,84	1,49	1,94	1,73
	7	1,55	1,68	1,72	1,82
	8	1,75	1,72	1,94	1,86
	9	1,89	1,78	2,0	1,90
	10	1,95	1,88	1,95	1,96
Average		1,66	1,49	1,84	1,55
Variant 1	1	1,11	1,84	1,33	2,05
	2	1,75	2,05	1,94	2,05
	3	1,85	2,15	1,95	2,15
Average		1,57	2,01	1,74	2,08
Variant 2	1	1,24	1,16	1,50	1,69
	2	1,55	1,52	1,75	1,76
	3	1,55	2,05	1,72	1,95
	4	1,85	2,05	1,95	2,10
Average		1,54	1,69	1,73	1,87
Variant 3	1	0,88	1,16	1,50	1,16
	2	1,00	1,52	1,46	1,61
	3	1,63	2,05	1,82	2,16
	4	1,52	2,05	1,70	2,16
	5	1,70	2,05	1,79	2,05
Average		1,34	1,76	1,65	1,82

Table 4. Average mass of grape per fertile bud

Variant	Variety	Chardonnay	Rheine Riesling
	Bud	Average mass of grape per fertile bud	
Standard	1	301	247
	2	260	260
	3	238	274
	4	252	222
	5	274	250
	6	260	235
	7	236	247
	8	266	210
	9	230	240
	10	222	252
Average		254	244
Variant 1	1	333	284
	2	384	296
	3	274	306
Average		330	295
Variant 2	1	248	218
	2	272	258
	3	374	284
	4	292	310
Average		296	268
Variant 3	1	266	225
	2	338	265
	3	322	270
	4	294	289
	5	256	315
Average		295	273

Table 5. Average mass of cluster in g

Variant	Chardonnay		Rheine Riesling	
	g	index	g	index
Standard	162	100	148	100
Variant 1	175	108	146	98
Variant 2	164	101	157	106
Variant 3	171	105	153	103

Table 6. Average berry mass in g

Variant	Chardonnay		Rheine Riesling	
	g	index	g	index
Standard	1,40	100	1,17	100
Variant 1	1,52	108	1,23	105
Variant 2	1,57	112	1,24	106
Variant 3	1,47	105	1,21	103

In Table 6 the values for the average berry mass are shown for both varieties. In the Chardonnay are varying from 1,47g in Variant 3, 1,52 g for Variant 1 and 1,57 for Variant 2. The values for the Riesling are from 1,21g for Variant 3, 1,23 g for Variant 1 and 1,24 g for Variant 2. Also there are indexes for the values to be compared with the Standard.
The quantity of harvested grape is shown in Table 7.

Table 7. Harvested grape in kg

Variant	Chardonnay		Rheine Riesling	
	Kg/vine	Kg/ha	Kg/vine	Kg/ha
Standard	3,389	15.687	2,437	11.280
Variant 1	3,536	16.368	2,793	12.929
Variant 2	3,288	15.220	2,915	13.493
Variant 3	3,606	16.692	2,804	13.678

The results from the Chardonnay the quantity of harvested grape is from 3,288 kg/vine in Variant 2, 3,526 kg/vine or 16.368 kg/ha in Variant 1. The highest values of 3,606 kg/vine and 16.692 kg/ha are measured in Variant 3. The Rheine Riesling table variety has lower values and they are from 2,793 kg/vine in Variant 1, 2,804 kg/vine in Variant 3 and 2,915 kg/vine in Variant 2 or 13.493 kg/ha.
The chemical composition of the grape must with sugar content in g/l or total acids in g/l is shown in Table 8.

Table 8. Chemical composition of grape must (g/l)

Variant	Chardonnay		Rheine Riesling	
	Sugar g/l	Total acids g/l	Sugar g/l	Total acids g/l
Standard	245	5,92	216	6,45
Variant 1	248	6,15	224	6,24
Variant 2	243	6,37	210	6,80
Variant 3	221	6,75	208	6,85

The values for the sugar content in the grape must in the Chardonnay grape variety is 221 g/l for Variant 3, 243 g/l for Variant 2 and 248 g/l for Variant 1. The Rheine Riesling grape variety the values are from 208 g/l for Variant 3, 210 g/l for Variant 2 and 224 g/l for Variant 1. The total acid contents in the Chardonnay grape variety is from 6,15 g/l in Variant 1, to 6,37 g/l to Variant 2 and 6,75 in Variant 3. In the Rheine Riesling grape variety the values for the total acids are higher than the Chardonnay and are from 6,24 g/l in Variant 1, 6,80 g/l in Variant 2 and 6,85 g/l in Variant 3.

Conclusions

From the concluded researches and the shown results we can make these conclusions:

Republic of Macedonia has beneficial conditions for successful cultivating of grape varieties that can give high quality white wine.

In the grape variety Chardonnay, the Variant 2 has the highest percentage of developed shoots of 96,25% and at the Rheine Riesling cultivar the highest values are achieved in the Variant 1 with 98,33%.

The percentage of fertile shoots in the Chardonnay is with the highest values in Variant 1 with 86,66%, or in the grape variety Riesling the highest values are recorded in the Variant 1 with 95,00 % of fertile shoots.

The relative coefficient of fertility (average number of clusters of developed shoot) at the Chardonnay is with highest value of 1,57 in Variant 1, as in the Riesling in Variant 1 with 2,01 cluster per developed shoot.

The absolute coefficient of fertility is with the highest value in Variant 1 at the Chardonnay grape variety with 1,74 clusters per fertile shoot, or 2,08 clusters in Variant 1 at the Riesling.

The average mass of grape per bud in grams in the Chardonnay grape variety is with the highest value in Variant 1 with 330 g, or 295 g in Variant 1 in the Rheine Riesling.

