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THE EFFECT OF ADDITION OF ORGANIC SELENIUM ON PHEASANT PRODUCTION CHARACTERISTICS

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Abstract: The effect of organic selenium as feed additive contained in the feed was investigated, applied in concentrations of 0.3 and 0.4 mg Se/kg mixture on production characteristics pheasant. The study was conducted on a total of 45 common pheasant individuals *Phasianus colchicus,* six weeks old, divided into three equal groups of 15 individuals for 60 days. The control pheasants group was fed with a standard mixture without addition of selenium during the experiment, while the mixture of group I contained 0.15 g/kg and pheasants group II had 0.20 g/kg additives with organic selenium. The results showed that different amounts of organic selenium presence in pheasants' feed had a positive effect on analyzed productivity indicators of pheasants' growth rate, both their final body weight and weight gain ($p<0.05$). Among examined groups of pheasant, gained differences in average feed conversion and total production index were not statistically significant ($p> 0.05$). The best production results were achieved by individual II group, which also had the highest selenium content in muscle tissue of the pectoral muscles, drumstick and thigh ($p <0.05$).

Key words: pheasant, selenium, production results

Introduction

Pheasants brought up in aviaries receive is gaining importance not only as a game species, but also as a good dietary foodstuff for human consumption. The basic preconditions for a successful breeding of pheasants are providing of housing conditions, health care and feed quality throughout the production process. Technological modifications of high-quality pheasants' meat obtaining involve usage of different biologically active substances (nutricines), organic growth

promoters and related minerals to improve production parameters and higher percentage of bioactive substances in meat obtaining (*Adams, 1999*).

Selenium has many physiological functions in the organism and actively participates in the regulation of the body's cells redox potential, as well in antioxidant defense against free radicals in the organism of mammals and birds. Therewith, selenium is an integral part of many proteins that affect the normal functioning of the thyroid, prostate, pancreas, reproductive organs, and the entire immune system. The largest depots of selenium are placed in liver, kidney cortex, pancreas, pituitary, while the lowest concentrations are in adipose tissue (*Rotruck et al., 1973; Surai, 2000, 2002*).

Previous researches in poultry nutrition have confirmed that better production performance, health improvement and obtaining of functional products, can be achieved by organic selenium usage, which is usually linked to methionine amino acid, so-called selenium amino acid preparations (*Cantor, 1997; Edens, 2001*). Selenium deficiency in the poultry organism causes many pathological changes and ailments as: pancreas atrophy, kidney damage, exudativa diathesis, reduced insemination and immunity.

Security level of selenium in the bird's nutrition depends on its chemical composition, with the different of inorganic forms of selenium as selenite and selanatas. Chelated forms of selenium are highly soluble, easily absorbed, and certain organs such as liver, pancreas, skeletal muscles, and kidneys showed a high degree of affinity on them and incorporate them into their proteins. Unused portion of absorbed selenium is excreted from the poultry organism through urine, feces and lungs (*Mihailović, 1996; Jacques, 2001*).

There is a relatively large amount of literature data processing needs and problems of providing selenium in poultry nutrition nowadays, but few of the available researches highlight the influence of organic selenium on production performances and meat quality of pheasants. The aim of this study was to determine the effects of various organic selenium aspects in the nutrition of pheasants, with special emphasis on basic production parameters, utilization of nutrients and quality of certain meat categories.

Materials and methods

The experiment was conducted at the pheasant farm LU Čačak (March, April 2013.) on 45 individuals of common pheasant *Phasianus colchicus*, average body mass K group 385 g, I group 389 g, II group 381 g, six weeks old, divided into three equal groups of 15 individuals each (females and males 8:7). During the experiment which lasted 60 days zoo-hygienic conditions, accommodation and nutrition were adapted to under floor heating system. For pheasants feeding pellet mixture of ordinary composition was used, but the control pheasant group did not

receive organic selenium with the feed (selenomethionine), and as a feed additive for other two groups Alkosel product was used (*Lallemand, Fra*) which composition includes organic selenium in concentration of 2000-2400 mg/kg. Mixtures are composed of FSH "Agroprodukt" – Knić (Serbia) in premix mixer.

