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INFLUENCE OF SUPPLEMENTED GENISTEIN AND DAIDZEIN ON THE PRODUCTION PERFORMANCE AND EGG STRUCTURE DURING THE FIRST EGG-LAYING CYCLE

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A b s t r a c t: The process of egg formation and egg quality depend on several biomechanisms that can be modifed by various environmental, genetic and nutritional components. This experiment was performed to estimate the influence of supplementation with dietary isoflavones (daidzein and genistein) in feed on the production performance and egg structure during the first egg production period. Eighty ISA Brown laying hens were randomly divided into four groups, 20 birds per group, and surveyed during 3 consecutive periods (27–42 wks, 43–60 wks and over 60 wks). Concerning diet supplemented with isoflavones (genistein and daidzein), the egg weight was statistically different compared with the control group (confidence interval of 95%) in all the 3 periods of the experiment. The yolk:white ratio was significantly higher in the control group compared with the groups fed with 1000, 2000 and 3000 mg of isoflavones per 1 kg of feed in the periods of 27–42 wks and 43–60 wks ($P<0.05$).

Key words: soy isoflavones; laying hens; egg structure

ВЛИЈАНИЕ НА ДОДАВАЊЕТО НА ГЕНИСТЕИН И ДАИДЗЕИН НА ПРОИЗВОДСТВОТО И СТРУКТУРАТА НА ЈАЈЦАТА ВО ТЕКОТ НА ПРВИОТ ЈАЈЦЕНОСЕН ПЕРИОД

А п с т р а к т: Процесот на формирање на јајцето и квалитетот на јајцето зависи од неколку биомеханизми кои можат да се модифицираат од разни компоненти на животната средина, генетските и исхраната. Овој експеримент беше спроведен за да се оцени влијанието на употребата на диетални изофлавони (даидзеин и генистеин) во добиточната храна на производните перформанси и структурата на јајцата во текот на првиот период на производство на јајца. Осумдесет кокошки несилки ИСА Браун беа поделени во четири групи, 20 птици по група и беа испитувани во текот на 3 последователни периоди (27–42 недели, 43–60 недели и над 60 недели). Што се однесува до исхраната надополнета со изофлавони (генистеин и даидзеин, тежината на јајцето беше статистички различна во споредба со контролната група (сингнификантност од 95%) во сите 3 периоди на експериментот. Односот на жолчка: белтокот беше значително повисок во контролната група во споредба со групите хранети со 1000, 2000 и 3000 мг изофлавони на 1 кг добиточна храна во периодите од 27–42 недели и 43–60 недели (P <0,05).

Клучни зборови: изофлавони од соја; кокошки несилки, структура на јајцето

INTRODUCTION

The process of egg formation and subsequent egg quality is dependent on several biomechanisms that can be altered by various environmental, genetic and nutritional components (Chukuwuka et al., 2011). Nutritional manipulation and genetic selection for egg size and production may lead to changes in egg components. Poultry eggs are one of the most attractive targets for nutrition modulation, owing to the extraordinary responsiveness of most of its properties to dietary factors (Wang et al., 2017). Inclusion of the soybean meal which is the good source of protein and isoflavones in the poultry feed rapidly increased in recent years. The isoflavones are potential dietary supplement that may affect the growth (Jiang et al., 2007; Gjorgovska et al., 2014), the productive performance (Gjorgovska et al., 2016), deposition in the egg yolk (Saitoh et al., 2001; Lin et al., 2004; Gjorgovska and Kiril, 2013), reducing the egg yolk cholesterol (Gjorgovska et al., 2015) and positive and some negative impact.

Therefore, the purpose of this experiment was to evaluate the effect of isoflavones on the productive performance and egg quality during first egg laying cycle.

MATERIAL AND METHODS

Eighty ISA Brown laying hens were randomly divided into four groups, 20 birds per group and estimate during 3 periods (27 – 42 wks, 43 – 60 wks and Over 60 wks). The hens were housed in laying cages (2 birds per cage) in a standard poultry house. The laying hens were fed basal feed (control group) and the supplemented feed with 1000, 2000 and 3000 mg isoflavones per kg feed. Water was offered for ad libitum consumption throughout the experiment, which was conducted for 12 months. The experimental feed was supplemented with a concentrated product, 40% isoflavones, produced by the North China Pharmaceutical Corporation. The isoflavone composition of the product is presented in Table 1.