The average mass of cluster in g is with the highest value at Variant 1 of 175 g at the Chardonnay or 157 g in Variant 2 at the Rheine Riesling.

The value of the average mass of berry is the highest in Variant 2 at the Chardonnay grape variety with 1,57 g, or 1,24 g at the Riesling.

The quantity of harvested grape per vine is with lowest values in Variant 2 with 3,288 kg/vine, but with highest values with 3,606 kg/vine or 16.692 kg/ha at the Chardonnay, or 2,793 kg/vine at Variant 1 until 2,915 kg/vine or 13.593 kg/ha at the Rheine Riesling.

The content of sugar in grape must is with highest values in Variant 1 with 248 g/l in the Chardonnay, or 224 g/l in Variant 1 at the Riesling.

Total acids content at the Chardonnay grape variety has the highest values in Variant 3 with 6,75 g/l , or 6,85 g/l in Variant 3 at the Rheine Riesling.

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DIFFERENT LENGTHS OF PRUNING IN VINE CULTIVARS CABERNET SAUVIGNON AND MERLOT IN TIKVESH WINE REGION

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Abstract
Wine grape is cultivar that grows for many years, but every year in the vegetation period creates large number of winter fertile buds from which in the next vegetation new shoots will develop. To keep it's shape, to plan it's yield and growth and also the quality of the wine grape it's necessary to make pruning every year until the start of the vegetation to remove all the unnecessary shoots that developed. Wine grape from the whole assortment in Republic of Macedonia takes place in 70% from the whole grape production.The research is focused on the possibility of using different ways of pruning to have the best results in the yield and quality of the ripped grape and also for introduction of machine pruning and machine harvest. The research is conducted on the wine grape varieties: Cabernet Sauvignon and Merlot. On the two researched grape varieties there are 4 variants on vine training from which one is Control. On the two researched variants and grape varieties, the percentage of developed shoots is calculated, potential fertility, number of clusters per vine and shoot, cluster mass per bud and variant, grape yield per vine and hectare, total sugars and total acids. Results from the research in 2016 for the grape yield per vine and per bud, yield per vine, chemical analysis for sugar content and total acids show that the best variant from the Cabernet Sauvignon is Variant 2, for the Merlot is Variant 3.

Keywords: wine grape, Cabernet Sauvignon, Merlot, vine training, yield.

Introduction

Republic of Macedonia has favorable agrobiological and pedological conditions which can create successful cultivation of different grape varieties such as Cabernet Sauvignon and Merlot used for producing high quality red wine. The grape wine is multi year plant which can be cultivated for 25 - 30 years with good profits. Every year during the vegetation the grape wine produces large number of winter fertile buds from which vine shoots will be developed in the next vegetation. The pruning during the dormant period of the vine is regular ampelotechnical measure which enables yield planning, grape quality and vine shoot growth. Also to keep the vine's shape, removal of all unnecessary shoots that developed the previous season but won't be necessary into the next season should be made. The different ways of pruning gives opportunity to achieve the best results in the yield and quality of the grape whether is short spur, half long (short canes),or cane pruning. The results obtained from the different lengths in pruning will enable us to make a conclusion which variant will be the best to be mechanical (machine) pruned and also machine harvested.

Material and methods

The research is conducted on two wine grape varieties Cabernet Sauvignon and Merlot purposed for production of high quality wines. On the two researched grape varieties there are 4 variants with different vine training from which one is a Standard (Control). The Variants differ each other by the length of the cane. The Standard in the both Merlot and Cabernet Sauvignon is with Double Guyot pruning system with two canes with 10 fertile buds and 2 spurs with 2 fertile buds with total of 24 buds per vine. In both researched vines the Variant 1 is consisted of 8 spurs with 3 buds with total 24

buds per vine. The Variant 2 is consisted of 6 long spurs with 4 buds or total of 24 buds per vine. Variant 3 is consisted of 6 long spurs with 5 buds or total of 30 buds per vine. On all researched variants and both grape varieties, the percentage of developed and fertile shoots is calculated, number of clusters per bud, number of clusters per shoot(relative coefficient of fertility) and number of clusters per fertile shoot (the absolute coefficient of fertility). At every grape variety and variant it's calculated the average mass of grape per bud, average mass of cluster in the researched varieties and average mass of berry for all variants. The yield that is calculated from each variant is showed as grape yield per vine and grape yield per hectare. The chemical composition of the must is showed with the contents of total sugars in g/l and the contents of total acids in g/l for every variant and grape variety. Uvologic researches are conducted by the specifications of prof, d-r Zvonimir Bozinovic (Ampelografija 2010). Total sugars are measured with Oechsle Must meter and read on Saleron - Dijardin table. The total acids are calculated by the method of the neutralisation of all acids and their salts with solution of 0,1 m - NaOH. On the base of the spent solution the quantity of total acids is calculated.

Results and discussion

Several elements for the fertility of the researched grape wine varieties are researched. The results for the percentage of developed shoots for grape variety Cabernet Sauvignon and Merlot are shown in Table 1.

Table 1. Developed shoots in percent

	Variety	Cabernet Sauvignon	Merlot
Variant	bud	Developed shoots in %	
Standard	1	70,00	90,00
	2	95,00	100,00
	3	95,00	95,00
	4	85,00	100,00
	5	90,00	95,00
	6	90,00	95,00
	7	95,00	100,00
	8	90,00	100,00
	9	95,00	95,00
	10	100,00	100,00
Average		*90,50*	*97,00*
Variant 1	1	85,00	90,00
	2	95,00	100,00
	3	95,00	100,00
Average		*91,66*	*96,66*
Variant 2	1	90,00	85,00
	2	80,00	90,00
	3	85,00	100,00
	4	95,00	100,00
Average		*87,50*	*93,75*
Variant 3	1	90,00	85,00
	2	95,00	95,00
	3	85,00	95,00
	4	95,00	95,00
	5	100,00	100,00
Average		*93,00*	*94,00*

The Cabernet Sauvignon has relatively high percentage of developed shoots at all variants and standard with values from 87,50% in Variant 2 to 93,00% in Variant 3. In comparison the Merlot has higher values than the Cabernet per Variants and buds which varying from 93,75% in Variant 2 to

96,66% in Variant 1. The development of sufficient number of shoots per vine is important agrobiological characteristic because during the vegetation period on the shoot will be developed other organs of the vine such as leafs, fertile buds, flowers, clusters and tendrils. The results for the fertile shoots are shown in Table 2.

