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COMPARISON OF QUALITY PROPERTIES OF CERTAIN VARIETIES OF FRESH AND FROZEN GREEN BEANS

Abstract

Green beans is a vegetable rich in nutritional and bioactive component. In this paper, three varieties of green beans grown in the vicinity of Skopje were used: *golden molivka*, *green molivka*, and *colorful butter* green beans. Freezing technology with blanching as a pretreatment has been applied. A comparison was made of the obtained sensory and nutritional properties, of fresh and frozen green beans. It was determined the content of proteins, fats, carbohydrates, water, total dry matter and the energy value. The green beans, variety *golden molivka* was distinguished by the highest energy value as fresh kcal 50,75, blanched 45,31 kcal and frozen 30,62 kcal.

Key words: *green beans*, *sensorial*, *nutritional properties*, *energy value*

INTRODUCTION

Green beans (*Phaseolus vulgaris*, L.) are one-year crops that botanically belong to the same family as the beans. Young legumes are used in human nutrition. It is a significant agricultural crop that is produced in many countries in the world. It is successfully grown in the Republic of Macedonia due to the favorable climatic and soil conditions. In our country, the green beans are produced on an area of about 1000 ha.

Today, there are more than a thousand different forms of green beans in the world, which are divided into several groups according to their different characteristics. Legumes, depending on the variety and cultivation conditions, vary widely according to their shape, color, length and breadth. Regarding the length, the green beans legumes may be: short (4–6 cm), medium (11–13 cm), long (14–20 cm), and some may even reach over 20 cm. The width of the legumes can be from 0.8 to 2 cm. In terms of shape, the green beans legumes can be flat or cylindrical, but also can be straight and more or less bent. According to the color, the young legumes may be yellow, waxy yellow, pale green, green, purple or sprayed with anthocyanins spots on a green or yellow basis. The legumes can contain from 4 to 10 and more grains, depending on the variety, with a different in shape and color (Tudzarov, 1990).

When choosing a variety, care must be taken to avoid any threads. The appearance of threads is a varietal feature, but most varieties in the mature state have threads on the edges of the legumes, which makes them inadequate for eating and for various processing treatments (Ljubosavljević, 1989). It is best to use youth green beans, immediately after harvesting during the season, in the summer months or early autumn. According to the national regulations, when determining the quality of green beans, for the legumes it is important to be whole, healthy, clean, fresh at the first glance, without debris of broken legumes, without pesticide damage, without excess moisture and any outer odor (Todorović, 2008).

The green bean is a plant that have a significant application in human nutrition because of its nutritional value. The nutritional value is determined according to the content of proteins, carbohydrates, oils, cellulose, vitamins and other components that characterize the biological value of the green beans. The green beans, depending on the variety and the method of processing, usually have a low energy value (32–38 kcal) what makes it the ideal food for humans. According to Vračar (2012), in terms of their chemical composition, the green beans are characterized by low content of total acids, low energy value due the average value of total dry matters of about 10%, which includes: total carbohydrates with 6.5 %; proteins 2.5 % and minerals 0.8 % (K, Ca, Na, Mg, Fe) and vitamins (A, B₁, B₃, B₆, C, etc.) (Neuss, 2010).

The content of some micronutrients of 100 g fresh green beans according to the examinations of the National Institute for Health and Welfare, Nutrition Unit (2011) were: sodium 6 mg; potassium 320 mg; calcium 48 mg; phosphorus 40 mg; carotenoids 657.2 µg; folate 140 µg; vitamin A 16.2 µg; vitamin K 47 µg and vitamin C 20 µg. According to Adams et al. (2006), the green beans are an excellent source of vitamin K, which plays an important role in the bone mineralization. Also, the green beans are a good source of vitamin A, due to the high content of carotenoids, which are important antioxidants that protect against cardiovascular disease, some types of cancer, etc. It is characterized by rich content of high-quality amino acids and raw fibers that are important for proper digestion and function of the colon. Green beans are recommended in a well-balanced diet, which is characterized by nutritional benefits in the fight against human diseases (Byers & Perry, 1992).

