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ANTIOXIDANT ACTIVITY, SE DEPOSITION AND GROWTH PERFORMANCE OF BROILERS AS AFFECTED BY SELENIUM-ENRICHED YEAST

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ABSTRACT: The purpose of this investigation was to study effects of using selenium-enriched yeast on productive performance, carcass composition, Se deposition in meat, some blood constituents and antioxidant activity of broiler chickens. One hundred fifty chicks of commercial broiler strain were divided into five groups, each group comprised five replicates (6 birds per replicate). The groups received a basal diet complemented with 0.2 (control), 0.3, 0.4, 0.5, or 0.6 ppm selenium (Se)/ kg diet. The experiment continued from one-day-old to five weeks of age. Data obtained illustrated that dietary treatments had insignificant effect on growth performance. Selenium (Se) concentration in breast muscles was increased by increasing Se-enriched yeast level in the diet, where the highest content of Se was in birds fed diet supplemented with 0.6 ppm Se/ kg (being 0.48 ppm /kg). Also, supplementing broiler diets with Se-enriched yeast resulted in higher activities of catalase (CAT), glutathione peroxidase (GPx) and superoxide dismutase (SOD) than in control group. Conversely, plasma malondialdehyde (MDA) levels were significantly declined by increasing dietary Se levels. Concerning total antioxidant capacity (TAC) levels, groups received 0.3 and 0.4 ppm Se/ kg diet appeared significantly similar to control group. Levels of triglyceride (TG), total cholesterol (TC), as well as low-density lipoprotein (LDL-C) in plasma were decreased in all treated groups compared to control group. In conclusion, complementing broiler diets with Se-enriched yeast might be recommended to improve the antioxidant status and blood lipid profile.

Keywords: selenium – broilers – performance – antioxidant.

INTRODUCTION

Lipid peroxidation is a natural process which can cause degradation of lipids, and therefore damage of cell membrane. Malondialdehyde (MDA) as a metabolic product generated through lipid peroxidation, can move lipid oxidation that is brought by reactive oxygen species (ROS) in living tissues. Free radicals damage proteins, DNA, carbohydrates and lipids as they are very reactive and unsteady. Damage of DNA might generate mutation, inhibition of protein synthesis or errors of translation. Whilst, damaging proteins, can promote changes in enzyme activity and transport of ions. Additionally, oxidation of polyunsaturated fatty acids can alter activity of membrane enzymes, permeability and membrane structure. Damage of biological molecules and numerous systems endangers the health status and production abilities in animals (Todorovic et al., 2012). Also, in some physiological and pathological states, excess amounts of ROS, might damage cell phospholipid membranes and other macromolecules (Wiseman and Halliwell, 1996).

Antioxidant systems of the body, comprise several antioxidant enzymes, including; glutathione peroxidase (GSH-Px), GPX, superoxide dismutase (SOD) and thioredoxin peroxidase (TPx), while, the body is protected from oxidative stress by other several non-enzymatic substances (Flohé, 2010). Utilization of appropriate antioxidants will benefit the biological system by hunting reactive oxygen, which in turn, reduces lipid peroxidation or increases activity of antioxidant defense system (Nunes et al., 2005). Selenium (Se) is a trace mineral discovered in 1817, is indispensable to all animals, including poultry, to keep animal's good body health (Kohrle, 2004). Additionally, exudative diathesis and pancreatic degeneration might be attributed to Se deficiency (Toghyani et al., 2008). As well, Glutathione peroxidase prevents damage of animal cells triggered by free radicals, while dietary Se could prevent lipid peroxidation of biological membranes (Flohé, 2010).

Activity of selenoenzymes, glutathione peroxidase defends the organism from peroxidative damages, maintaining lower level of MDA. Reduced MDA level as well as increased GSH-Px activity in tissues present major indicators of acceptable protection of muscle tissues from oxidation, which means a prolonged shelf life of fresh meat (Zhan et al., 2007). Selenium might be added to diets as inorganic mineral salts, as sodium selenite (SS) or in organic forms such as seleno-methionine, seleno-cysteine or Se-enriched yeast. Usually, Se organic forms are more bioavailable and have better antioxidant properties compared to Se inorganic forms (Mahmoud and Edens, 2003).

In addition, organic Se sources are more environmentally friendly and less toxic compared to inorganic forms (Kim and Mahan, 2001; Kuricova et al., 2003). Compared to inorganic Se, organic Se has vital benefit as the fact that seleno-methionine is utilized in the body as an amino acid (in same way as methionine). Organic Se builds up Se reserves in body tissues, mainly in muscles, in seleno-methionine form, which might improve antioxidant defenses during stress conditions (Surai et al., 2016).

Enhancement activity of GSH-Px in chick's tissues, is closely associated with the source and level of dietary selenium. Organic Se is more efficiently absorbed, transported and accumulated in egg and embryonic tissues comparable to the

inorganic Se (Surai, 2006 and Upton et al., 2008).

The present investigation is to evaluate growth performance, carcass traits, blood componentsand antioxidant activity in broilers as influenced by supplementing diets with Se-enriched yeast.