Table 2. Fertile Shoots in percent

Variant	Variety	Cabernet Sauvignon	Merlot
	bud	Fertile shoots in %	
Standard	1	60,00	65,00
	2	90,00	85,00
	3	85,00	75,00
	4	90,00	50,00
	5	85,00	60,00
	6	80,00	60,00
	7	85,00	60,00
	8	80,00	75,00
	9	90,00	80,00
	10	90,00	95,00
Average		83,50	70,50
Variant 1	1	60,00	55,00
	2	90,00	95,00
	3	85,00	100,00
Average		78,33	83,33
Variant 2	1	80,00	75,00
	2	75,00	80,00
	3	60,00	95,00
	4	80,00	95,00
Average		73,75	86,25
Variant 3	1	80,00	60,00
	2	70,00	75,00
	3	60,00	75,00
	4	85,00	95,00
	5	90,00	100,00
Average		77,00	81,00

The percentage of fertile shoots in the Cabernet Sauvignon grape variety is varying from 60% at the first bud until 85 % at the third, fifth and seventh bud in the Standard, with average of 83,50% or average of 78,33% in Variant 1. Variant 2 has average of 73,75% of fertile shoots and Variant 3 has value of 77,00%. The Merlot has higher percentage of fertile shoots at the upper top buds of the vine. The values are from 81% in Variant 3, 83,33% at Variant 1, until 86,25% in Variant 2. The values in the Standard are from 50-95% or average of 70,50% of fertile shoots. The relative coefficient of fertility (number of clusters per developed shoot) and absolute coefficient of fertility (number of clusters per fertile shoot) are shown in Table 3.

Table 3. Number of clusters per developed shoot and per fertile shoot

Variants	Variety	Cabernet Sauvignon	Merlot	Cabernet Sauvignon	Merlot
	bud	Cluster per developed shoot		Clusters per fertile shoot	
Standard	1	1,18	0,73	1,44	1,07
	2	1,53	1,50	1,64	1,58
	3	1,73	0,81	2,00	1,44
	4	1,30	1,12	1,54	1,58
	5	1,46	1,12	1,69	1,50
	6	1,28	1,17	1,50	1,66
	7	1,35	1,38	1,73	1,66
	8	1,56	1,70	1,78	1,81
	9	1,26	1,70	1,58	1,79
	10	1,50	1,89	1,78	1,89
Average		1,41	1,31	1,66	1,59
Variant 1	1	1,05	1,00	1,38	1,54
	2	1,57	1,50	1,66	1,58
	3	1,73	1,95	1,94	1,95
Average		1,45	1,48	1,66	1,69
Variant 2	1	1,33	1,33	1,50	1,60
	2	1,43	1,31	1,53	1,56
	3	1,47	1,75	1,92	1,84
	4	1,31	1,90	1,56	2,00
Average		1,38	1,57	1,63	1,75
Variant 3	1	1,28	0,83	1,43	1,25
	2	1,14	1,10	1,64	1,40
	3	1,23	1,29	1,61	1,46
	4	1,47	1,42	1,47	1,42
	5	1,65	1,80	1,83	1,80
Average		1,35	1,28	1,59	1,46

The relative coefficient of fertility in the wine grape variety Cabernet Sauvignon in Variant 1 is varying from 1,05 to 1,73 or average of 1,45 clusters per developed shoot. In Variant 2 the average value is 1,38 and in Variant 3 the average number of clusters per developed shoot is 1,35. The relative coefficient of fertility in the Merlot wine cultivar is varying of average value of 1,31 per developed shoot at the Standard, in Variant 1 is 1,48, at the Variant 2 the value is 1,57 and 1,28 clusters per developed shoot in Variant 3. The average number of clusters per fertile shoot in the Cabernet Sauvignon at Variant 1 is 1,66, in Variant 2 the value is 1,63 and at Variant 3 is 1,59 clusters per fertile shoot. The absolute coefficient of fertility is with somewhat higher values at the Merlot variety and varying from 1,69 clusters in Variant 1, with 1,75 clusters per fertile shoot in Variant 2 but with lower values in Variant 3 with 1,46 cluster per fertile shoot. In Table 4 the average mass of grape per fertile bud is shown.

We can mark several differences in the Standard and all the Variants in the Cabernet Sauvignon per buds and the average for the Variants. The values are higher in the higher upper buds on the shoot. There is also similarity in the values of the mass of grape per fertile bud and variant in the Merlot grape variety. The values of the average mass of cluster of the two researched grape varieties are shown in Table 5.

Table 4. Average mass of grape per fertile bud

Variants	Variety	Cabernet Sauvignon	Merlot
	Bud	Average mass of grape per fertile bud	
Standard	1	218	283
	2	196	280
	3	264	290
	4	200	230
	5	268	295
	6	235	275
	7	208	280
	8	250	307
	9	242	225
	10	282	290
Average		236	276
Variant 1	1	246	276
	2	312	292
	3	334	386
Average		297	318
Variant 2	1	248	270
	2	344	300
	3	332	334
	4	316	316
Average		310	305
Variant 3	1	224	236
	2	302	342
	3	346	348
	4	308	342
	5	316	290
Average		299	311

Table 5. Average mass of cluster in g

Variant	Cabernet Sauvignon		Merlot	
	g	index	g	index
Standard	165	100	183	100
Variant 1	152	92	186	102
Variant 2	160	97	179	97
Variant 3	169	102	184	101

The average mass of the grape cluster of Cabernet Sauvignon is varying from 152 g in Variant 1, at 160 g in Variant 2 until 169 g in Variant 3. The Merlo has higher values in all variants and can be from 179 g in Variant 2, 184 g in Variant 3 until 186 g in Variant 1. The values compared with the Standard for both varieties are also shown as indexes. In table 6 the values for the average berry mass are shown.

