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GROWTH PERFORMANCE AND IMMUNE RESPONSES OF LAMBS AS AFFECTED BY DIETARY SUPPLEMENTATION OF DIFFERENT SELENIUM SOURCES

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SUMMARY

The aim of the study was to evaluate the growth performance and antioxidant status as well as immune responses as affected by supplementation of different selenium (Se) sources in the ration of lambs. This experiment was carried out at the Animal Production Experimental Farm, Faculty of Agriculture, Sohag University, Sohag. Twenty-four healthy Sohagi lambs of about 7-8 month of age and an average body weight of 24.47±0.15 kg were randomly assigned into four dietary treatment groups (6 animals each).The experiment was extended for 25-wk after two weeks as adaptation period. Basal diet was formulated to meet all nutrient requirements except selenium. Lambs in the first group were fed a basal diet as a control (T0), whereas lambs in groups T1, T2, and T3 were fed the basal diet supplemented with 0.1 mg/kg DM from sodium selenite, vitamin E and selenium and selenized yeast, respectively. Animals were weighed at the beginning of the experimental period and thereafter at monthly intervals (for two consecutive days) before offering the morning feed and water throughout the experimental period to assess their growth rate. Values of total gain, average daily gain and feed conversion were calculated .Three blood samples from three animals in each group were collected before offering the morning feed and water throughout the experimental period from jugular venipuncture at 8.0 a.m. into 10-mL heparinized tubes at days 0, 30, 60, 90, 120, and 150 of the experiment. The concentrations of Se in whole blood were determined. The activity of glutathione peroxidase (GSH-Px) was determined in whole blood of lambs and the concentrations of interleukins (IL-1& IL-2) in blood plasma were analyzed as well. Results indicated that T3, T2 and T1 treatments increased body weight (BW) at the end of experimental period by 24.17%, 18.24% and 8.53%, respectively compared to control group. Also, T3, T2 and T1 treatments increased the daily gain (DG) by 56.28%, 43.76% and 22.81% respectively in comparison with control group. The feed conversion ratios differed (P<0.01) among treatments. The best values were recorded in T3 followed by T2, while the worst values were recorded in T1 and control groups. Values of blood Se concentrations differed (P<0.01) among groups. The highest value of Se concentration was recorded in T3 followed by T2, T1 and the lowest value was recorded in control group. Moreover, the GSH-Px activities in T3 and T2 were higher (P< 0.01) than those in T1 and control groups, but there was no significant difference in the GSH-Px activities between T3 and T2 groups. In addition, data showed that the concentrations of IL-1 and IL-2 in plasma increased in all of the supplemented groups during the period of supplementation. The highest values of plasma IL-1 and IL-2 concentrations were recorded in T3 followed by T2, T1 and the lowest values were recorded in the control group. In conclusion, supplementation of Se in the ration of sheep especially in the form of selenized yeast is highly beneficial for improving the productive performance and physiological responses as a result of positive effect on glutathione peroxidase (GSH-Px) as indicator of antioxidant and interleukins (IL-1& IL-2) concentrations as indicator of immune responses.

Keywords: Selenium sources, productive performance, glutathione peroxidase, interleukins, lambs

INTRODUCTION

Sheep and goat provide an economic support to the small livestock farmers in most developing countries. Imbalance in trace minerals may occur in farm animals, especially ruminants, whose intake of minerals depending largely on the forage species and particularly by the Se status of the soils on which they have grown. Selenium (Se) is an important trace element that has a narrow range between deficiency and toxicity in animals. Serious Se deficiency can lead to nutritional muscular dystrophy, but more common are subclinical symptoms such as weak lambs, reduced feed consumption and pregnancy complications (NRC, 2007)

The Se is essential for proper health, immunity and reproductive functions of animals. It is a component of glutathione peroxidase (GSH-Px) enzyme, which destroys free radicals in the cytoplasm and protects the tissues against oxidative damage (Awad *et al.,* 1994 and Levander *et al*., 1995). Se is also involved in immune function (McKenzie *et al*. 1998) and resistance against diseases (Huang and Yang, 2002). Safir *et al*. (2003) reported that macrophage supplemented with Se increased the release of IL-1 in vitro. However, as far as authors know, there are no previous data available

in the literature about that whether the activities of interleukins in plasma are enhanced in vivo upon Se supplementation. Also, few studies were undertaken on the effects of different Se sources on growth performance and Se status of sheep.