The green beans contain substances that are not desirable in the diet, such as cyanogenic glycoside (phasinine), as well as nitrates whose permitted daily amount according to FAO is 5 mg/kg body weight (Todorovic, 2008). The green beans should

not be consumed fresh because it contains the phytohemagglutinin, which is a lectin, or a protein linked to sugar and it is toxic if the green beans are consumed fresh (Hameltryck et al., 1996).

Due to the low energy value and the nutritional importance of the green beans, people use various preparation methods to make the green beans available for consumption year around. There are several known methods for domestic and industrial preservation of the green beans, such as: drying, biological preservation, salting, sterilization, and freezing. The frozen green beans is a product that is traditionally used in our diet. Suitable for processing are the green beans with good quality, gentle legumes, smaller grains and beautiful green color, which after defrosting maintain color and aroma. (Ljubosavljevic, 1989). For freezing, today are used fully automated mechanized technological lines, which provide rapid, continuous and uniform production. Before the freezing of the green beans, a blanching is applied. The process of freezing is performed mostly in continuous tunnels at -35°C or lower. During the processing of the green beans, there are certain changes in its nutritional value, what depends on its chemical composition as well as on the applied technological process (Vračar, 2012).

MATERIALS AND METHODS

Material of examination – during the preparation of this paper were used the legumes fruits of three varieties of green bean legumes were used for the preparations of this paper. They are produced by individual farmers at the villages in the vicinity of Skopje. The following varieties of green beans were used: yellow thin (*golden molivka*) produced at the village of Stajkovci; green thin (*green molivka*) produced at the village of Brnjarci; *colorful butter* green beans produced at the village of Dolno Lisice.

Freezing method – the fresh green beans were blanched and frozen in homes conditions and were used for comparison of nutritional and energy value with: frozen yellow green beans from three producers and frozen green beans from two producers, that were purchased from local markets.

For the freezing of the green beans in home conditions, were used young, healthy and fresh legumes that had the tops and stems removed. They were washed with clean water, cut into 2 to 3 pieces and placed in a pot of boiling water for 10 minutes. They were removed from water into a strainer, cooled and placed in polyethylene bags. Before closing the bags, it is important to squeeze the entire air out. Closed bags were placed in a refrigerator for deep freezing (Tudzarov, 1990).

Industrial freezing of green beans is performed at very low temperatures, and depending on the technological line, appropriate temperatures and freezing times are applied. If the freezing is appropriately done, the food undergoes very small changes in their sensorial properties and nutritional values (Fellows, 2000).

The freezing technology includes the following operations: reception and quality assessment; transport and dosage; air floatation; separating and dividing up of the legumes that are stuck together; rough and fine washing; acceptance and dosage; removing of the tops of the legumes; inspection; cross cutting; separation of small

parts; blanching; cooling and separation of water; inspection; drying of moisture; freezing; acceptance and inspection; packaging in single or group packaging; inspection and detection of metal particles; storage (Vračar, 2012).

Blanching is carried out at a temperature of 85°C , for 3 to 5 minutes, with boiling water or with water vapor. Then it is necessary to cool the green beans with cold water for 1 to 2 minutes and leave it to drain. The green beans should be subjected to flash freezing, under strictly controlled conditions at -35°C or lower, for 25 to 60 minutes, so that the temperature at the center of the package should not be higher than -18°C . The frozen green beans should be packaged in appropriate packaging, which must be correctly declared. Frozen green beans are carried into a storage chamber, at a temperature of -20°C or lower, in order to preserve the quality for up to 12 months (Vračar, 2012).

The production facilities in which all phases of the technological process of production of frozen green beans are performed, as well as the premises in which finished products are stored, need to be strictly controlled and meet the minimum required hygienic conditions. Due to the applying good manufacturing and hygiene practice, quality products are obtained, in which chemical changes are insignificantly. The transport of the frozen product is carried out with means of transport that provides the same hygienic and temperature conditions for the maintenance of the frozen products.