Table 6. Average berry mass in g

Variant	Cabernet Sauvignon		Merlot	
	g	index	g	index
Standard	1,16	100	1,69	100
Variant 1	1,09	94	1,63	96
Variant 2	1,08	93	1,70	100
Variant 3	1,26	108	1,76	104

In the Cabernet Sauvignon the average mass of berry is from 1,08 g in Variant 2, 1,09 g in Variant 1 until 1,26 g in Variant 3. In the Merlot the average mass of the berry is from 1,63 g in Variant 1,

Variant 2 is 1,70 g and 1,76 g in Variant 3. Also the indexes are shown in comparation with the Standard for both grape varieties. The quantity of the harvested grape is important technological characteristic because for cultivating grape the main target is to have optimal and quality yield Bozinović (2010), Hristov 2010). The results from the quantity of harvested grape from the wine cultivar Cabernet Sauvignon is in Table 7 in kg per vine and per hectare.

Table 7. Harvested grape in kg

Variant	Cabernet Sauvignon		Merlot	
	Kg/vine	Kg/ha	Kg/vine	Kg/ha
Standard	3,040	14.072	3,040	14.072
Variant 1	3,155	14.604	3,410	15.784
Variant 2	2,940	13.609	3,240	14.997
Variant 3	2,955	13.678	3,350	15.507

The yield in the Cabernet is varying from 2,940 kg per vine or 13.609 kg/hectare in Variant 2. Variant 3 has values from 2,955 kg per vine or 13.678 kg/hectare. The highest yield is registered in Variant 1 with value of 3,155 kg per vine or 14.604 kg/hectare. At the Merlot wine grape variety higher values per vine and per hectare are recorded in all Variants in comparison with the Cabernet Sauvignon. The quantity of harvested grape is varying from 3,240 kg per vine in Variant 2 or 14.997 kg/hectare. In Variant 3 the values are 3,350 kg per vine or 15.507 kg/ha. The highest yield per vine is 3,410 kg and 15.784 per hectare measured in Variant 1.
The chemical composition of the grape must is shown in Table 8 with sugar content shown in g/l or total acids shown in g/l.

Table 8. Chemical composition of grape must (g/l)

Variant	Cabernet Sauvignon		Merlot	
	Sugar g/l	Total acids g/l	Sugar g/l	Total acids g/l
Standard	218	5,78	228	4,95
Variant 1	236	4,95	226	4,60
Variant 2	220	5,55	230	4,80
Variant 3	210	5,40	234	4,50

The values for the sugar content in the grape must in the Cabernet grape wine variety is varying between variants. In Variant 3 the sugar content is 210 g/l, Variant 2 is 220 g/l but highest value has Variant 1 with 236 g/l. The results in the Merlot are from 226 g/l in Variant 1, 230 g/l in Variant 2 and 234 g/l in Variant 3. The total acid contents in the Cabernet Sauvignon is in the values from 4,95 in Variant 1, 5,40 g/l in Variant 3 and 5,55 g/l in Variant 2. In the Merlot grape variety lower values are measured for the total acid contents which are from 4,50 g/l for Variant 3, 4,60 g/l for Variant 1 until 4,80 g/l for Variant 2.

Conclusions

Republic of Macedonia has favorable condition for cultivating quality grape wine varieties for making high quality wines. The applications of different Variants gave specific differences in the researched results. In the Cabernet Sauvignon grape variety in Variant 3 are received the highest values with 93% for developed shoots, and in Merlot variety it is the Variant 1 with 96,66%. The highest percentage of fertile shoots is received at Variant 1 with 78,33% in the Cabernet Sauvignon grape variety and in the Merlot grape variety is the Variant 2 with 86,25%. The average mass of grape per bud in grams in the grape wine cultivar Cabernet Sauvignon has lowest values in Variant 1 from 297 g and highest value at Variant 2 with 310 g per bud. In Merlot the lowest value is measured in Variant 2 with 306 g per bud and highest at Variant 1 with 318 g per bud. The highest average mass of cluster in the Cabernet Sauvignon is with lowest value at Variant 3 (169 g) and in Merlot grape wine variety the highest value in Variant 1 with 186 g. The average mass of berry in Cabernet

Sauvignon is with lowest value in Variant 2 with 1,08 g, the highest in Variant 3 with 1,26 g. In the Merlot wine grape variety the highest value of the average mass of berry is measured in Variant 3 with 1,76 g. The quantity of harvested grape in the grape wine Cabernet Sauvignon is with lowest value in Variant 2 with 2,940 kg/vine, but highest value in Variant 1 with 3,155 kg/vine or 14.604 kg/ha. At the Merlot wine grape the lowest value is measured at Variant 2 with 3,240 kg/vine and highest in Variant 1 with 3,410 kg/vine or 15.784 kg/ha. In both of the researched grape varieties the content of sugar in grape must is with higher values and its varying with 210 g/l at Variant 3 to 236 g/l in Variant 1 in the Cabernet Sauvignon. At the Merlot wine grape variety the content of sugar is in limits of 226 g/l in Variant 1 to 234 g/l in Variant 3. Total acids content in Cabernet Sauvignon wine grape variety is measured between 4,95 g/l in Variant 1 to 5,55 g/l in Variant 2. In the Merlot wine grape variety the content of total acids is in limits from 4,50 g/l in Variant 3 to 4,80 g/l in Variant 2.