Table 1. Ingredients and chemical composition of feed for pheasants (%)

Component, %	**K** (Control)	**I**	**II**
Maize	40.50	40.485	40.48
Feeding meal	3	3	3
Soybean pellet	24	24	24
Sunflower pellet (33% total protein)	4.3	4.3	4.3
Alfalfa meal	3	3	3
Feeding yeast	3.5	3.5	3.5
Soybean grits	12	12	12
Sunflower pellet (42% total protein)	5	5	5
Lysine	0.1	0.1	0.1
Methionine	0.2	0.2	0.2
Feeding chalk	1.6	1.6	1.6
Mono-Ca-phosphate	1.5	1.5	1.5
Iodized salt	0.3	0.3	0.3
Premix	1	1	1
Alkosel	-	0.015	0.020

The average chemical feed composition of all three groups, g/kg: Proteins 242.50; Cellulose 60.50; Ash 73.50; Calcium 10.20; Total phosphorus 8.20; ME MJ/kg 12.75; Lysine 13.50; Methionine + Cystine 9.00. **Addition of the mixture per kg**: Vitamin A (IU/kg) 15000;Vitamin D_3 (IU/kg) 3000; Vitamin E (mg/kg) 32; Biotin (mg/kg) 0.20; Vitamin C (mg/kg) 15; Folic acid (mg/kg) 1.20; Niacin (mg/kg) 30; Pantothenic acid (mg/kg) 15; Vitamin B_6 (mg/kg) 3.20; Vitamin B_2 (mg/kg) 7; Vitamin B_1 (mg/kg) 2.10; Vitamin B_{12} (mg/kg) 0.03; Choline chloride (mg/kg) 500; Fe (mg/kg) 40; Mn (mg/kg) 80; Cu (mg/kg) 8; Zn (mg/kg) 60; J (mg/kg) 0.80; Co (mg/kg) 0.45; Se (mg/kg) 0.30; Antioxidant (mg/kg) 100.
g kg^{-1}

According to the manufacturer's specifications recommended preparation dosage for poultry feeding amounts 100 g/ton, respectively 0.2 mg/kg of organically bounded selenium. During the experiment pheasants of group I were fed with the mixture supplemented with 150 g/t of this preparation, what was equivalent with selenium concentration of 0.3 mg/kg, while the feed of the group II of pheasants contained 200 g/t of this additive, respectively 0.4 mg/kg of selenium. Pheasants were had the ad libitum access to feed and water during the experiment.

Used feed was chemically analyzed at the beginning of the experiment by standard testing methods (*AOAC, 1990*); therewith the energy content and amino acids were obtained by calculations. Ingredients composition of the used pheasants' feed during the experiment is shown in Table 1. The chemical composition of the used premix is shown in the table below (Manufacturer premix FSH "Agroprodukt" – Knić)

Body weight control measurements were performed on decimal, technical balance every ten days, before feeding, and the amount of consumed feed was measured every day. Also, health status of tested individuals, mortality and all behavioral changes were permanently monitored during the experiment. At the end of the 60 days experiment seven individuals were sacrificed from each group (4 females and 3 males). After slaughter and measuring, the basic body parts were segregated (brisket and drumstick with thigh) and measured on decimal scale (accuracy ± 0.03 g), and liver samples were taken for determination of selenium content. Based on the obtained data the production index was calculated at the end of the experiment.

The chemical meat composition of brisket, drumstick and thighs were analyzed by usage of standard testing methods (*AOAC, 1990*), and the search included determination of water content, lard, protein and ash. Selenium content in muscle tissue and pheasants' organs was determined by atomic absorption spectrometry, hydride technique. Statistical data analysis was performed by analysis of variance usage with assessment of statistical significance with the t-test.

Results and Discussion

The chemical composition of the used pheasant's mixtures presented in Table 1 is in accordance with the recommended standards *NRC (1994), Blake and Hess, (2009)*.

Final average pheasants' body weights at all three groups (Table 2) were in the normal range for individuals of this age, with the most intensive growth recorded on 50 and 60 day of the experiment, what is consistent with the results of other researchers (*Strakova et al., 2004; Šperanda et al., 2005*). The best results with statistical significance in terms of body weight was achieved by individuals from group II, when their average body weight was higher by 2.12% compared with the body weight of pheasants from group K ($p < 0.05$), while body weight of the pheasants from group I was statistically significant ($p < 0.05$) and higher than group K for 1.71%. Accordingly, in comparison to the pheasants group K, group II had higher values of total body weight gain for 3.33%, what was statistically significant ($p < 0.05$), and individuals of group I for 2.70%, but this difference was not statistically significant. These are normal values for the investigated production parameters for pheasants growing (*Ristić, 2005; Blake and Hess, 2009*).

