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ORIGINAL ARTICLE

Influence of Organic Selenium Source on Carcass Characteristics and Oxidative Stability of Meat of Male Broilers

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ABSTRACT

An experiment was conducted to assess the effects of replacing sodium selenite (SS) by Se-yeast (SY) in diet on growth performance and selenium and vit E contents in male broilers tissue.One day-old 240 male birds OOwere randomly assigned to 4 treatments with 4 replicates of 15 birds each. The experimental grower diets that were supplemented with OOSS or OOSY at 0.3 mg Se/kg of feed, as follows: T1= 0.3 SS, T2= 0.2 SS+0.1 SY, T3= 0.1 SS+0.2 SY, and T4= 0.3 SY were given ad libitum to the birds during a 21 d-old grower period. The basal diet was also, supplemented with 75 mg of vitaminE. Weight of abdominal fat, thighs, liver and giblets were not significantly affected by treatments, except for breast weight that increased ($P < 0.05$) with replacement of selenium source from SS to SY in diets contain α-tocopherol.O the replacing SY in the diet reduced malondialdehyde (MDA) values in breast samples after 0, 3, and 5 days of chilled storage (4 to 6°C).

Key words: Selenium-enriched yeast, Carcass, malondialdehyde, male broiler.

Introduction

Selenium, a component of glutathione peroxidase in animal's body, can protect cells and cell membrane from damaging caused by oxidation. Selenium (Se) has a biological functionOonly when it is incorporated in to different seleno proteins [1]. The Se requirement for broilers throughout the growth period is 0.15 ppm [2]. Selenium is an essential micronutrient required for normal growth and maintenance in poultry. In June, 2000, an organic source of Se such as Se-enriched yeast was approved for use as a feed supplement in poultry diets [3]. Selenium is a dietary essential nutrient for poultry and Se content of feed grains varies widely from region to region (NRC, 1994). Thus, it is a common practice in the poultry industry to supplement Se in broilers diets. Historically, the Se source that has been used is the inorganic sodium selenite (Na_2SeO_3). Organic Se has a couple of advantages compared to inorganic Se sources. First, the organic Se sources have a greater bio-availability and secondly, organic Se will not under go pro-oxidation because it is already in the organic form [4]. The supplementation of selenium, especially organic selenium, might improve meat quality and shelf life of poultry meat [5]. Increasing dietary selenium improved the Se status or retention of the muscle and oxidative stability of chicken meat during refrigerated storage [6-7]. Moreover, it is recognized that vitamin E as a strong natural antioxidant help to protect the polyunsaturated fatty acids in cell membranes from peroxidative damage. Organic selenium is present in cereals, livestock feed and certain feed components, mainly in the form of selenomethionine. Therefore, its metabolic path is the same as methionine, i.e. active transport through intestinal membrane and active accumulation in liver and muscle tissue [7].

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The effect of selenium and the comparison of its inorganic and organic sources on performance of broiler chickens and carcass characteristics were studied by Payne and Southern [8], Ševčíková *et al.* [9], Robert Upton *et al.* [10] and Skřivan *et al.* [11]. They added vitamin E to diets supplemented by inorganic selenium also, observed performance improvement by higher body weight and carcass or portions yields in end of their experiments. The objective of the present study was to evaluate the effects of Se-enriched yeast (SY, organic source) in diet on Carcass Characteristics and oxidative stability of meat of Male BroilersOin meat of broiler chicks.

Materials and methods

Six hundred one day-old ROSS-308 unsexed chicks obtained from a commercial hatchery were reared with commercial feed starter from day 1 to 20. On the 21st days, 240 male chickens were sexed, individually weighed and randomly placed in 16 floor pens of 1.5 × 1.5 meters with 15 birds per pen.The chicks were fed by the same starter diet up to 3 weeks of age. The diets were supplemented with organic Se-yeast (SY or Sel-Plex [SP], Alltech, Inc.) or sodium selenite (SS or NaSe) at 0.2 mg Se/kg of feed and were formulated in accordance with the NRC [2]. The feed mixture contained 200.7 g of CP and 12.91 MJ of ME. The treatments consisted of the followed diets: 3% SS (T1), 2% SS + 1% SY (T2), 1% SS + 2% SY (T3) and 3% SY (T4). They were fed to the birds during 21 days growth period. Vitamin E, sodium selenite and Se-yeast supplements were included in the premix.