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YIELD PLANNING IN TABLE GRAPE PRODUCTION ON STRASHENSKI GRAPE VARIETY

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Abstract
Table grape production takes considerable place in the total grape production in Republic of Macedonia. Central Povardarie wine regions, especially Tikvesh wine district has good conditions for producing table grape for consumption in fresh state. Obtaining optimal yield and quality table grape demands aplication of suitable ampelotechnical measures such as: yield planning per vine and hectare, pincage of grape cluster, partial defoliation, and use of biostimulators, use of modern packing centers and use of adequate packing for the table grape. The purpose of the research was yield planning with leaving specific numbers of grape clusters per vine to get high yield and high quality table grape. Three Variants were researched with 18, 23 and 27 grape clusters per vine and Standard with leaving of all grape clusters per vine. Measuring of the yield per vine and per hectare was conducted, percentage of packed grape and remnants, mechanical analysis of the grape cluster and berry, pressure resistance of the berry, resistance of cluster stem breakage and chemical analysis. The results and information received from the yield per vine and hectare, percentage of packed grapes and remnants, the chemical analysis of sugar content and total acid content are showing that the best results are achieved at the Variant with 27 grape clusters per vine.

Keywords: table grape, Strashinski, pincage, yield planning per vine and hectare.

Introduction

Republic of Macedonia has long tradition in successful production of table grape along with its favorable agro ecological conditions The area planted with table grape are 30-35% from the whole grape production. Successfully can be produce table grapes with very early, early, medium late and late ripening.For optimal yield and high quality table grape that will be used for fresh consumption the application of specific ampelotechnical measures such as: yield planning per vine, hectare and m^2 ,pincage of grape cluster, partial defoliation, use of bioregulators for berry growing. Also agrotechnical measures should be used such as: leaving specific number of clusters on the vine per square meter, yield planning with mature pruning as well as the use of modern quality packages for the packing of the table grapes.

Material and methods

The subject of this research was the table grape variety Strasenski in Tikves wine region. This variety originates from Moldova (Kisinev) and it is developed by crossing (Kata Kurgan x Dodreljai) x SV 20 - 473. This variety has large loose clusters with big dark blue round berries. The skin is thick, the flesh is juicy with acidic taste. It ripens in first epoch. Strasenski belong to the group of high yield grape varieties that is resistant to grapevine downy mildew, but not resistant to powder mildew and botrytis. It is also sensitive to winter temperatures. In Macedonia this variety is found in small areas in the Tikves wine district and also in Gevgelia - Valandovo wine region. (Bozinović, Ampelografija, 2010). The distance between rows is 2,5 m and between the vines is 1,8 m. This research was conducted on 4 test Variants from which one is a taken as a main vine or standard.

- Standard (main vine) with leaving of all clusters per grape on each vine,
- Variant 1 with leaving of 18 clusters per grape on each vine,

- Variant 2 with leaving of 23 clusters per grape on each vine,
- Variant 3 with leaving of 27 clusters per grape on each vine,

All Variants and the Standard were equally treated in a matter of irrigation, fertilization, soil cultivation and phyto protection during the period the research was conducted. In the start of the flowering and pollination phase, 1/3 of the cluster length was removed to all vine variants except for the standard. During the technological ripeness of the grape: total yield, the percentage of packed grape and remnants are calculated for every variant and standard.

The information about the mechanical contents of the grape cluster and berry, structure of the cluster, mechanical conditions of the grape cluster and berry, sugar content, total acids and pH value of the must are all conducted and received in laboratory conditions. Oechsle must meter was used to measure the total sugar content in must along with the Dijardin - Salleron table to all variants and standard Total acids are given in g/dm^3 calculated with potentiometric titration with the use of bromthymol blue. The neutralization was concluded with 0,1 m NaOH. Potentiometric method was used to measure the pH with the use of pH meter with calomel electrode.

Results and discussion

One of the main indicators for the fertility of the grape is the yield as a parameter and it's shown in Table 1.The yield is an indicator calculated as a total grape mass for a specific grape variety or area. Also another parameters such as: total yield, percentage of packed grapes and remnant are given for each variant and standard in Table 1.

Table 1. Total yield for Strasenski table grape variety

Variants	Packed grape		Remnants		Total
	kg/ha	%	kg/ha	%	kg/ha
1	17.932	94,81	980	5,19	18.912
2	20.046	94,18	1.238	5,82	21.284
3	21.970	93,72	1.470	6,28	23.440
Standard	23.384	89,47	2.752	10,53	26.136

From the given results we can conclude that the lowest total yield from all variants has the Variant 1 with 18.912 kg/ha. The highest yield has the Standard with 26.136 kg/ha. Relatively high yield is measured in Variant 3 of 23.440 kg/ha. The percentage of remnants is the lowest in the Variant 1 with 5,19 %, and the highest in the Standard with 10,53%. In Variant 3 the percentage of remnant is 6,28% and the percentage of packed grape is 93,72 %. Other main characteristics of the table grapes are the dimensions of the cluster and berry shown in table 2.

Table 2. Dimensions of the cluster for Strasenski grape variety

Variant	Length in cm	Width in cm	Size
1	17,25	11,28	Medium
2	14,65	13,22	Medium
3	15,27	12,77	Medium
Standard	18,90	9,37	Large

The largest dimensions of the cluster is measured in the Standard because the cluster is whole and not pincaged. The dimensions of the berry for Strasenski grape variety for all the researched variants are given in Table 3.

There are specific differences in length and width of the berries between the variants and the standard. The standard has the smallest dimensions of the berry in comparison with the other researched variants. The results of the mechanical contents are given in Table 4.