Based on the obtained production results (Table 2) it can be concluded that the presence of organic selenium in mixtures for pheasants feeding caused achieving of greater feed intake in groups I and II in relation to K group of pheasants, but these differences were not significant ($p > 0.05$)

Analyzing the feed conversion, evidently the best feed conversion was achieved by group II (with addition of 0.04 mg / kg of selenium in the feed) and it

was amounted 3.14, then group I (with addition of 0.03 mg / kg of selenium in the feed) with the amount of 3.17, and at last the group K with 3.21. Statistical analysis of feed conversion results showed no significant differences among examined groups of pheasant ($p > 0.05$). Gained results are consistent with a numerous researches in which it was found that selenium addition in poultry feed has a positive impact on weight gain, feed conversion ratio reducing and feeding efficiency improving (*Aravind et al., 2001; Arruda et al., 2004; Payne and Southern, 2005*).

The value of production index ranged from 54.90 (K group) to 57.24 (group II). The highest value of this indicator was in pheasants of group II, what is the result of a higher vitality percentage and better feed conversion of this group. Among examined groups of pheasant, gained differences in average weight of the pectoral muscle were not statistically significant ($p > 0.05$) and ranged from 221.50 g in group K to 229.42 g in the group II. During the experiment are not registered mortality in the tested groups

Similar results with no established statistical differences were obtained for drumsticks and thighs mass (Table 3), where the lowest mass had individuals from the group K (197.00 g), and the largest from the group II (205.16 g). Based on the data presented in Table 3, a substantial uniformity of the pheasants' chemical meat composition among groups was obviously, what showing the absence of significant differences ($p > 0.05$), what is consistent with the researches of *Cvrtila et al. (2007)*.

Analysis of the average selenium concentration in pectoral muscle (0.135 mg/g), drumsticks with thighs (0.110 mg/g) and liver (0.410 mg / g) of pheasants from group II showed that they were statistically significant ($p < 0.05$) compared with the K group (pectoral muscle 0.121 μg/g; drumstick with thigh 0.102 μg/g; liver 0.345 μg/g). The presence of organic selenium in pheasants feeding mixtures caused higher concentrations of selenium in the muscle tissue and liver of pheasants' group I, but no significant differences. Based on shown data (Table 3) it can be concluded that concentration of selenium in muscle tissue and liver of pheasant depends on the amount of selenium in feed. Similar results of increasing selenium in broilers had presented a numerous researchers (*Arruda et al., 2004; Payne and Southern, 2005; Bou et al., 2005*) who found that the concentration of selenium in muscle tissue and organs was increased by usage of organic selenium compared with the usage of inorganic forms of this mineral.

Table 2. Production indicators during the test

Groups /days	1	10	20	30	40	50	60
	BW- body weight of live pheasants (g)						
K	385.00	454.00	542.15	663.25	791.75	922.95	1056.45
I	389.00	455.00	543.80	667.25	800.40	936.30	1074.55*
Index, %	-	0.22	0.30	0.60	1.09	1.45	1.71
II	381.00	455.50	545.00	669.40	803.00	939.80	1078.80*
Index, %	-	0.33	0.53	0.93	1.42	1.83	2.12
Groups /days	The average total weight gain per period (g)						
	0-10	**10-20**	**20-30**	**30-40**	**40-50**	**50-60**	**0 - 60**
K	69.00	88.15	121.10	128.50	131.20	133.50	671.45
I	70.00	88.80	123.45	133.15	135.90	138.25	689.55
Index, %	1.45	0.74	1.94	3.62	3.58	3.56	2.70
II	70.50	89.50	124.40	133.60	136.80	139.00	693.80*
Index, %	2.17	1.53	2.73	3.97	4.27	4.12	3.33
Groups /days	The average feed consumption per period (g)						
	0-10	**10-20**	**20-30**	**30-40**	**40-50**	**50-60**	**0 - 60**
K	217.00	237.00	330.00	367.00	386.00	395.00	1932.00
I	218.00	240.00	337.00	375.00	391.00	403.00	1964.00
Index, %	0.46	1.27	2.12	2.18	1.30	2.03	1.66
II	219.00	239.00	336.00	372.00	390.00	402.00	1958.00
Index, %	0.92	0.84	1.82	1.36	1.04	1.77	1.35
Groups /days	The average feed conversion rate per period (g / g)						
	0-10	**10-20**	**20-30**	**30-40**	**40-50**	**50-60**	**0 - 60**
K	3.14	2.69	2.73	2.86	2.94	2.96	3.21
I	3.11	2.70	2.73	2.82	2.88	2.92	3.17
Index, %	-0.97	0.52	0.18	-1.39	-2.21	-1.48	-1.15
II	3.11	2.67	2.70	2.78	2.85	2.89	3.14
Index, %	-1.23	-0.68	-0.88	-2.51	-3.10	-2.25	-2.04