In most practical way and conveniently the fortifying Se in fertilizers was anticipated to be the best means for supplying the livestock with adequate Se through plant uptake of various Se compounds. Selenium supplements are in two principle forms, inorganic mineral salts, typically sodium selenite or selenite or in organic forms such as Se enriched yeast. Selenium absorption occurs within the small intestine whilst SeMet is absorbed via the methionine transporter system. The absorption of inorganic Se, such as sodium selenite, is less efficient and occurs mainly by passive diffusion (Weiss, 2003). Specifically, research has shown that organic Se is more bioavailable than so in inorganic form like for instance sodium selenite (Cantor *et al*., 1982). Therefore, organic sources of Se, such as Se-yeast have been explored as an alternative to inorganic supplementation. Additionally, the use of organic Se resulted in less Se being transferred to the environment through feces and more Se is deposited into body tissues and animal products. The dietary concentration and source of Se have been demonstrated to affect antioxidant system and Se status (Juniper *et al*., 2009; Vignola *et al.,* 2009 and Petrera *et al*., 2009). The aim of this study was to evaluate the growth performance of male lambs and on glutathione peroxidase (GSH-Px) as indicator of antioxidant and interleukins (IL-1& IL-2) concentrations as indicator of immune responses. as affected by supplementation of different selenium sources.

MATERIALS AND METHODS

This experiment was carried out at the Animal Production Experimental Farm, Faculty of Agriculture, Sohag University, Sohag. It lasted about 25 weeks from February up to July, 2014. All lambs were raised under the same managerial and environmental conditions.

Proximate chemical analysis:

Chemical analyses for basal diet according to the methods of A.O.A.C. (2000), for dry matter, crude protein, ether extract, crude fiber and ash on dry matter bases were 90.02, 16.53, 3.10, 13.98 and 12.75 %, respectively. Also, the concentration value of selenium was 0.088 ppm.

Experimental design:

Twenty-four healthy Sohagi male lambs of about 7-8 month of age and an average body weight (BW) of 24.47±0.15 kg were randomly assigned into four dietary treatment groups (six animals each). The experiment was extended for 25 weeks preceded by two weeks as adaptation period. Basal diet was formulated to meet nutrient requirements according to NRC (1985) except Se. Se requirement according to NRC (1985) level of 0.1–0.2 mg Se/kg dry matter was recommended for sheep .The basal diet consisted of 30% wheat straw and 70% concentrate mixture. Lambs in control group (T0) were fed a basal diet without supplement, whereas lambs in groups T1, T2, and T3 were fed the basal diet supplemented with 0.1 mg/kg DM from sodium selenite, vitamin E and selenium and selenized yeast, respectively. The basal diet was formulated to be adequate in protein, energy, vitamins and mineral for growing lambs phase except for Se content. Lambs were fed individually and water was available *ad libitum*. Feed intake of each animal was recorded daily during the experimental period to measure the daily DM intake (DMI) and feed conversion ratio (FCR). Animals were weighed at beginning of experimental period and then at monthly intervals (for two consecutive days) in the morning before offering feed and water throughout the experimental period to assess their growth rate. Values of total gain (TG), daily gain (DG) and feed conversion ratio (daily DM intake/ daily gain, g/g) were calculated.

Blood sampling and analysis:

Blood samples from three animals in each group were collected before offering morning feed and water from the jugular vein at 8.0 a.m. into 10/mL heparinized tubes at day 0, 30, 60, 90, 120, and 150 of the experiment. Samples of whole blood were stored at –20°C for subsequent specific chemical analysis. Blood plasma samples were then separated by centrifugation at 3000 rpm for 15 minutes. The concentrations of Se in whole blood were determined by atomic absorption spectrometry with a hydride generator system (Norheim and Haugen, 1986). Before analysis, each sample was prepared by oxidative digestion in a mixed solution with concentrated nitric and perchloric acids, using an automated system. All selenium concentrations were calculated as mg / L blood. The activity of GSH-Px was determined in whole blood of lambs with commercial test kits. Method for determination of GSH-Px is based on catalytic oxidation of glutathione as described by Sankari (1985) IL-1 ^{125}I radioimmunoassay (RIA) Kits and IL-2 ^{125}I RIA Kits were used to assay the concentrations of interleukins in blood plasma. The detection range (DR) of the IL-1 kits is 0.125–4.0 ng/mL. The detectable concentration (DC) is less than 0.08 ng/ml and the inter-assay and intra-assay variation coefficients were 10% and 8%, respectively. The DR of the IL-2 kit is 0.2–9.6 ng/ml, the DC is less than 0.1 ng/mL, and inter-assay and intra-assay variation coefficients were 7% and 8%, respectively.