The conclusion from the given results is that highest cluster mass was measured in Variant 1 with 487,70 g and the lowest cluster mass in the standard. According to the cluster size classification the whole variants including the standard have weight more than 400 grams and belong to a group of

very large clusters. The mechanical content of the berries for the Strasenski table grape variety is given in the Table 5.

Table 3. Dimensions of the berry for Strasenski grape variety

Variants	Length in mm	Width in mm	Median value	Length - width ratio in mm
1	25,34	23,16	24,25	1,09
2	24,54	22,45	23,49	1,09
3	25,05	23,41	24,23	1,07
Standard	24,29	22,67	23,48	1,07

Table 4. Mechanical content of the cluster for Strasenski grape variety

No:	Elements	Variants			
		Standard	1	2	3
1	Cluster weight in g	410,10	487,70	462,50	438,60
2	Cluster remnant in grape bunch g	8,14	8,45	8,60	8,18
3	Berry weight in g	401,96	479,25	453,90	430,42
4	Cluster content indicator	49,38	56,71	52,77	52,61
5	Cluster remnant percentage according to weight	1,98	1,73	1,86	1,86
6	Berry percentage according to weight	98,02	98,27	98,14	98,14
7	Numbers of berries in cluster	72,16	74,55	70,37	68,52
8	Berry indicator	17,59	15,28	15,21	15,62

Table 5. Mechanical content of the berries for the Strasenski grape variety

No	Elements	Variants			
		Standard	1	2	3
1	Weight of 100 berries in g	770,42	910,02	880,68	860,94
2	Weight of seed in 100 berries in g	15,14	16,12	15,64	15,70
3	Weight of skin in 100 berries in g	37,18	40,04	38,56	39,10
4	Weight of flesh in 100 berries in g	718,10	853,86	826,48	806,14
5	Content indicator in berries	19,31	21,32	21,43	20,61
6	Number of seeds in 100 berries	276	282	286	290
7	Number in seeds in cluster	113,18	137,53	132,27	127,19
8	Weight in 100 seeds in g	5,48	5,71	5,46	5,41
9	Weight in seeds in cluster	10,92	12,01	11,00	10,75
10	Weight in skin in cluster g	26,82	29,84	27,13	26,79
11	Weight in flesh in cluster g	364,22	437,40	415,77	392,88

Table 6. Structure of cluster for the Strasenski grape variety

No	Elements	Variants			
		Standard	1	2	3
1	Percentage of cluster remnant	1,98	1,73	1,86	1,86
2	Percentage od skin	6,54	6,11	5,86	6,10
3	Percentage od seeds	2,66	2,46	2,37	2,45
4	Percentage of flesh	88,82	89,70	89,91	89,59
5	Skeleton	8,52	7,84	7,72	7,96
6	Hard remnant	11,18	10,30	10,09	10,41
7	Structural indicator	7,94	8,70	8,91	8,60
8	Theoretical randman	87,06	88,14	88,23	87,92

There are differences in values between the variants and the standard. Above 700 grams measured values are found in all the variants and the standard in the elements of weight of 100 berries in g.

The structure of the cluster that shows the contents of the cluster is measured in %. For the Strasenski table grape variety it is shown in Table 6.
We can conclude that all of the variants and the standard have high percentage of flesh.
The mechanical characteristics of the berries are presented through their pressure resistance in Table 7.

Table 7. Pressure resistance of the berry in g/cm^2 for the Strasenski grape variety

Variant	X - min	X - max	X
1	900	1800	1420
2	1000	1900	1400
3	900	1900	1360
Standard	700	1800	1230

The lowest average value for the pressure resistance of the berry is measured in the standard. It can be concluded that all variants have relatively high values for pressure resistance.The chemical content of the cluster for the Strasenski grape is presented through the sugar content, total acids and pH value of the must shown in Table 8.

Table 8. Chemical content of the cluster for Strasenski grape variety

Variants	Sugar g/l	Total acids g/dm^3	pH
1	190	5,68	3,62
2	194	5,82	3,40
3	186	5,14	3,46
Standard	188	5,73	3,32

The lowest sugar content in g/l is measured in the Variant 3 with 186 g/l but with very close value with the Standard with 188 g/l. The highest sugar content of all with 194 g/l is in Variant 2. The contents of total acids are highest in the Variant 2 with 5,82 g/dm^3 and lowest in Variant 3 with 5,14 g/dm^3.

Conclusions

Variant 3 has the highest measured yield of 23.440 kg/ha with 93,72% of packed grape compared with the Standard which has 26.136 kg/ha but with much lower percentage of packed grape of 89,47%. The pressure resistance of the berry for the Strasenski grape variety is with high values in all variants and the standard. This is a good sign because it also increases the transportability of the grape. The cluster reduction increases the sugar concentration in the grape. Summarizing the overall results for total yield, percentage of packed grape, the sugar content, the total acids, the pressure resistance of the berry we can conclude that the best variant is the Variant 3 with leaving of 27 clusters per grape.

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BIOCHEMICAL AND MINERAL PARAMETERS IN PIGS OF TWO BREEDS REARED IN LARGE INDUSTRIAL COMPLEXES OF WESTERN SIBERIA

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Abstract
Pig farming has a long tradition in Russian agriculture. The objectives of the present study were to investigate some indicators of blood biochemistry and hematology, and mineral metabolism in pigs (aged 6 months) of Landrace and Kemerovskaya breeds reared and kept in large industrial complexes named "Chistogorsky" and "Altaimyasoprom" (250 thousand heads in each) and to determine differences between two breeds in biochemical, hematological and mineral parameters. The Kemerovskaya breed belonged to local one but the Landrace breed was introduced from Ireland 3 generations ago. Concentrations of albumins, urea and phosphorus were higher in the Landrace breed then in the Kemerovskaya breed. In contrast, there was increased concentration of globulins and AST activity in animals of the Kemerovskaya breed in comparison with the Landrace breed. In addition, there were differences between breeds in some hematological indices and mineral metabolism parameters excluding phosphorus. The average population levels of the parameters investigated in two pig breeds could be used as reference values to evaluate animal's interior at other pig farms in Western Siberia. The selected biochemical indices are recommended to farmers to assess the physiological status of animals in large industrial pig-raising plants.

