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Influence of Replacing Inorganic by Organic Selenium Source in Ration on Performance and Carcass Characteristics of Male Broilers

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Abstract: The aim of this study was to evaluate the effects of replacement sodium selenite (SS, inorganic source) by Se-enriched yeast (SY, organic source) on growth performance and carcass traits in broiler chicken. Two hundred forty one-day-old male broilers were randomly assigned to 4 treatments in 4 replicates of 15 birds each. The starter diet was fed from 1-19 days of age. In the grower diet, SS was replaced by SY (0.3 mg Se/kg) (T1= 0.3 SS, T2= 0.2 SS+0.1 SY, T3= 0.1 SS+0.2 SY and T4= 0.3 SY). This diet was fed *ad libitum* to the birds from day 19 to 42 of age. The basal diet was also supplemented with 75 mg vitamin E/kg of diet. Replacing SS by SY in diet increased the live weight of chickens significantly ($P < 0.01$). Also, birds fed 3% SY (T4) diet had better ($P \leq 0.05$) feed conversion ratio (FCR) compared to the others treatments. The mortality rate was lowest in T3 and T4. 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. It can be concluded that when inorganic Se replaced with Se-yeast, the better results can be observed for performance and carcass characteristics, if organic selenium in combination with vitamin E were supplemented in diets.

Key words: Sodium selenite · Selenium-enriched yeast · α-tocopherol · Performance · Male broiler

INTRODUCTION

Selenium (Se) has a biological function only 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 in poultry nutrition was described in reviews by Surai [4,5]. Metabolic paths of organic and inorganic selenium are different. 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 [6]. 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 [7], Ševčíková *et al*. [8], Robert Upton *et al*. [9] and Skřivan *et al*. [10]. 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 replacement of sodium selenite SS (inorganic sources) by Se-enriched yeast (SY, organic source) in diet on performance and carcass traits in broiler chicken.

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

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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 mix[1]	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. [2]1% 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 (Na_2SeO_3; 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. [3]T1, control diet = 3% SS; T2 = 2% SS + 1% SY; T3 = 1% SS + 2% SY; T4 = 3% SY. [4]Provides 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.

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. Chickens were slaughtered after 12 hours of food deprivation, in order to eliminate the influence of outside factors on weight ratios.

Data were analyzed using SAS software [11] 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).

RESULTS

The growth performance was improved in male broilers fed diets containing SY when compared to birds fed SS diets (Table 2). Replacing inorganic selenium (sodium selenite) by organic selenium (Se-enriched yeast) in the regular diet significantly($P \leq 0.01$) increased the live weight of chickens. Also, significant differences in feed

Table 2: Body weight, feed conversion and mortality of broiler chickens fed with different selenium sources

	Experimental diets					
Variable	T1	T2	T3	T4	SE	P value
d-1 BW (g)	45	45	45	45	0.35	[3]NS
d-21 BW (g)	627.5	630.6	628.7	629.4	2.53	NS
d-42 BW (g)	2207.9[c]	2239.6[b]	2264.2[b]	2315.0[a]	10.72	**
F:G, g:g, 0 to 20 days	1.36[a]	1.36[ab]	1.36[bc]	1.36[c]	0.007	NS
F:G, g:g, 21 to 42 days	1.78[a]	1.77[ab]	1.74[bc]	1.72[c]	0.008	*
Mortality (%)	3	3	2	2		

[a,b,c,d] b treatment means with different superscripts differ at P < 0.05. [1]Values are means of eight observations per treatment and their standard errors.

[2]T1= 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. SS = sodium selenite; SY = selenium enriched yeast; BW = body weight; F: G = feed: gain

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

	Experimental diets					
Variable	T1	T2	T3	T4	SE	P value
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. [1]Values are means of eight observations per treatment and their standard errors.

[2]T1= 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

conversion ratio (FCR) were observed among the groups ($P \leq 0.05$). Broiler chickens fed 3% Se-enriched yeast (T4) diet had lowest feed conversion compared to others diets. Mortality rate were not affected ($P < 0.05$) by Se source or supplementation level in period of growth or trial. The mortality rate was numerically lowest for T3 and T4. Similarly, carcass characteristics were not affected by replacing of SS by Se enriched yeast in 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 head were 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 ($P < 0.05$) with replacing of SS by SY in diet.

DISCUSSION

In this study, the efficiency of organic selenium administration in ration were observed clearly. Present results about growth performance agrees with Payne and Southern [7] and Robert Upton *et al*. [9]. In a study by Robert Upton *et al*. [9], the effects of two type source of inorganic and organic Se sources (sodium selenite and Se-enriched yeast, combinational or alone) compared to control diet were assessed. They reported that the SY affected the performance of broilers. Body weight for broilers fed SY were increased in compared to no Se or SS treatments and the combination of SS and SY was not more effective than SY alone. Also, FCR improved with SY and SY+SS being superior to SS [9]. However, the present results do not agree with those of Yoon *et al*. [12], who reported that selenium supplementation did not influence ($P < 0.05$) the growth performance of broilers at 42 d of age. In their study, broilers were fed with corn-soy-based diets formulated to contain 0 (negative control), 0.1, 0.2, or 0.3 ppm Se from Seleno-Source AF (Se yeast A), 0.3 ppm of Se from Sel-Plex (Se yeast B), or 0.3 ppm of Se from sodium selenite. On the other hand, these findings in the indices are in agreement with the results of the study by Ryu *et al*. [13], who reported that feeding even higher concentrations (1 to 8 ppm) of dietary Se from an inorganic source did not affect the BW of broilers. Considering the use of Na_2SeO_3 alone in dietary supplementing and feeding these practical diets to

broilers from 3 to 6 wk of age, no adverse effect was observe for Se on the growth performance of broiler chickens. The addition of vitamin E to diets with Se supplementation can be useful for improvement of performance or other studied traits. The addition of selenium plus vitamin E results in two different effects compared to using a single antioxidant. This is an important component of the antioxidant defence system in poultry diets and helps to protect the polyunsaturated fatty acids in cell membranes from peroxidative damage [14]. In Japanese quail kept under a heat stresss, Şahin and Kuçuk [15] also reported better performance and dressing percentage after the application of a dietary supplement of 250 mg vitamin E and 0.2 mg Se in the form of Na2SeO3. Ševčíková *et al*. [8], Dlouhá *et al*. [16] and Skřivan *et al*. [10] that added vitamin E to experimental diets also observed BW in end of their experiments.

These results are in accordance with those stated by Choct *et al*. [17], who found that birds receiving organic Se in their diets had improved eviscerated weight, breast yield and reduced drip loss. Ševčíková *et al*. [8] 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. Markoviæ [18], 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. Jokič *et al*. [19], 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 present study, replacing SS by SY increase body weight gain, breast weight and decrease FCR for male broiler chickens. With consider to couple effects of incorporation of dietary selenium and vitamin E in diet on good antioxidant maintain of diet and helps to better protect body tissues from peroxidative damage and therefore, health promoting diets and performance improvement [20].

It can be concluded that when inorganic Se replaced with Se-yeast, the better results can be observed for performance and carcass characteristics, if organic selenium in combination with vitamin E were supplemented in diets.

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