Table 1

Composition of the 40% isoflavone product

Isoflavone	%
1. Genistin	7.30
2. Genistein	1.26
3. Daidzin	22.12
4. Daidzein	1.74
5. Glycitin	8.01
6. Glycitein	0.45
Total	40.88

Table 2

Composition and nutritive value of the basal feed (BF)

Ingredient, g/kg	Period from hatch to 6 weeks	From 6 weeks to 13 weeks	From 13 weeks to 16 weeks	Before the first egg laid (16 to 20 weeks)
Maize	562.3	603.9	607.2	552.5
Soybean meal 44%	188.4	187.8	74.1	168.9
Sunflower meal 33%	153.4	65.0	146.8	150.0
Fish meal	50.0	25.7	–	–
Wheat bran	–	73.4	127.8	50.0
Soybean oil	3.5	–	–	7.0
Methionine 99%	0.7	0.2	0.3	0.7
L-lysine	1.0	0.7	0.8	0.6
Calcium carbonate	16.4	19.8	18.2	43.9
Mono calcium phosphate	14.2	13.2	13.8	14.5
$NaHCO_3$	–	–	1.0	1.6
Minezyl (Zeolites)	3.0	3.0	3.0	3.0
Salt	2.2	2.2	2.1	2.4
Mineral premix	5.0	5.0	5.0	5.0
Total	1000	1000	1000	1000
Chemical composition, calculated				
Dry matter, g/kg	89.24	89.04	88.95	89.42
Metabolic energy, kcal/kg	2900	2800	2750	2750
Crude protein, g/kg	21.44	18.20	14.81	17.50
Crude fat, g/kg	3.14	2.86	2.89	3.13
Calcium, g/kg	1.05	1.10	1.00	2.00
Phosphorus (available), g/kg	0.78	0.74	0.81	0.78
Lysine, g/kg	1.20	1.00	0.65	0.85
DL Methonine, g/kg	0.53	0.39	0.33	0.41
Methionine + cystine, g/kg	0.83	0.67	0.57	0.68
Soybean meal isoflavones, mg/kg*	43.33	43.19	17.04	38.85

*Native isoflavones in soybean meal

Egg collection and egg quality analysis: The number of produced eggs was monitored every day. The egg structure parameters (egg weight, white weight, yolk weight and eggshell weight) and their percentage in the egg weight was measured on 6 randomly selected eggs 3 times during the experiment (every 15th day) on balance with 0.1 g accuracy. The eggs were weighed, and then yolks were separated with an egg separator and weighed. The shell was wiped clean and weighed. The albumen weight was calculated by subtracting yolk and shell weight from total egg weight.

RESULTS AND DISCUSSION

Hen's weight, egg production and feed intake of laying hens in the four groups are shown in Table 3. The egg production of laying hens during the first egg laying cycle was similar across the treatment ($P > 0.05$).

Table 3

Supplemented genistein and daidzein's influence on the laying performance during the first egg-laying cycle

	27 – 42 wks				43 – 60 wks				Over 60 wks			
	Basal feed (BF)	BF +1000 mg SI/kg	BF +2000 mg SI/kg	BF +3000 mg SI/kg	Basal feed (BF)	BF +1000 mg SI/kg	BF +2000 mg SI/kg	BF +3000 mg SI/kg	Basal feed (BF)	BF +1000 mg SI/kg	BF +2000 mg SI/kg	BF +3000 mg SI/kg
Number of hens	20	20	20	20	20	20	20	20	20	20	20	20
Hen's weight												
– initial, g	1674 ±128	1688 ±122	1660 ±97	1680 ±155	1781 ±109	1800 ±111	1760 ±105	1768 ±165	1928± 183	1809 ±193	1934 ±169	1883 ±180
– final, g	1772 ±111	1774 ±110	1756 ±109	1761 ±170	2049 ±204	1842 ±256	2063 ±204	2016 ±204	1940 ±176	1851 ±220	1919 ±168	1860 ±178
Egg, production, %	92.60	88.18	91.41	95.00	83.00	76.80	75.06	80.60	74.31	65.60	58.70	66.27
Feed consumption												
– daily consumption, g	110	110	110	110	115	115	115	115	120	120	120	120

Values are means ± S.D

$^{a\text{-}b}$ Different superscripts within collumns are significantly different ($P<0.05$).

In Table 4 are presented the results of the egg parameters during the first egg laying cycle of the laying hens fed with diet supplemented with different dose of genistein and daidzein. Nutritional manipulation for egg size and production may lead to changes in egg components. Isoflavones inclusion into the feeding ration of laying hens improved the pre-ovulation follicular development (Liu and Zhang, 2008), increased the egg weight and the laying performance (Guo-zhen and Li, 2014), increased the eggshell thickness and strength and raised the level of calcium in the shell (Etxeberria et al., 2013). This experiment was carried out to analyze the egg structure parameters of eggs produced by Hisex Brown laying hens fed with diet with different supplements inclusion. The egg weight during the trial was significantly different ($P<0.05$) in comparison of the control group and other groups of laying hens fed with 1000, 2000 and 3000 mg/kg supplemented genistein and daidzein. Egg weights were the greatest in laying hens supplemented with genistein and daidzein, whereas they were the lowest in laying hens unsupplemented with genistein and daidzein (Table 4). Similar trends were also noted in white weights and yolk:white ratio in response to the dietary treatments, while there was no differences in egg yolk egg shell, egg percentage (white, yolk and shell) and edible portion ($P>0.05$). The present study provided evidence that genistein and daidzein significantly effected the egg weignt and the egg white and yolk:white ratio during the first year period of egg laying in ISA hens (Table 2). The improvement of the two egg quality characteristics (egg weight and white weight) was therefore probably due to increases the albumen formation which is the biggest egg component. Previous studies from Saitoh *et al*. (2001) and Zhao *et al*. (2005) have also shown that soy isoflavone supplementation improved egg production and egg quality in poultry. In the experiment performed by Shi et al. have been shown that isoflavones added as supplements in the diet of laying hens during the later period of laying, after the peak production, significantly affect egg production, egg weight and feed conversion.