Keywords: animal breeding, animal biochemistry, breed, pig raising plants.

Introduction

The study of continuously varying traits, which include hematological and biochemical parameters, makes a huge contribution to animal and plant breeding (Mazer & Dzhinks, 1985). Along with this, the establishment and evaluation of genetic and paratypic variability lead to complexity. In this regard, there is an increase in the number of studies whose purpose is to evaluate genotype-environment interaction. This allows making adjustments in the characteristics of genetic and evolutionary factors (Solbrig & Solbrig, 1982). Thus, the accuracy of the evaluation of gene and phene pool impact is increased for farm animals to obtain high productivity, adaptability to severe environmental conditions (Glazko, Zubets, Kushnir, Tarasyuk, & Glazko, 2005) and resistance to dangerous diseases (Petukhov, 1981, 1989). At the present stage of livestock development, a large number of different breeds of animals of different species have been created, but the uniqueness of their gene and phene pools have yet to be fully appreciated (Moiseeva et al., 2006; Ukhanov et al., 1993). In this regard, the biochemical indices are of particular interest, since they are the result from multilevel interactions and are under control of complex interacting systems of genes (Lande, 1981; Zeng, Houle, & Cockerham, 1990). In turn, such systems can have some of their copies - polymers of polygenes, which can be significantly affected by a large number of fixed and random factors (Bliznyuchenko, 2010). In many scientific papers assessments of the phene pool of animal breeds of different species have been carrying out. In this regard, the indigenous and disappearing Kemerovo pig breed are of particular interest. It is important to compare some interior parameters of this

breed with the recently introduced population of the Landras pigs bred in the conditions of large pig raising plant for 3 generations. An assessment of the phene pool should be carried out taking into account environmental conditions and, in particular, in the sharply continental climate of Western Siberia. The aim of the research was to evaluate the Kemerovskaya and Landrace pig breed phene pool using some hematological and biochemical blood parameters at the conditions of large pig raising plants.

Material and methods

The research was conducted on the populations of Kemerovo and Landrace pigs, bred at two large industrial complexes (pig raising plants) of Kemerovo and Altai regions of Russia. Some indicators of protein and mineral metabolism in slaughtered animals reaching 100 kg (age 6 months) were used to make comparisons. In our and other studies have found that the content of heavy metals and other pollutants in organs, tissues, soil, water, feed, organs and tissues of animals of different species did not exceed the maximum permitted concentrations (MPC). The territory on which these animals are bred is therefore suitable for obtaining healthy products. Hematological parameters were quantified using the hematological analyzer PCE-90VET. Biochemical indices were determined by means of Vector-Best reagent's kits and a semi-automatic "Photometer-5010" analyzer manufactured by Robert Riele GmbH & CoKG. The statistical analysis was performed using the statistical environment "R". The distribution was assessed using the Anderson-Darling and Shapiro-Wilk criteria. The comparison of the groups was carried out using the Welch and Mann-Whitney tests.

Results and discussion

In many scientific publications, reference values of haematological and biochemical indices for farm animals are usually given without taking into account the direction of productivity, pedigree and environmental conditions and other factors. Here we intended to compare local and introduced pig breeds on haematological and biochemical parameters (protein a mineral metabolism are of great importance to the meat production). It was important to show the real situation at the conditions of large pig raising plants with population of more then 200 thousand animals. In fact, many farmers in Russia do not always perform haematological and biochemical analysis for all the animals they keep. It leads to the appearance of weak animals that look like apparently healthy ones. On the one hand, the problem is that the animals are slaughtered when they reach 100 kg (6 months) and we do not know completely whether the animals were healthy or not but are used as food. On the other hand, perhaps, there is breed difference in the haematological and biochemical parameters. For that reason, some haematological and biochemical indices were used to assess possible distinction between the breeds. More than 60 haematological and biochemical parameters were determined initially and only several of biochemical indices were selected to recommend farmers. These parameters are quite stable and easy to determine at reasonable price. No significant differences were found between the breeds for a number of hematological indices. The intrabreed similarity among some biochemical parameters associated with protein and mineral metabolism was identified (table).

There were no significant differences in the content of total serum protein, albumins/globulins ratio, ALT activity, Ca, Ca/P, Mg and K levels in blood. However, differentiation of the two breeds based on the rest of the parameters was observed. The level of albumin in Kemerovo pigs was 1.5 times lower than in Landrace pigs. At the same time, the globulins content in the Kemerovo pig breed significantly higher in comparison with the Landrace breed. This can be indicators of adaptive ability of the indigenous Kemerovo population of pigs to the ecological conditions of Siberia. The activity of aspartate aminotransferase in pigs of the Kemerovo breed was significantly higher than that of the Landrace subpopulation and less variable. In most indices of mineral metabolism, the animals of the two breeds did not differ from each other. However, the phosphorus content in the blood serum was twice as high as that of another breed. It was associated with highest variability of these parameters in comparison with those assessed previously. A comparatively higher variability in the

majority of parameters of protein metabolism in Kemerovo pig breed in contrast to Landrace was observed. To assess possible difference in variability of the biochemical indices the interquartile range levels were visualized in the same scale (%, fig 1.).