MATERIALS AND METHODS

Experimental birds, management and diets

The present trial was done at Poultry Production Department, Faculty of Agriculture, Ain Shams University. One-hundred-fifty, one-day-old unsexed broiler (Hubbard) chicks obtained from commercial hatchery, were weighted and distributed randomly over five treatment groups, each group included five replicates of 6 birds each. Chicks were fed similar basal diet that was supplemented with selenium-enriched yeast (Sel-plex® - organic selenium yeast from Alltech®) at levels of 0.2 (recommended level of Hubbard broilers chicks as control), 0.3, 0.4, 0.5, or 0.6 ppm se/kg diet. Chicks received the same level of Se either in starter (1-21d) or grower (22-35d) diets. The diets were formulated based on National Research Council (NRC, 1994) and nutrient requirements suggested by the guidebook of Hubbard broilers chicks to be isonitrogenous and isocaloric (Table 1). Chicks were raised within similar hygienic, managerial, and environmental conditions. Birds were maintained in battery cages equipped with nipple drinkers and hanging tuber feeders. Feed and water were provided ad libitum. Chicks were vaccinated against Newcastle and Gumboro diseases using drinking-water-based vaccinations. All vaccines were obtained from Veterinary Serum and Vaccine Research Institute, Cairo, Egypt. Mean body weights by cage were taken at ends of both starter and grower phases (14 and 35 d of age). Rearing temperature was kept at 32 C for the first 5 days and then gradually reduced according to normal management practices, until a temperature of 28 C was reached. Continuous lighting was maintained.

Productive performance and carcass parameters

Live body weight, body weight gain, feed intake and feed conversion ratio (feed/ gain) were recorded and calculated by phase.

At 35 days of age (study end), five broilers per treatment (one bird per replicate) were slaughtered by severing the carotid arteries and jugular veins; 25 broilers were slaughtered in total. For 6 h prior to slaughter, birds were deprived of feed, and were weighed individually. After complete exsanguination birds were autopsied, the edible offals (gizzard, liver and heart) were removed and weighed. Also, the spleen, bursa of Fabricius, Kidneys and pancreas were removed and weighed. Whole eviscerated carcasses were individually weighed and the dressing percentage or carcass yield was recorded. Whole organ weights were proportionated to the live body weight. Carcasses were dissected to obtain samples from the muscles of breast (pectoralis major) to determine its selenium content.

Blood sampling and Biochemical assay

Blood samples were collected at 35 days of age from the slaughtered chicks during their exsanguination, and the Plasma samples were harvested after centrifugation of blood samples.

Plasma total lipids, total cholesterol (TC), low-density lipoprotein cholesterol (LDL-C), high-density lipoprotein cholesterol (HDL-C) and Triglycerides (TG) contents were determined according to methods described by Knight et al. (1972),

Röschlau et al. (1974), Assmann (1979) and Stein and Myers (1995), respectively.
Determination of malondialdehyde (MDA) and total antioxidant capacity (TAC) in plasma was carried out according to method described by Meltzer et al. (1997) and Koracevic et al. (2001), respectively. Catalase (CAT), Glutathione peroxidase (GPx) and Superoxide dismutase (SOD) were measured colorimetrically, in erythrocytes as stated by procedures of Rotruck et al. (1973); Nishikimi et al. (1972) and Aebi, (1984), respectively.
Selenium concentrations in breast meat were analyzed by atomic absorption spectrometry using inductive coupled plasma (ICP), Perkin Elmer, model optima 2000 DV, according to technique designated by Cantor and Tarino (1982).

Statistical Analysis

Data were subjected to one-way ANOVA variance analysis of General Linear Model (GLM) procedure of SAS software (1998) user's guide along with the following model:

$Yij = \mu + Ti + eij$

Where; μ = overall mean, Ti = dietary treatment, eij = experimental error. Individual effects of treatments were compared using multiple range tests at α level that is equal to 0.05 or 0.01, (Duncan, 1955).

RESULTS AND DISCUSSION

Growth performance

Although statistically insignificant, the lowest average body weight value was observed for control group at 5-weeks of age. Results of the current trial indicate that dietary supplementation of selenium-enriched yeast had no significant ($p>0.05$) effect on live body weight, daily weight gain, daily feed consumption and feed conversion ratio at different stage of the study (Table 2).

Several studies Choct et al. (2004), Payne and Southern (2005), Ryu et al. (2005) and Boostani et al. (2015) concluded that dietary selenium levels had no effects on growth performance, with no adverse effects on growth. Consistent results were observed by Yoon et al., (2007) and Kim et al., (2010) who reported that growth performance of broiler chickens was not affected by dietary supplementation with Se yeast at 0.3 ppm. Conversely, Upton et al. (2008) found significantly heavier broilers given diets enriched with 0.2 mg/ kg of organic Se when compared to those given inorganic Se source and those of control treatment, these reported differences are most likely due to different Se supplementation levels.
Carcass traits presented in Table (3) indicated that carcass yield (dressing %) was increased with dietary selenium-enriched yeast supplementations. Chicks received 0.3 and 0.4 ppm/kg selenium-enriched yeast recorded significantly higher ($P\leq 0.05$) dressing percentages compared to control. While, those fed diets with 0.5 and 0.6 ppm/ kg selenium-enriched yeast had intermediate dressing percentages when compared to control treatment or other treatments.
Chicks fed diet complemented with 0.4 ppm /kg selenium-enriched yeast having the greater ($P\leq 0.05$) increase in weights of pancreas and gizzard than those of control chicks. As shown in Table 3, selenium-enriched yeast supplementation had no significant effect on liver, heart, spleen, giblet, kidneys or bursa.
Carcass yield (dressing %) was increased with dietary selenium-enriched yeast supplementation, which is in agreement with the findings of Edens (1996) who reported that higher meat yield was associated with organic selenium supplementation. In this regard,