The laboratory analysis were performed to assess the quality properties of the examined varieties of green beans, both, in fresh and frozen condition. The following sample properties were examined: the length and width in fresh legumes; sensory properties (appearance, color, taste and smell) in fresh, blanched and frozen condition. In determining the chemical properties, standard laboratory methods were used, with proved statistical precision, accuracy and repeatability of the results. The following chemical properties were determined: total dry matter and water by drying at drying ovens, at a temperature of 105°C , to a constant mass; proteins by Kjeldahl method; fats by extraction with organic solvents according to the Soxhlet method (Vračar, 2001); total carbohydrates were determined by calculation, based on the determined values for proteins, fats and water; the total energy value represents the sum of the energy value of proteins, fats and total carbohydrates, expressed in calories (kcal) or kilojoules (kJ).

RESULTS AND DISCUSSION

Length and width of fresh legumes – the legumes of the variety *golden molivka* were characterized by a width of 0.8 to 1 cm and a length of 10–13 cm. The legumes of the variety *green molivka* was characterized by a width of about 1 cm, with a different length of 14–18 cm. The *colorful butter* green beans legumes were by a width of 1 to 1.5 cm, with a length of 12 to 15 cm. According to Ljubosavljević (1989), these three varieties are characterized with: 12 to 15 cm in length and about 1 cm in width for *golden molivka*; 1 cm width and length of 14–18 cm for *green molivka*; length of about 10 cm for *colorful butter* green beans.

Sensory properties of the examined varieties of green beans – the legumes of the variety *golden molivka*, in fresh condition were characterized by golden-yellow

color, in shape were straight, round, with poorly expressed aroma, with a typical taste of green beans, solid, fragile and juicy. In the blanched state, the legumes got softer, their color did not change, but their aroma and taste became weaker expressed. The frozen legumes did not change the color, taste or the aroma from the blanched state, they were solid, but became softer with defrosting.

The legumes of the variety *green molivka* in fresh condition were green, fragile and juicy, straight in shape, round, with a distinctive flavor and taste for green beans that are poorly expressed. In the blanched state, the legumes were getting softer, the color did not change, and the taste and the aroma were of a lower intensity. In the frozen condition, the color of the green beans remains unchanged, they were solid, but with defrosting became - softer.

The *colorful butter* green beans in fresh condition, the legumes were flattened shape, straight, with a flavorless taste and a weak characteristic aroma, a yellow color with anthocyanin spots, fragile and juicy. After blanching for 10 minutes, the anthocyanin spots were lost, the legumes became yellowish gray, soft, and the flavor and taste were even weaker. If before the freezing the legumes are blanched 3 to 4 minutes, the anthocyanin spots on the legumes remain unchanged. Frozen legumes were solid, but with defrosting became softer.

Total nutritional value of the examined samples of green beans – On the basis of the performed analysis for the chemical properties of the samples of fresh, blanched and frozen green beans, were determined the values for: water, total dry matter, total carbohydrates, proteins and oils, according on which were calculated their energy values.

According to the obtained results, presented in Table 1., below, in terms of the green beans condition, fresh, blanched or frozen, the variety *golden molivka* as fresh was characterized by the highest values of total dry matter (10.38 %), total carbohydrates (5.27 %), proteins (3.78 %), oils (1.24 %) and total energy value (48.99 kcal or 205.13 kJ). In frozen green beans of this variety, the highest value of water content (92.70 %) was determined, as well as the lowest values of total dry matter (7.70 %), total carbohydrates (4.82 %), proteins (2.53 %), oils (0.35 %) and total energy value (33.38 kcal or 139.76 kJ).

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The variety *green molivka* was characterized by the highest values of total dry matter (11.81 %), total carbohydrates (8.10 %), proteins (3.26 %), oils (0.45 %) and total energy value (50.75 kcal or 212.46 kJ). The frozen green beans of this variety were characterized by the highest value of water content (90.00 %), and the lowest values of total dry matter (10.00 %), total carbohydrates (6.80 %), proteins (2.11 %), oils (0.2 %) and total energy value (37.36 kcal or 156.41 kJ).