Table 1. Intrabreed differences on selected biochemical parameters of swine blood

Biochemical parameter	Landrace breed			Kemerovskaya breed			Reference values
	$\bar{x} \pm s_{\bar{x}}$	Me	IQR	$\bar{x} \pm s_{\bar{x}}$	Me	IQR	
Protein (total), g/l	80.7±19.7	84.5	8.25	79.6±3.25	79.1	23.0	55-86
Albumins, g/l	49.6±1.35	50.0	5.25	32.2±2.35***	29.2	18.3	35-50
Globulins, g/l	31.1±1.88	31.5	6.25	47.4±4.82**	52.3	38.7	53-64
Albumins/Globulins ratio	1.68±0.151	1.50	0.487	1.16±0.263•	0.475	1.04	0.3-0.6
Urea, mmol/l	10.3±0.75	10.5	2.73	7.32±0.453**	6.78	3.34	3-8
Alanine transaminase activity (ALT), U/l	10.2±1.22	8.77	3.08	10.9±1.04	9.16	5.06	0.5-41
Aspartate transaminase activity (AST), U/l	5.81±1.06	5.69	5.69	10.2±0.694**	8.99	3.19	0.6-38
de Ritis coefficient	0.58±0.098	0.525	0.36	0.99±0.04***	0.985	0.275	1.33
Ca, mmol/l	4.14±0.671	5.43	3.44	3.43±0.478	2.50	1.65	2.4-3
P, mmol/l	5.22±0.596	4.60	2.50	2.40±0.124***	2.56	0.71	1.3-3.3
Ca/P ratio	0.877±0.18	0.790	0.668	1.58±0.239	0.945	1.24	1-1.5
Mg, mmol/l	1.99±0.814	1.15	0.85	1.11±0.103	0.740	0.90	0.9-1.7
K, mmol/l	6.51±0.302	6.45	1.46	7.08±1.27	4.75	6.40	4-5

Note: significant differences at • – α<0.10, ** – α<0.01 and *** – α<0.01

The lowest variability in most of the traits was observed in Landrace pigs (lower than 30% - globulins, K, albumins and total protein). On the contrary, the only P content had low variability level in Kemerovskaya breed. This can be considering as unique variability profile of the breeds reared in large industrial complexes of Western Siberia. Obtaining high quality and safe livestock products is one of the most important tasks in field of animal husbandry. To accomplish this task, the content of heavy metals and other pollutants in the water, soil, plants and animals is constantly monitored (Konovalova et al., 2017; Korotkevich, Petukhov, Sebezhko, Barinov, & Konovalova, 2014; Marmuleva, Barinov, & Petukhov, 2003; Miller, Petukhov, Korotkevich, Korotkova, & Konovalov, 2013; Miller et al., 2013; Narozhnykh et al., 2016, 2016; Narozhykh et al., 2017; Osadchuk et al., 2017; Syso et al., 2017).

All these factors can affect the quality of animal husbandry products. Without limiting the preceding, within the large pigs raising complexes, animal health problems are not completely observed. Among such diseases, liver diseases are prominent. This is clearly evidenced by the ALT/AST ratio. This is due to the intensification of pork production negatively affecting the physiological state of the animal's organism. Our research has shown that the local Kemerovo breed pigs are better adapted to the conditions of large industrial complex with presence of many stress factors. This is demonstrated by such indicators as: urea, ACT activity, de Ritis coefficient and phosphorus content. Thus, intrabreed difference of the level of phenotypic variability on some biochemical parameters was revealed. The selected biochemical parameters can be used to assess the interior of animals, the phenotypic similarity of breeds, can be taken into account in environmental studies and recommended to farmers as biochemical parameters used to assess the physiological status of animals in large industrial pig raising complexes. The data presented are part of a comprehensive

study of the gene pool- and phene pool of porcine breeds in Western Siberia by molecular genetics, immunogenetic, cytological, cytochemical, immunological and zootechnical parameters (Kamaldinov, 2013; Petukhov et al., 2012).

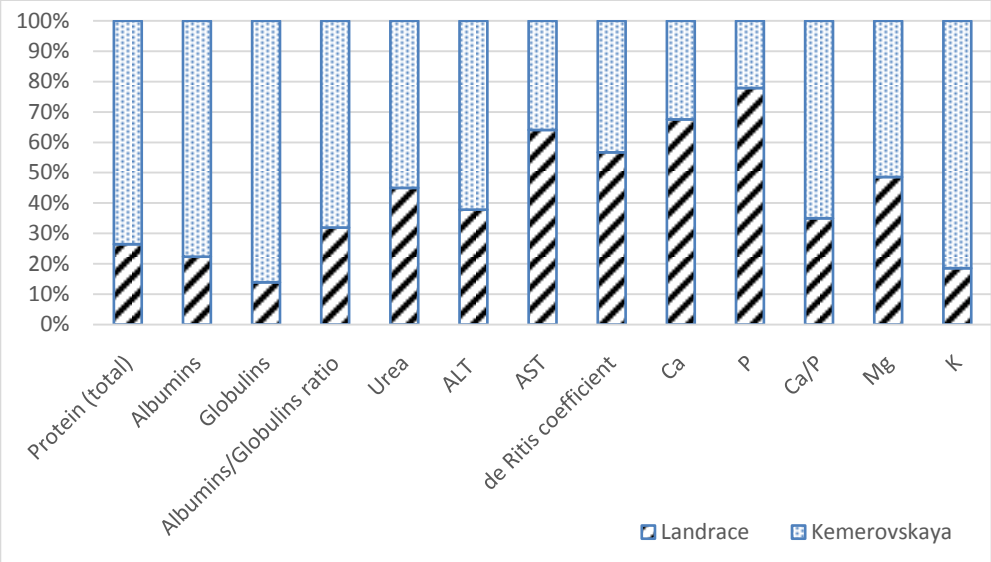

Figure 1 Variability of the biochemical indices in relation to Landrace and Kemerovskaya pig breeds

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