Results of the analysis of the experimental diets for Se are shown in Table 1. According to the analysis, levels of Se were 0.365 , 0.362 , 0.371 and 0.375 mg/kg in the T1, T2, T3 and T4 diets, respectively, that were consistent in all diets, and there are no major discrepancies between diets with different Se sources. The chicks were maintained on a 24-h constant lighting schedule until slaughter at 42 days of age. The diets and fresh water were offered *ad libitum.* Ingredient composition and nutrient calculation for diets are shown in table 1. At the end of the 5th week, samples of excreta were collected for the analysis of selenium content. On day 42 were used 8 birds from each treatment (two males per pen) to evaluate slaughter traits. . Lipid peroxidation in breast and thigh muscles was measured by the thiobarbituric acid method accordingly to OOPiette and Raymond [12] and the results were expressed as thiobarbituric acid-reactive substances (TBARS) in mg of malondialdehyde/kg. Data were analyzed using SAS software [13] by ANOVA test which were appropriate for a randomized complete block design, and when significant differences (P < 0.05) were detected, means were compared post-hoc using the Duncan multiple range test. The results are expressed as means and their Standard Error (SE).

Table 1: Ingredients and chemical analyses composition of the starter and grower diets.

Ingredients (g/kg)	Starter	Grower
Maize	557	300
Wheat	--	330
Soybean meal	370	300
Soybean oil	30	40
Fish meal	20	--
Limestone	10	--
Oyster shell	--	12
Dicalcium phosphate	5	15
Vitamin-mineral mix1	5	5
dl-methionine	1	1
Sodium chloride	2	2
Vitamin E (mg/kg)	--	75
Se (sodiumselenite/se-yeast) (mg/kg)2	--	0.3
Analyzed chemical composition (g/kg)	**Starter**	**Grower**
Dry matter	892.2	893.5
Crude protein	222.3	200.7
Fat	62.4	62.9
Fiber	36.1	35.6
Ash	61.7	57.0
Calcium	8.22	8.15
Phosphorus	5.48	5.57
Selenium (mg/kg)	0.53	(0.365, 0.362, 0.371 and 0.375)3
ME by calculation (MJ/kg)	12.78	12.91

[1]Starter diet fed to birds from 0 to 20 days. 21% basal premix was made with the selenium products for mixing of dietary Treatments in grower phase. Selenium contained 1000 mg Se/kg and it was supplemented, individually or mixed (sodium selenite/se-yeast) to the diet mixture. Sodium selenite (Na2SeO3; SS) content was more than 98%. Se-enriched yeast (SY) provided per kg of diets: selenium 0.3 mg, calcium 0.75 mg, phosphorus 2.33 mg, sulfur 1.21 mg, potassium 3 mg, magnesium 0.94 mg, iron 0.074 mg, manganese 0.034 mg, copper 0.015 mg, zinc 0.107 mg. 3T1, control diet = 3% SS; T2 = 2% SS + 1% SY; T3 = 1% SS + 2% SY; T4 = 3% SY. 4Provides per kilogram of diet: vitamin A, 9,000 IU; vitamin D3, 2,000, IU; vitamin E, 18 IU; vitamin B1, 1.8 mg; vitamin B2, 6.6 mg; vitamin B3, 10 mg; vitamin B5, 30 mg; vitamin B6, 3.0 mg; vitamin B9, 1 mg; vitamin B12, 1.5 mg; vitamin K3, 2 mg; vitamin H2, 0.01 mg; folic acid, 0.21 mg; nicotinic acid, 0.65 mg; biotin, 0.14 mg; choline chloride, 500 mg; Fe, 50 mg; Mn, 100 mg; Cu, 10 mg; Zn, 85 mg; I, 1 mg; Se, 0.2 mg.

Results:

The carcass characteristics were not affected by replacing of SS by Se enriched yeastOin diet, exception to breast weight.

Breast weight was increased ($P < 0.05$) in broilers fed SY diet. The carcass gathered (Table 3) after removing the feet and headOwere similar among the treatments and ranged from 70.48 to 71.25% as the average dressing percentage was not significantly increased. Carcass parameters such as abdominal fat, thighs, liver, and giblets were not significantly affected by the treatments, exception of breast weight that increased ($P < 0.05$)Owith replacing of SS by SY in diet. The influence of replacement of inorganic with organic Se on lipid oxidation measured as MDA formation in the breast and thigh muscles is shown in Table 3.

The concentration of malondialdehyde increased in all treatments during chilled storage (4 to 6°C) for up to 8 d, but the extent of lipid oxidation was lower in broilers fed diets containing SY compared to the control (SS diet).