Edens(1997) presented a correlation between vitamin E and organic selenium regarding their effects on increased dressing percentage in broilers. Downs et al., (2000) reported the average carcass percentage of 71% after addition of 0.3 mg/kg selenium as Se-enriched yeast. Similar to data presented in Table 3, Robert et al., (2003) and Bagheri et al., (2015) stated that weights of spleen and bursa of fabricius were not significantly affected by selenium addition to the diet.

Several studies that used different Se forms concluded that dietary Se supplementations, did not affect carcass and breast yields of broilers (Payne and Southern (2005), Khajali et al., (2010), Yang et al., (2012) and Hada et al. (2013)).

Selenium deposition in muscles

Selenium concentration in breast muscle of broilers was significantly ($P \leq 0.05$) increased by increasing dietary selenium-enriched yeast level (Fig 1). The highest Se value in breast muscle was 480 µg/kg in group fed diet supplemented with 0.6 ppm/kg selenium-enriched yeast and the lower value was recorded for the control group. Similar results were reported by Wang et al., (2011) who found that adding of seleno-methionine increased Se concentrations in different tissues of broilers chicks. Similar observations were stated by Spears et al., (2003) who reported that adding of seleno-methionine to broilers diets resulted in higher breast muscle Se concentrations. Boiago et al., (2014) observed highest Se concentration in muscles of broilers fed diets enriched with organic Se.

Regarding to Se sources, Mahan and Parrett Nishikimi (1996) reported that muscle tissues had retained much lower concentration of inorganic Se, which was less efficiently absorbed and excreted at a higher rate than organic Se because of their different metabolic pathways.

Oliveira et al., (2014) stated that human daily intake of 150 g breast meat of broilers fed diet complemented with 300 µg/ kg of Selenium yeast would be sufficient to offer 117.00 and 138.27% of the daily Se needs for men and women, respectively. Consumption of similar amount of breast meat from broilers fed diet complemented 450 and 600 µg/kg of Selenium yeast would provide more Se than is recommended by (FAO ,2002). These recommendations for daily intake of Se are about 0.065 and 0.055 mg for men and women aged 19 to 65 years old, respectively.

Antioxidant activities

At five weeks of age, GPx activity of broiler erythrocytes in 0.4, 0.5 and 0.6 ppm/kg selenium-enriched yeast treatments was significantly ($P \leq 0.05$) higher than either the 0.2 or 0.3 ppm/kg selenium-enriched yeast supplemented groups. (Fig. 2). There were no significant ($P \geq 0.05$) differences in SOD activities among all groups, however numerically the SOD values was increased as the level of selenium-enriched yeast increase in treated groups (Fig 3). Birds fed 0.4, 0.5 and 0.6 ppm/kg selenium-enriched yeast had higher catalase compared to control and those of 0. 3 ppm/kg selenium-enriched yeast treatments ($P \leq 0.05$). (Fig 4).

Plasma levels of malondialdehyde (MDA) are illustrated in Figure (5). Significant differences ($P \leq 0.05$) could be noted among control group and other treatments. The lowest MDA level was found with birds fed highest level of selenium-enriched yeast, conversely, control group had the greatest value of it.

Plasma TAC were greatest ($P \leq 0.05$) in chicks fed higher levels (0.5 and 0.6

ppm/kg diet) of selenium-enriched yeast when compared to other groups (Fig 6). Generally, it is notable that supplementation of broilers diet with organic Se increased activities of catalase (CAT), glutathione peroxidase (GPx), superoxide dismutase (SOD) and total antioxidant capacity (TAC) compared to control treatment (0.2 ppm/kg selenium-enriched yeast). On the other hand, form of selenium either organic or inorganic controls interactions between dietary selenium and GSH-Px activity (Bermingham et al., 2014).

Our findings on GSH-Px are in agreement with Dalia et al., (2017) who stated that, GSH-Px activity was highest in all Se supplemented groups compared to the negative control in serum and examined tissues. Also, Göçmen et al., (2016) who found that higher concentration of plasma GSH-Px activity was recorded with the group fed higher (0.60 ppm) organic Se compared with other groups. Moreover, Chen et al. (2013) provoked a strong suggestion that oxidation resistance of broilers, was significantly improved with higher levels of dietary selenium.

In our study, activities of catalase (CAT), superoxide dismutase (SOD) and total antioxidant capacity (TAC) were increased by increasing organic Se levels. Conversely, Payne and Southern (2005) reported that glutathione peroxidase activity was not affected by organic, inorganic as well concentration of Se. Moreover, Reddi and Bollineni, (2001) and Kurz et al., (2002) found an increase in SOD activity in hens fed diets with lower Se levels, with decreased activity when Se level were above 0.5 mg/kg diet.