Production index (60 days)		
K	**I**	**II**
54.90	56.50	57.24
Index, %	2.90	4.25

*p<0.05; ** p<0.01

Table 3. Chemical composition and selenium content in muscle and liver of pheasant

Parameters in muscle tissue	**Pectoral muscles**			**Thighs and drumsticks**		
	K	**I**	**II**	**K**	**I**	**II**
Average pH of meat	6.1	6.0	6.2	6.0	6.0	6.1
Mass, g	221.50	224.60	229.42	197.00	203.25	205.16
Moisture, %	72.63	72.38	72.49	73.04	73.00	73.12
Lard, %	1.08	1.10	1.11	4.25	4.26	4.23
Total proteins, %	25.14	25.15	25.11	21.52	21.48	21.51
Ash, %	1.18	1.20	1.20	1.12	1.11	1.09
Selenium, µg/g	0.121	0.129	0.135*	0.102	0.106	0.110*

The content of selenium in the liver			
	K	**I**	**II**
Liver weight, g	22.35	22.50	22.50
Selenium, µg/g	0.345	0.383	0.410*

*p<0.05; ** p<0.01

Previous studies indicated positive effects of selenium addition into feed overall metabolism of nutrients in the organism of animals and poultry. The effect of selenium is based on increasing the concentration of thyroid hormones T3 (triiodothyronine) and T4 (thyroxin), which serves to reduce the concentration of cholesterol in the blood and increase the absorption of glucose, while encouraging protein anabolism (*Iizuka et al., 2001; Gursu et al., 2003*). Organically bounded selenium in the form of selenium-methionine manifests a strong antioxidant effect on the poultry organism. It directly effects on the increase in enzyme glutathione peroxidase increasing in the liver and decreases lipid peroxidase concentration. The result is a high quality meat rich in selenium (*Kang et al., 2000*).

Conclusion

Based on the conducted research, it can be concluded that usage of organic selenium as pheasant mixtures' supplement had a positive effect on examined results of the productions and the selenium content in muscle and liver. The best production results were achieved in the group II which feed had the organic selenium used at a concentration of 0.4 mg/kg. Slightly lower values of production parameters were achieved by pheasants of group I, which mixture contained 0.3 mg/kg of selenium, while the lowest values of the examined parameters were established in the K group.

The results of this study show that pheasants except the status of hunting animals could have a great importance in the meat production of high quality with a significant content of antioxidant – selenium, which could contribute to the prevention of various diseases of the immune system and improve human health status. Also, from an economic point of view, by pheasants feeding mixtures containing selenium optimization, feed conversion could be rationalized and feed costs reduced.

Uticaj dodavanja organskog selena na proizvodne karakteristike fazana

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Rezime

Na osnovu sprovedenih istraživanja može se zaključiti da je upotreba organskog selena kao dodatka smešama za ishranu fazana imala povoljan učinak na ispitivane proizvodne rezultate i sadržaj selena u mišićnom tkivu i jetri. Najbolje

proizvodne rezultate je postigla II grupa fazana u čijoj hrani je upotrebljen organski selen u koncentraciji od 0,4 mg/kg. Nešto niže vrednosti proizvodnih pokazatelja su ostvarili fazani I grupe, čija je smeša sadržavala 0,3 mg/kg selena, dok su najniže vrednosti ispitivanih parametara ustanovljene u K grupi.

Rezultati ovog istraživanja pokazuju da fazani osim statusa lovne divljači mogu imati veliki značaj u proizvodnji kvalitetnog mesa sa značajnim sadržajem antioksidanta selena koji bi doprineo prevenciji raznih oboljenja imunog sistema i poboljšanja zdravlja ljudi. Takođe, sa ekonomske tačke gledišta optimatizacijom smeša za ishranu fazana koje sadrže selen može se racionalizovati konverzija hrane i ujedno smanjiti troškovi ishrane.

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