The highest value (44.00±5.75) of the yolk: white ratio was noticed in the eggs of the control group (P<0.05) during the period from 43rd week to 60st week laying hen's age. Several factors affect total edible portion and yolk:white ratio. Age of hen, size of eggs, nutrition, and strain can affect these parameters (Ahmadi and Rahimi, 2011; Roberts, 2004; Galea, 2011).

Table 4

Supplemented genistein and daidzein's influence on the egg quality during the first egg-laying cycle

	27 – 42 wks				43 – 60 wks				Over 60 wks			
	Basal feed (BF)	BF +1000 mg SI/kg	BF +2000 mg SI/kg	BF +3000 mg SI/kg	Basal feed (BF)	BF +1000 mg SI/kg	BF +2000 mg SI/kg	BF +3000 mg SI/kg	Basal feed (BF)	BF +1000 mg SI/kg	BF +2000 mg SI/kg	BF +3000 mg SI/kg
Egg, g	59.56 ±5.47^{a}	63.50 ±4.54^{b}	61.89 ±5.93^{b}	63.34 ±5.90^{b}	63.71 ±3.88^{a}	67.18 ±5.27^{b}	68.76 ±4.76^{b}	66.19 ±4.36^{b}	65.51 ±2.95^{a}	70.80 ±3.62^{b}	68.33 ±5.08^{b}	67.53 ±4.90^{b}
White, g	38.02 ±3.48	41.17 ±3.21	39.90 ±4.21	40.81 ±3.90	39.70 ±3.54a	41.95 ±4.23^{ab}	43.19 ±3.75^{b}	41.75 ±3.10^{ab}	41.80 ±1.86^{a}	45.24 ±3.46^{b}	43.49 ±3.62^{b}	43.47 ±3.68^{b}
Yolk, g	14.86 ±2.05	15.30 ±1.68	15.09 ±1.90	15.49 ±1.95	17.30 ±1.29	17.73 ±1.29	18.46 ±1.89	17.43 ±1.67	16.61 ±1.37	18.17 ±1.09	17.39 ±1.40	16.87 ±1.41
Shell, g	6.68 ±0.61	7.03 ±0.56	6.91 ±0.66	7.06 ±0.66	6.71 ±0.85	7.50 ±0.66	7.11 ±0.91	7.00 ±0.48	7.10 ±0.67	7.39 ±0.70	7.45 ±0.70	7.20 ±0.65
White, %	63.87 ±1.95	64.83 ±1.84	64.44 ±2.20	64.44 ±1.64	62.23 ±2.42	62.37 ±2.22	62.78 ±2.52	63.07 ±1.59	63.81 ±1.95	63.83 ±2.09	63.62 ±1.71	64.34 ±1.78
Yolk, %	24.89 ±1.82	24.08 ±1.85	24.39 ±2.02	24.41 ±1.59	27.25 ±2.59	26.46 ±1.73	26.88 ±2.41	26.31 ±1.47	25.34 ±1.64	25.71 ±1.71	25.47 ±1.24	25.00 ±1.64
Shell, %	11.24 ±0.83	11.08 ±0.69	11.18 ±0.64	11.15 ±0.70	10.52 ±1.06	11.18 ±0.80	10.34 ±1.12	10.61 ±0.87	10.83 ±0.74	10.46 ±1.14	10.91 ±0.73	10.66 ±0.67
Edible portion, %	88.76 ±0.83	88.92 ±0.69	88.82 ±0.64	88.85 ±0.70	89.48 ±1.06	88.82 ±0.80	89.66 ±1.12	89.39 ±0.87	89.17 ±0.74	89.54 ±1.14	89.09 ±0.73	89.34 ±0.67
Yolk:white	39.09 ±4.06^{a}	37.25 ±3.88^{b}	37.99 ±4.39^{b}	37.97 ±3.38^{b}	44.00 ±5.75^{a}	42.56 ±4.28 b	43.00 ±5.26 b	41.79 ±3.27 b	39.79 ±3.63	40.38 ±3.85	40.11 ±2.96	38.95 ±3.57

Values are means ± S.D

[a-b] Different superscripts within collumns are significantly different (P＜0.05).

CONCLUSIONS

In conclusion, data obtained in the present study showed that suitable and available genistein and daidzein supplements could improve egg weight and white weight. The egg weight and egg white during the trial was significantly different (P<0.05) in comparison of the control group and other groups of laying hens fed with 1000, 2000 and 3000 mg/kg supplemented genistein and daidzein. Egg weights and white were the greatest in laying hens supplemented with genistein and daidzein, whereas they were the lowest in laying hens unsupplemented with genistein and daidzein

These findings indicated that the genistein and daidzein could be a very effective additive to improve laying performance and egg quality in the birds during the whole first egg laying period.

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