The present trial examined effects of different organic Se levels on MDA levels as an indicator of oxidative stress in broilers. MDA is an outcome of lipid peroxidation, and, by increasing Se concentration in chicks diet, the levels of MDA were decreased. This might be an indicator that lipid peroxidation was reduced by increasing organic Se levels via enhancing antioxidative action. Kim et al. (2010) showed that selenium plays a significant role in antioxidative system efficiency.

Plasma Lipids profile

Plasma lipids components of broilers chicks fed different levels of Se-enriched yeast are illustrated in Table (4). Plasma total lipids (TL) significantly increased in 0.5 ppm/kg selenium-enriched yeast treatments compared to other treatment groups except those fed 0.4 ppm/ kg Se-enriched yeast treatments. Supplementation with Se-enriched yeast significantly increased plasma HDL-C levels in chicks fed 0.5 and 0.6 ppm/kg selenium-enriched yeast compared to control one. Opposite trend was detained in these groups for cholesterol (TC), triglyceride (TG) along with low-density lipoprotein (LDL-C) in plasma were decreased in groups fed diets supplemented with 0.3, 0.4, 0.5 and 0.6 ppm/kg selenium-enriched yeast treatments compared to control. These observations might be attributed to antioxidant action of supplementing broiler diets with selenium as resulting in low production of MDA in liver by increased glutathione peroxidase enzyme protecting chicks against oxidative damage and thereby serves to reduce the plasma concentration of total cholesterol, triglycerides and LDL cholesterol. In rats Iizuka et al. (2001) cited that selenium suppressed free fatty acids, triacylglycerol and total cholesterol concentrations in serum.

CONCLUSION

In conclusion, supplementing broiler diets with Se-enriched yeast might be recommended in broiler rations especially highest levels (0.5 ppm /0.6 ppm organic Se/kg diet) to enhance Se deposition in breast muscles and improved the antioxidant status and blood lipid profile.

Table (1): Ingredients (%) and calculated analysis of basal diets.

Ingredients (%)	**Starter (0-21 day of age)**	**Grower (22-35 day of age)**
Yellow Corn	56.00	59.93
SBM 44 %	28.85	26.42
Corn Gluten 60 %	8.95	6.90
Soybean Oil	1.50	2.50
Ca Carbonate	1.60	1.45
MCP	1.85	1.60
LYS	0.40	0.35
METH (MHA)	0.25	0.25
Salt (NaCl)	0.30	0.30
Premix	0.30	0.30
Total	100.00	100.00
Calculated composition		
CP%	23.00	21.00
ME Kcal/Kg diet	3000	3100
Lysine	1.41	1.29
Methionine	0.66	0.62
Methionine + Cysteine	1.05	0.98
Ca%	1.00	0.90
NPP%	0.51	0.45

SBM: soybean meal, MCP: mono-calcium phosphate, MHA: methionine hydroxy-analogue, NPP: non-phytate phosphorus.

The premix contains: Vitamins: A: 12000000 IU; Vit. D3 2000000 IU; E: 10000 mg; K_3: 2000 mg; B_1:1000 mg; B_2: 5000 mg; B_6:1500 mg; B_{12}: 10 mg; Biotin: 50 mg; Coline chloride: 250000 mg; Pantothenic acid: 10000 mg; Nicotinic acid: 30000 mg; Folic acid: 1000 mg; Minerals: Mn: 60000 mg; Zn: 50000 mg; Fe: 30000 mg; Cu: 10000 mg; I: 1000 mg and Co: 100 mg.

Table (2): Effect of selenium-enriched yeast on productive performance of broilers.

Items	selenium-enriched yeast levels (ppm/kg diet)					MSE	Sig.
	0.2	0.3	0.4	0.5	0.6		
Initial body weight (g)							
1 day	45.00	44.23	44.13	44.76	44.86	0.396	NS
Live body weight (g)							
2 weeks	252.64	239.95	233.81	261.01	253.73	24.34	NS
5 weeks	1463.48	1532.63	1540.52	1522.54	1483.75	43.528	NS
Daily weight gain (g)							
0–2 weeks	15.81	16.15	15.45	18.90	15.86	1.312	NS
3–5 weeks	57.66	60.11	62.22	60.07	58.57	1.85	NS
0–5 weeks	40.52	42.53	42.75	42.22	41.11	1.24	NS
Daily feed consumption (g)							
0–2 weeks	22.78	26.14	26.87	31.25	27.20	3.132	NS
3–5 weeks	107.57	110.26	111.30	112.78	116.52	4.446	NS
0–5 weeks	73.66	76.04	77.53	80.17	80.79	3.178	NS
Feed conversion ratio (g feed/ g gain)							
0–2 weeks	1.45	1.65	1.79	1.66	1.70	0.11	NS
3–5 weeks	1.86	1.80	1.80	1.83	1.86	0.062	NS
0–5 weeks	1.81	1.79	1.82	1.79	1.83	0.07	NS

Table (3): Effect of selenium-enriched yeast on some of carcass characteristics of broilers at 35 days of age.