Table 1. Nutritional value of 100 g for the examined varieties of green beans

Variety	Condition	Water	Total dry matter	Total carbohydrates	Proteins	Oils	Energy values	
							kcal	kJ
<i>golden molivka</i>	fresh	89.62	10.38	5.27	3.78	1.24	48.99	205.13
	blanched	91.10	8.90	5.00	3.12	0.78	40.54	169.71
	frozen	92.70	7.70	4.82	2.53	0.35	33.38	139.76
<i>green molivka</i>	fresh	88.19	11.81	8.10	3.26	0.45	50.75	212.46
	blanched	89.20	10.80	7.84	2.76	0.20	45.31	189.69
	frozen	90.00	10.00	6.80	2.11	0.20	37.36	156.41
<i>Colorful butter</i> green beans	fresh	90.25	9.75	6.49	2.45	0.84	44.33	185.61
	blanched	93.10	6.90	4.09	2.30	0.54	31.62	132.40
	frozen	92.80	7.20	4.86	2.12	0.22	30.67	128.35

For the fresh *colorful butter* green beans were estimated the highest values of total dry matter (9.75%), total carbohydrates (6.49 %), proteins (2.45 %), oils (0.84 %) and total energy value (44.33 kcal or 185.61 kJ). The highest value of water content (93.10 %) was determined for blanched beans, and also the lowest values of total dry matter (6.90 %) and total carbohydrates (4.09 %). Frozen green beans from this variety were distinguished with the lowest values of proteins (2.12 %), oils (0.22 %) and total energy value (30.67 kcal or 128.35 kJ).

In terms of the variety, according to the results presented in Table 1, it can be concluded that for the fresh green beans: the variety *golden molivka* was characterized by the highest values of proteins (3.78 %) and oils (1.24 %); the variety of *green molivka* was characterized by the highest values of total dry matter (11.81 %), total carbohydrates (8.10 %) and total energy value (50.75 kcal or 212.46 kJ); the highest value of water content (90.25%) and the lowest values of total dry matter (9.75%), proteins (2.45%) and total energy value (44.33 kcal or 185.61 kJ) were determined for *colorful butter* green beans.

According to the data from the National Institute for Health and Welfare, Nutrition Unit (2011), in 100 g fresh green beans were estimate following average nutritional values: carbohydrate 4.10 g, protein 1.90 g, oil 0.20 g, while the average energy value was 32.00 kcal. Comparing the results obtained from the examined varieties with the literature data, it can be concluded that the green beans that are cultivated in our country have better nutritional quality and higher energy value, which is due primarily to the favorable soil and climatic conditions.

The following results were obtained by the examination of the three varieties of blanched green beans: the *golden molivka* variety was characterized by the highest values of proteins (3.12 %) and oils (0.78 %); the variety of *green molivka* was characterized by the highest values of total dry matter (10.80 %), total carbohydrates (7.84 %) and total energy value (45.31 kcal or 189.69 kJ); the highest value of water content (93.10 %) and the lowest values of total dry matter (6.90%), total carbohydrates (4.09 %), proteins (2.30 %) and total energy value (31.62 kcal or 132.40 kJ) were determined for the variety *colorful butter* green beans.

According to the Table 1, for the examined varieties of frozen green beans were obtained the following results: the *golden molivka* was characterized by the highest values of proteins (2.53 %) and oils (0.35 %); the variety of *green molivka* was characterized by the highest values of total dry matter (10.00 %), total carbohydrates (6.80 %) and total energy value (37.36 kcal or 156.41 kJ); the highest value of water content (92.80%) and the lowest values of total dry matter (7.20%) and total energy value (30.67 kcal or 128.35 kJ) was determined for *colorful butter* green beans.

Based on the analysis of the frozen yellow colored green beans, from three different producers, we can conclude that the results for their nutritional and energy values were in the following ranges: total carbohydrates from 5.20 % to 7.00 % or an average value of 6.40 %; proteins from 1.40 % to 1.60 % or an average value of 0.47 %, oils from 0.10 % to 0.20 % or an average value of 0.17 %, and the energy values were in the range of 30.00 kcal to 36.20 kcal or an average value of 34.12 kcal.