The dietary utilization of Se-enriched yeast reduced MDA values in breast and thigh meat samples after 0, 4 and 8 days under chilled storage.

Table 3: Carcass characteristics of broilers chickens fed with different selenium sources[1].

Variable	Experimental diets				SE	P value
	T1	T2	T3	T4		
Carcass yield, 4 %	70.48	70.92	71.14	71.25	0.202	ns
Abdominal fat (g)	15.9	15.7	15.8	15.9	0.126	ns
Breast (g)	369.0^{c}	370.5^{bc}	372.0^{ba}	373^{a}	0.673	*
Thigh (g)	358.0	359.7	360.5	361.6	1.084	ns
Liver (g)	40.75	41.32	41.87	41.75	0.352	ns
Giblets (g)	191.0	190.6	191.7	192.0	0.431	ns

^{a,b,c,d}treatment means with different superscripts differ at P < 0.05. 1Values are means of eight observations per treatment and their standard errors. 2T1= diet with 3% SS; T2 = diet with 2% SS + 1% SY; T3 = diet with 1% SS + 2% SY; T4 = diet with 3% SY. 3 NS= P>0.05; *= P<0.05; **= P<0.01. 4 Carcass yield,without head either feet.

Table 3: Effect of Se supplementation and chilled storage (4 to 6°C) on the concentration of malondialdehyde (mg/kg) in breast and thigh muscles.

	Experimental diets2					
Time of storage	T1	T2	T3	T4	SE	P[3]
			Breast muscle			
d-0	0.37^{a}	0.35^{a}	0.30^{ba}	0.26^{b}	0.024	*
d-4	0.85^{a}	0.83^{a}	0.77^{ba}	0.70^{b}	0.025	**
d-8	1.20^{a}	1.20^{a}	1.07^{b}	0.96^{b}	0.038	**
			Thigh muscle			
d-0	0.36^{a}	0.35^{a}	0.32^{ba}	0.30^{b}	0.014	*
d-4	0.86^{a}	0.86^{a}	0.82^{b}	0.78^{c}	0.011	**
d-8	1.24	1.23	1.13	1.03	0.066	NS

^{a,b,c,d}Averages with different superscripts differ at P < 0.05. 1Values are averages of eight observations per treatment and their standard errors. 2Treatments: T1= 0.3 SS; T2 = 0.2 SS + 0.1 SY; T3 = 0.1 SS + 0.2 SY; T4 = 0.3 SY of mg/kg. 3 NS= non significant; *= P<0.05; **= P<0.01.

Discussion:

These results are in accordance with those stated by Choct *et al* [14], who found that birds receiving organic Se in their diets had improved eviscerated weight, breast yield and reduced drip loss. Ševčíková *et al*. [15] studied carcass traits of broiler cockerels fed diets supplemented with inorganic selenium in two enriched types (Se-enriched alga Chlorella and Se-enriched yeast) and also contained 50 mg vitamin E/kg, were observed that average weight of breast skin on, was highest ($P \leq 0.05$) in Se-enriched alga Chlorella compared to group II receiving Se-enriched yeast that were probably influenced by higher variability in this trait. Marković [16], establishing in his research that addition of 0.3 mg of organic selenium and 100IU of vitamin E increased considerably (P < 0.05) yield of broiler meat. Jokić *et al*. [17], investigated effect of different levels of organic selenium (selenized yeast) on slaughter meat traits of fattening chickens (male and female broilers) and documented that addition of organic selenium in the form of selenized yeast (0.3, 0.6 and 0.9 mg/kg Se yeast) in the food for fattening chickens can be increased the breast mass and share of breasts in percentage in mass of processed carcass compared to chickens of the first group (T1= 0 mg/kg Se yeast). In this study, TBARS formation in breast meat decreased in SY treatment compared with SS or SS in mixed with SY treatment. However, for all treatments and tissues, concentration of MDA increased with storage time, as expected, but replacing SS with Se-enriched yeast in the diet decreased lipid peroxidation speed in breast and thigh samples of T4 treatment, which showed the lowest values of MDA.

Ševčíková *et al*. [10] found that the supplementation of selenium, especially organic, might improve poultry meat quality and shelf life by reducing the drip loss.

Increasing dietary selenium improved the Se status or retention of the muscle and oxidative stability of chicken meat during chilled storage [6,15]. Poultry meat is quite sensitive to oxidative deterioration due to its high content of polyunsaturated fatty acids. Moreover, it is recognized that vitamin E as a strong antioxidant helps to protect the polyunsaturated fatty acids in cell membranes from peroxidative damage.