Items	selenium-enriched yeast levels (ppm/kg diet)					MSE	Sig.
	0.2	0.3	0.4	0.5	0.6		
Dressing %	68.78^{b}	71.38^{a}	71.23^{a}	71.03^{ab}	69.70^{ab}	0.76	*
Liver %	2.55	2.16	2.42	2.18	2.41	0.12	NS
Gizzard %	1.19^{b}	1.19^{b}	1.40^{a}	1.36^{ab}	1.27^{ab}	0.05	*
Heart %	0.41	0.40	0.45	0.45	0.45	0.02	NS
Giblets¥ %	4.16	3.76	4.27	4.00	4.14	0.16	NS
Spleen %	0.07	0.09	0.09	0.08	0.07	0.01	NS
Bursa %	0.16	0.12	0.13	0.11	0.16	0.02	NS
Kidneys %	0.56	0.54	0.59	0.61	0.65	0.03	NS
Pancreas %	0.16^{b}	0.23^{ab}	0.24^{a}	0.21^{ab}	0.25^{a}	0.02	*

[a, b] Means within the same row with different superscripts are significant1y different. Sig. = Significance), * (P≤0.05). NS = Non Significant. ¥Giblets = Liver + Gizzard + Heart.

Table (4): Effect of selenium-enriched yeast on Lipid profile of broilers at 35 days of age.

Items	selenium-enriched yeast levels (ppm/kg diet)					MSE	Sig.
	0.2	0.3	0.4	0.5	0.6		
Total Lipids (g/dl)	935.30^{b}	850.98^{b}	994.12^{ab}	1109.80^{a}	925.49^{b}	40.59	*
Triglycerides (mg/dl)	103.72^{a}	102.93^{a}	102.41^{ab}	100.31^{b}	97.22^{c}	0.68	*
Total cholesterol (mg/dl)	164.14^{a}	161.27^{ab}	159.75^{ab}	159.28^{bc}	155.57^{c}	1.18	*
HDL- C (mg/dl)	29.20^{c}	30.68^{bc}	31.31^{bc}	32.95^{ab}	35.32^{a}	0.75	*
LDL- C (mg/dl)	97.39^{a}	96.55^{a}	95.69^{a}	92.97^{b}	92.66^{b}	0.67	*

$^{a, b, c}$ means having different superscripts within the same row are significantly different, Sig. = Significance, * (P≤0.05).
HDL-C: High-density lipoprotein cholesterol, LDL-C: low-density lipoprotein cholesterol.

Fig. (1): Selenium concentration in breast meat of broilers as affected by selenium-enriched yeast.

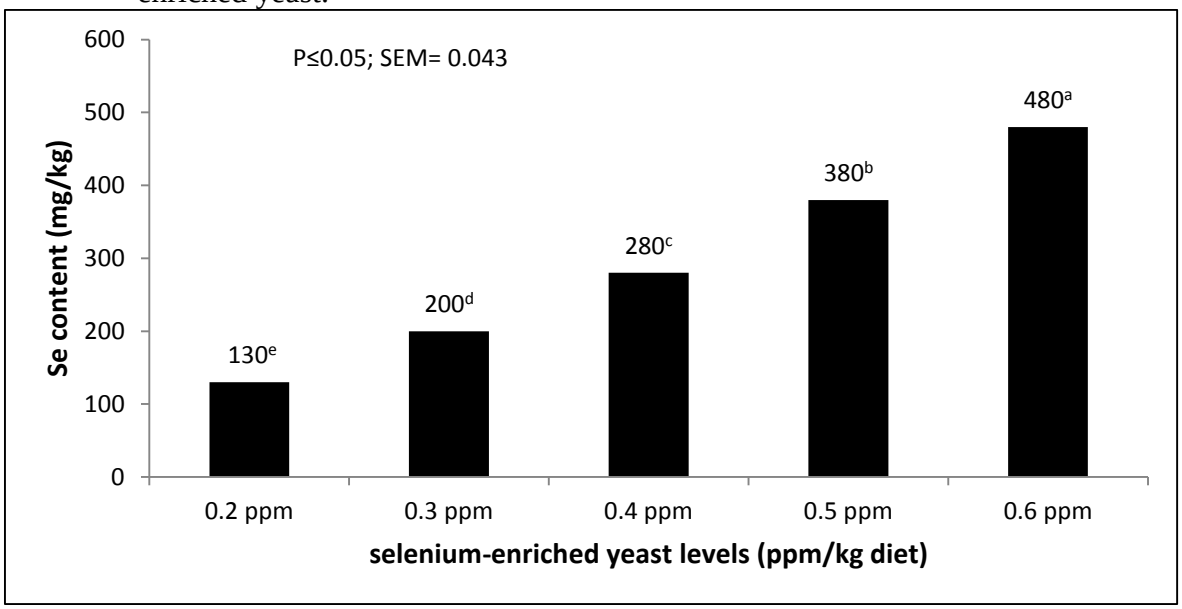


Fig. (2): Activityof erythrocytes Glutathione peroxidase (GPx) of broilers as affected by selenium-enriched yeast.