In the frozen green colored green beans of two different producers, the following nutritional and energy values have been determined: total carbohydrates were in the range of 5.80 % to 6.00 % or an average value of 5.90 %; proteins with a total value of 2.20 %; oils from 0.20 % to 0.70 % or an average value of 0.45 %; while the energy values were in the range of 28.00 kcal to 41.40 kcal or an average value of 34.70 kcal.

The difference in values obtained by the analysis of the examined frozen samples purchased from local markets and on homemade frozen samples are due to the fact that they were obtained by analyzing different varieties of green beans grown under different soil and climatic conditions.

CONCLUSION

As a result of the performed analyzes and presented results of examinations, the following conclusions can be made: for the legumes of *golden molivka* and *green molivka* varieties, the yellow and green color respectively were retained after blanching and freezing; the legumes of the *colorful butter* green beans were yellow, with anthocyanin spots and by blanching were lost and they become yellow gray; the average value for the width was determined as the lowest 0.8 cm for the *golden molivka* variety, and the highest 1.5 cm for the variety of *colorful butter* green beans; the average value for the length was estimated as the lowest 10 cm for the *golden molivka* variety, and the highest average value of 18 cm for the variety of *green molivka*.

According to the obtained results in this research can be concluded that the content of the assessed nutrients, as well as the determined energy values are higher in the examined homemade varieties compared to frozen green beans from different producers. It can be concluded that green beans have excellent growing conditions opportunities in our country and due to the good nutritional value need to be used more in our diet, such as vegetables rich in nutritional properties and with a good health benefits.

REFERENCES

1. Adams MR, Golden DL, Chen H et al. (2006). A Diet Rich in Green and Yellow Vegetables Inhibits Atherosclerosis in Mice. The Journal of Nutrition. Bethesda: Jul. Vol. 136, Iss. 7; pg. 1886–1889.
2. Byers, T., & Perry, G. (1992). Dietary carotenes, vitamin C and vitamin E as protective antioxidants in human cancers. Annual Reviews in Nutrition, 12, 139–159.
3. Fellows P. (2000) Food processing technology – Principles and Practice Second Edition, Cambridge England.
4. Hamelryck T, Dao-Thi M, Poortmans F, Chrispeels M, Wyns L, Loris R (1996). The cryo-stallographic structure of phytohemagglutinin-L.
5. Ljubisavljevic M., 1989 Voce povrce pecurke i preradevine, Beograd.
6. National Institute for Health and Welfare, Nutrition Unit, 2011.
7. Neuss G. (2010), Chemistry, Oxford pg. 310.
8. Todorović J., Vasić M; Todorović V., (2008). Pasulj I Boranija – Poljoprivredni fakultet Banja Luka.
9. Tuparov T. (1990), Грашок, Грав, Боранија и Бакла – Наша книга, Скопје.
10. Vračar LJ. (2001). Priručnik za kontrolu kvaliteta i svežeg i preradenog voća, povrća i pečurki i osvežavajućih bezalkoholnih pića, Novi Sad, 2001, 220; 20, 48–53.

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ПОРЕЂЕЊЕ КАРАКТЕРИСТИКЕ КВАЛИТЕТА СВЕЖИХ И ЗАМРЗНУТИХ СОРТИ БОРАНИЈЕ

Апстракт

Боранија је билька богата са нутритивном и биохитивном компонентом. У овом раду коришћене су три сорте бораније гајене у близини Скопља: златна моливка, зелена моливка и шарена путер боранија. Примењена је технологија замрзавања са бланширањем као претрајментом. Изражено је поређење добијених сензорних и нутритивних својстава свеже и замрзнуте бораније. Утврђен је садржај протеина, масти, угљених хидрата, воје, укупне суве материје и енергетске вредности. Сорта бораније златна моливка имала је највишу енергетску вредност као свежа 50,75 kcal, бланширана 45,31 kcal и замрзнута 30,62 kcal.

Кључне речи: боранија, сензорна, нутритивна својства, енергетска вредност