The researchers by studies on broiler chickens [7,18] or turkeys [19], reported that a OOhigher oxidative stability of lipids could occur if selenium in combination with vitamin E were supplemented in diets. This finding suggested that dietary supplementation of Se, especially in combination with vitamin E, more influenced oxidative stability of the meat during refrigerated storage.

References

1. Rotruck, J.T., A.L. Pope, H.E. Ganther, A.B. Swanson, D.G. Hafeman, and W.G. Hoekstra, 1973. Selenium: biochemical role as a component of glutathione peroxidase. Poult. Sci., 179: 588-590.
2. NRC (National Research Council), 1994. Nutrient Requirements of Poultry. 9th rev. ed. National Academy Press, DC. Washinton.
3. FDA, 2000. FDA approves food additive petition for selenium yeast. Page 10 in FDA Veterinarian Newsletter (July/August). U. S. Food and Drug Administration, D.C. Washington
4. MAHAN, D.C., 1995. Selenium metabolism in animals: what role does selenium yeast have? Biotechnology in the Feed Industry. In: Proceedings from Alltech's 11th Annual Symp., Nottingham, Nottingham Unites Press., 257-267.
5. Ševčíkovooá, S., M. Skřivan, G. Dlouhá and M. Koucký, 2006. The effect of selenium source on the performance and meat quality of broiler chickens. Czech Journal of Animal Science, 51: 449-457.
6. Yoon, I., T.M. Werner, J.M. Butler, 2007. Effect of Source and Concentration of Selenium on Growth Performance and Selenium Retention in Broiler Chickens. Poult. Sci., 86: 727-730.
7. SMET, K., K. Raes, G. Huyghebaert, L. Haak, S. Arnouts, and De S. SMET, 2008. Lipid and protein oxidation of broiler meat as influenced by dietary natural antioxidant supplementation. Poultry Science, 87: 1682-1688.
8. Surai, P.F., 2006. Selenium in nutrition and health. Nottingham University Press, Nottingham, UK.
9. Payne, R.L. and L.L. Southern, 2005. Comparison of inorganic and organic selenium sources for broilers. Poult. Sci., 84: 898-902.
10. Ševčíková, S., M. Skřivan, G. Dlouhá and M. Kouck, 2006. The effect of selenium source on the performance and meat quality of broiler chickens. Czech J. Anim. Sci., 51: 449-457.
11. Robert Upton, J., F.W. Edens, P.R. Ferket, 2008. Selenium Yeast Effect on Broiler Performance. Int. J. Poult. Sci., 7: 798-805.
12. PIETTE, G. and Y. Raymond, 1999. Vergleichende bewertung verschiedener methoden. Bestimmung der Ranzigkeit in Fleischprodukten. Fleischwirtschaft, 7: 69-73.
13. SAS Institute, 1998. SAS/STAT User's Guide: Statistics for windows company. Release 6.12.0.8. SAS Institute Inc., N.C. Cary.
14. Choct, M., A.J. Naylor and N. Reinke, 2004. Selenium supplementation affects broiler growth performance, meat yield and feather coverage. Brit. Poult. Sci., 45: 677-683.
15. Skřivan, M., G. Dlouhá, O. Mašata and S. Ševčíková, 2008. Effect of dietary selenium on lipid oxidation, selenium and vitamin E content in the meat of broiler chickens. Czech J. Anim. Sci., 53: 306-311
16. Markovič, O.R., 2007. Uticaj selena organskog i neorganskog porekla I različite količine vitamina E na proizvodne rezultate i kvalitet mesa brojlera. Doktorska disertacija odbranjena na Fakultetu veterinarske medicine u ,Beogradu.
17. Jokič, Ž., Z. Pavlovski, S. Mitrović and V. Đermanović, 2009 . The effect of different levels of organic selenium on broiler slaughter traits. Biotech. Anim. Husbandry, 25:: 23-34.
18. Villaverde, C., M.D. Baucells, E.G. Manzanilla and A.C. Barroeta, 2008. High levels of dietary unsaturated fat decrease α-Tocopherol content of whole body, liver, and plasma of chickens without variations in intestinal apparent absorption. OPoultry Science, 87: 497-505.
19. Mikulski, D., J. Jankowski, Z. Zduńczyk, M. Wróblewska, K. Sartowska and T. Majewska**,** 2009. The effect of selenium source on performance, carcass traits, oxidative status of the organism, and meat quality of turkeys. J. Anim and Feed Sci., 18: 518-530.