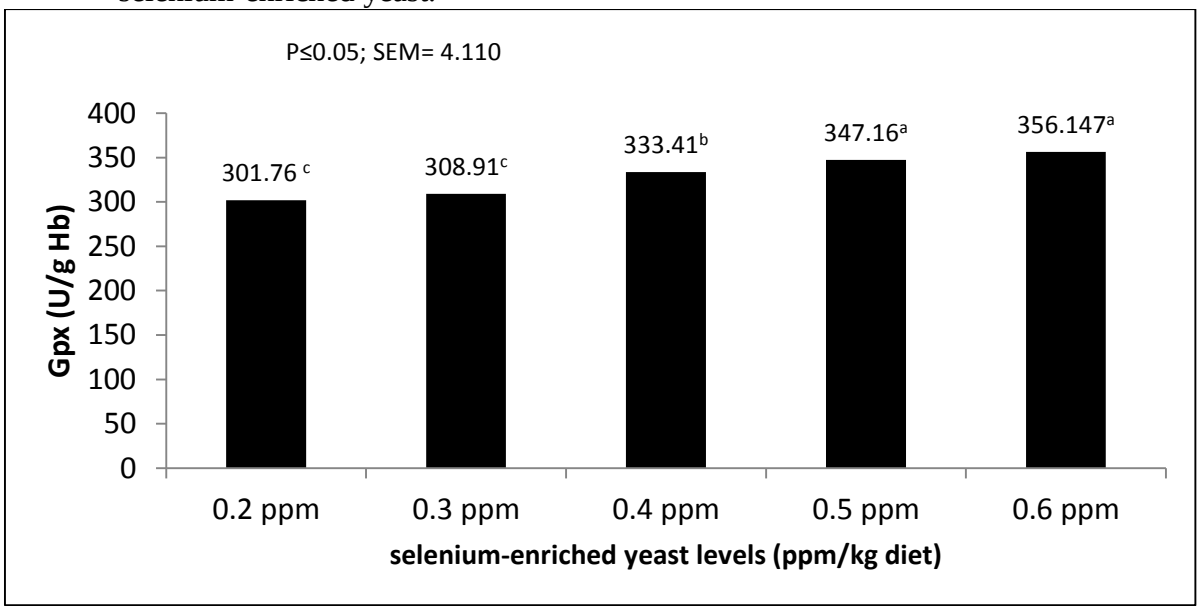


Fig. (3): Superoxide dismutase (SOD) activity of broilers as affected by selenium-enriched yeast.

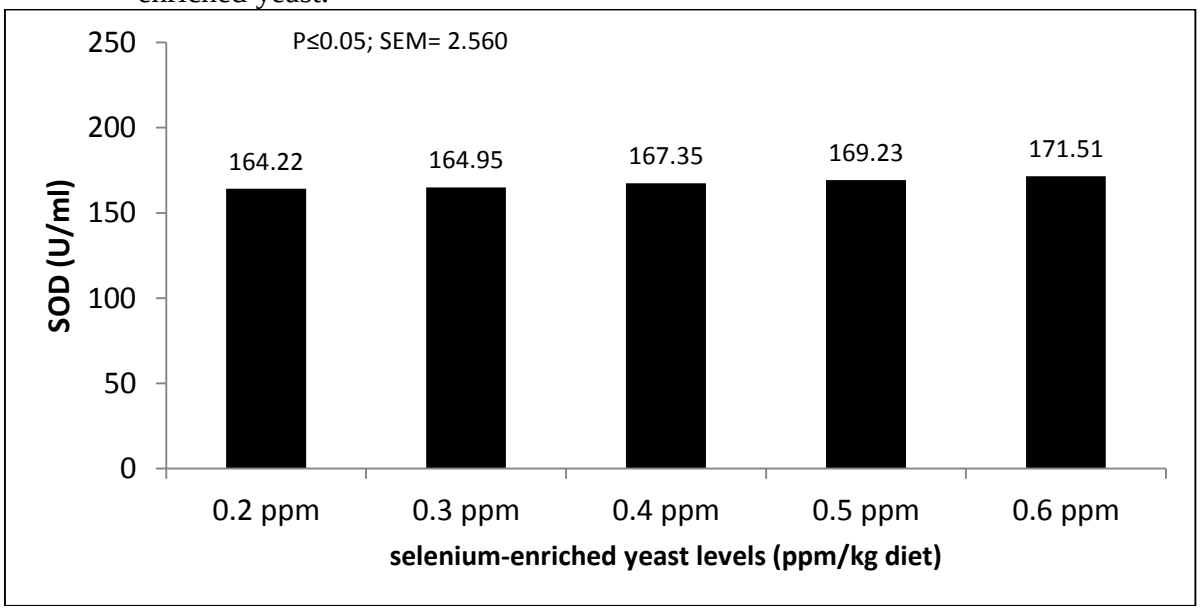


Fig. (4): Catalase activity of broilers as affected by selenium-enriched yeast.

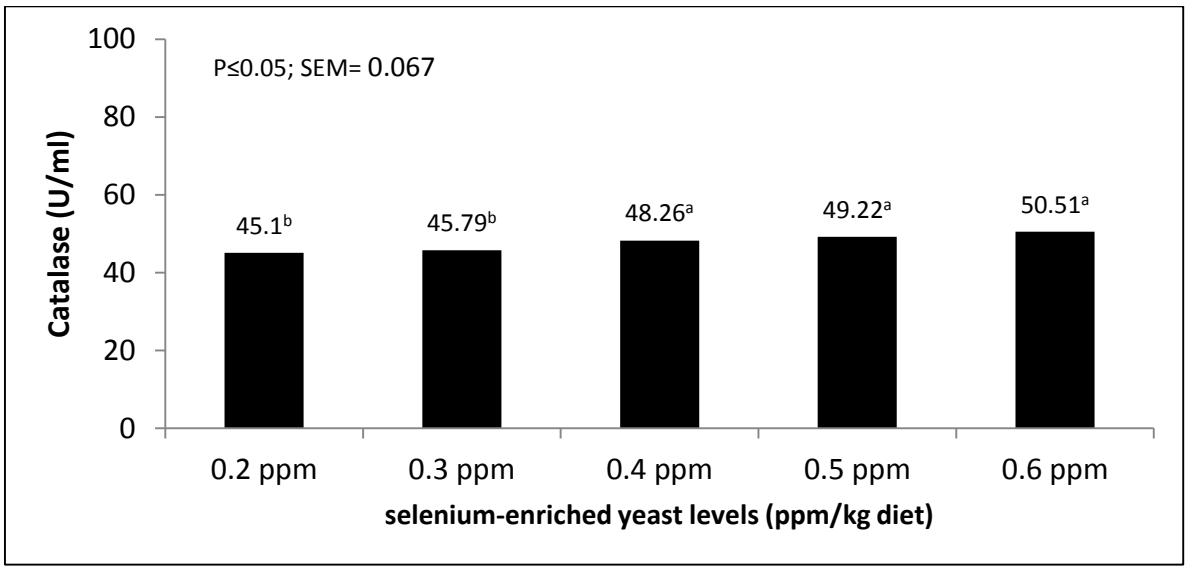


Fig. (5): Plasma malondialdehyde (MDA) levels of broilers as affected by selenium-enriched yeast

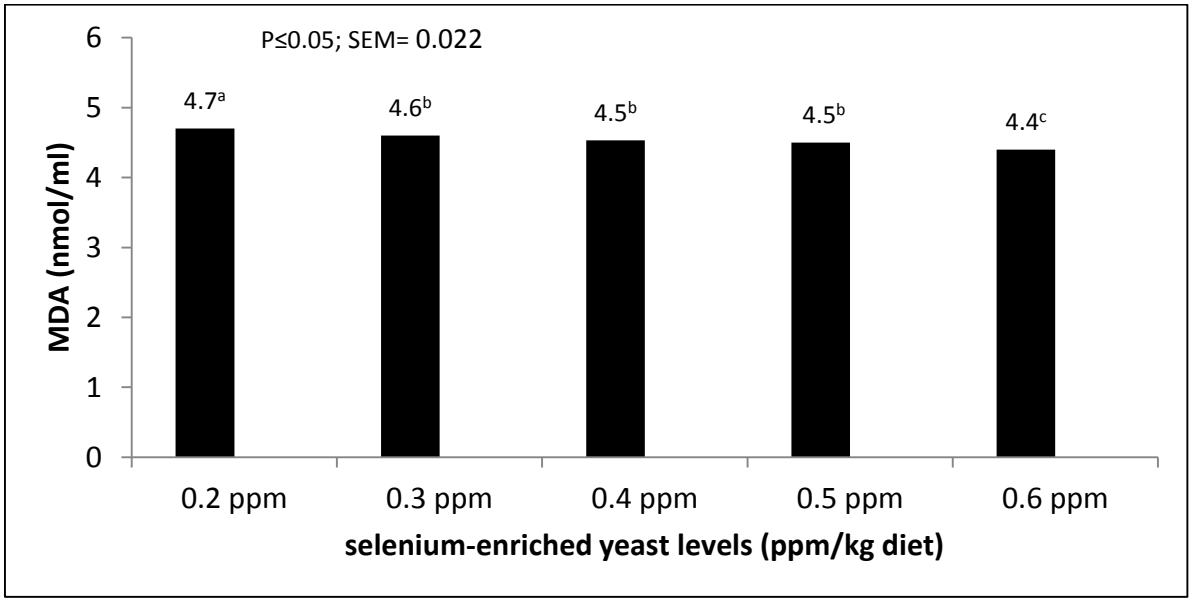
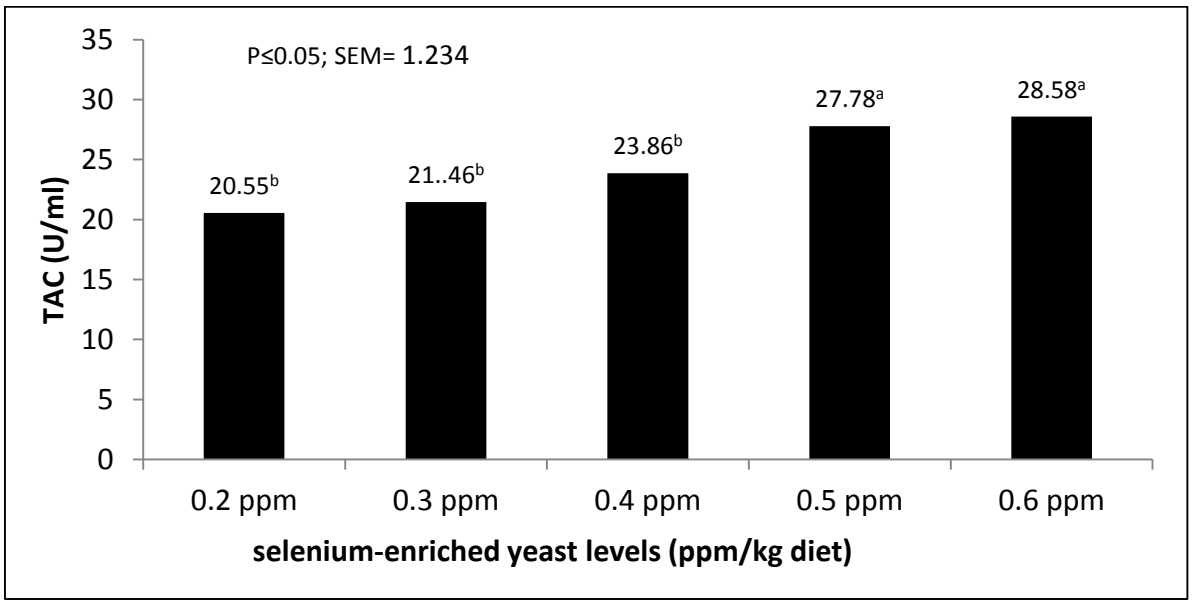


Fig. (6): Total antioxidant capacity of broilers as affected by selenium-enriched yeast



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الملخص العربي

تأثير الخميرة الغنية بعنصر السيلينيوم على نشاط مضادات التأكسد وترسيب عنصر السيلينيوم والأداء الإنتاجي لدجاج التسمين

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الغرض من هذا البحث دراسة تأثيرات استخدام الخميرة الغنية بعنصر السيلينيوم على الأداء الإنتاجي، وتكوين الذبيحة ومحتوها من السلينيوم، وبعض مكونات الدم، وكذلك النشاط المضاد للأكسدة في دجاج اللحم. تم تقسيم مائة وخمسين طائر من سلالة اللحم التجارية "هابرد" إلى خمس مجموعات تجريبية، كل مجموعة تتألف من خمس مكررات كل مكرر يحتوي على ستة طيور. تلقت المجموعات التجريبية عليقة قاعدية مُدعمة بـ 0.2 (مجموعة كنترول) أو 0.3 أو 0.4 أو 0.5 أو 0.6 جزء في المليون سيلينيوم عضوي لكل كيلو جرام واحد من العليقة. استمرت التجربة من عمر يوم واحد إلى خمسة أسابيع من عمر الطيور. أظهرت النتائج التي تم الحصول عليها أن اضافة عنصر السيلينيوم بصورته العضوية لم يظهر تأثير معنوي على الأداء الإنتاجي لدجاج التسمين محل الدراسة، بينما كان هناك زيادة في محتوي عضلات الصدر من عنصر السيلينيوم مع زيادة مستوى الخميرة الغنية بالسيلينيوم المضافة في علائق الطيور التجريبية، حيث كان أعلى محتوى من عنصر السيلينيوم في تلك الطيور التي تغذت على العلائق المُدعمة بـ 0.6 جزء في المليون سيلينيوم / كجم علف. وجد أيضاً أن إضافة الخميرة الغنية بعنصر السيلينيوم في علائق دجاج اللحم أدى إلى زيادة نشاط كلاً من إنزيمات الكتاليز والجلوتاثيون بيروكسيديز والديسموتيز الفائق (سوبر أوكسيد ديسموتيز) في دم الطيور التجريبة مقارنة بالمجموعة الكنترول. من ناحية أخرى، انخفضت مستويات المالونديالدهيد بشكل معنوي في دم الطيور مع زيادة مستويات السيلينيوم في العلائق. وفيما يتعلق بمجموع مستويات القدرة المضادة للأكسدة، وجد أن طيور المجموعات التي تغذت على 0.3 و 0.4 جزء في المليون من عنصر السيلينيوم كانت متقاربة معنوياً مع مجموعة الطيور الكنترول. انخفضت مستويات الدهون الثلاثية والكوليسترول الكلي وكذلك البروتين الدهني منخفض الكثافة في سيرم الدم لطيور المجموعات التجريبية مقارنة مع المجموعة الكنترول.
في الختام، من خلال النتائج المتحصل عليها يمكن التوصية بتدعيم علائق دجاج التسمين بالخمائر الغنية بالسيلينيوم خاصةً المستويات (0.5 جزء في المليون / 0.6 جزء في المليون سيلينيوم عضوي / كجم علف) لرفع محتوى لحم الدجاج من السيلينيوم وكذلك تحسين نشاط مضادات الأكسدة وحفض مستويات دهون الدم في جاج اللحم.