Statistical analysis:

Data were statistically analyzed using the General Linear Model (SAS, 2008) one way analysis of variance. All statements of significant difference are

based on the 0.05 or 0.01 probability levels. Significant differences among treatments, within the experiment were analyzed using L.S.D (Petersen, 1985) for growth rate, feed conversion ratio, blood parameters. The following model was used,

$Y_{ij} = \mu + T_i + E_{ij}$

Where,

Y_{ij} = Experimental observation. μ = The overall mean.

T_i = The effect of dietary treatments, i= T0, T1, T2, and T3

E_{ij} = The errors (Standard Error (S.E)) related to individual observation.

RESULTS AND DISCUSSION

Growth performance of lambs:

Data in Table (1) showed the effect of different selenium sources on body weight (BW), total gain and daily gain (DG). Data revealed that, the final BW was differed (P<0.01) among treatments. The highest value for BW was recorded for the selenized yeast (T3) followed by vitamin E and selenium (T2), sodium selenite (T1) and the lowest one was recorded for the control group. The present results indicated that T3, T2 and T1 treatments increased BW at the end of the experimental period by 24.17%, 18.24% and 8.53%, respectively compared to control. Supplementation of Se had a positive effect on the growth performance of the lambs being the best impact with organic Se. Table (1) showed that T3, T2 and T1 treatments significantly increased the total daily gain (DG) by 56.28%, 43.76% and 22.81%, respectively in comparison with control group. Similar trend among treatments regarding total gain was observed, with the superior value that associated with selenized yeast treatment T3. Kumar *et al*. (2009) showed that supplementation of organic as well as inorganic Se improved the growth rate of the lambs. Also, organic Se was more effective than inorganic Se. Similar results were obtained in chicken, goats and cow (Wang and Xu, 2008; Yue *et al*., 2009 and Shi *et al*., 2011).

In contrast, some investigation results indicated that Se levels or Se source did not influence growth of lambs (Vignola *et al.* 2009 and Antunović *et al.,* 2014). The discrepancy among the previous studies may be associated with the variation in feedstuffs, breeds or the environmental conditions in each experiment (Ružić-Muslić *et al.*, 2014). Moreover, high Se intake (Lopez *et al.,* 1968) and also in some cases high dietary protein level (Ganther *et al*., 1966) may increase expired selenium.

Table 1. Effect of different selenium sources on growth performance of lambs during the 150 days of the experimental period

Items	Treatments			
	T 0	T1	T2	T3
Initial BW, (kg)	24.50 ±0.35	24.10 ±0.69	24.53 ±0.23	24.83 ±0.25
Final BW, (kg)	41.95^{D} ±0.45	45.53^{C} ±0.69	49.60^{B} ±0.23	52.09^{A} ±0.25
Total gain, (kg)	17.45^{D} ±0.42	21.43^{C} ±0.14	25.07^{B} ±0.03	27.27^{A} ±0.03
Daily gain, (g/d)	116.33^{D} ±2.81	142.83^{C} ±0.96	167.13^{B} ±0.17	181.77^{A} ±0.18

Control= Without treatment; T1= Sodium selenite treatment; T2= Vitamin E and Selenium treatment. T3= Selenized yeast treatment . Means and Standard error (S.E) followed by superscript letters different within the same row are significantly different at P<0.01

Intake and feed conversion ratio:

Table (2) showed non significant differences in daily DM intakes among experimental dietary treatments, while daily gain in Table (1) showed significant increase in different treatments. Thus, the feed conversion ratio (daily DM / daily gain, g/g) differed (P<0.01). The best value was recorded in T3 followed by T2, while the worst value was recorded in T1 and T0 (control). Improve feed conversion ratio was observed in the Se supplemented rations of lambs (Grace and Knowles, 2002 and Juniper *et al*., 2009), in cattle (Wichtel *et al*., 1994), as well as beef cattle (Nicholson *et al*., 1991). Moreover, in an experiment with rabbits, Hassan *et al*. (2015) found that, rations supplemented with Se-algae (organic form) significantly improved FCR in comparison with the free form of the supplement. Contrary, Mudgal *et al*. (2007) reported no difference in feed conversion ratio in buffalo calves supplemented with 0.3mg Se/kg DM. Heider and Bock, (1993) identified Se as a part of cellular glutathione peroxidase, which provided evidence for Se movement in many metabolic processes and subsequently affecting potentially productive performance of animals.

Table 2. Effect of different Se sources on total DM intakes and feed conversion ratio during the experimental period

Items	Treatments			
	Control (T0)	T1	T2	T3
Average daily consumption of DM				
Daily DM(g) intak	984.71 ± 14.57	985.48 ± 14.6	986.22 ±14.64	986.47 ±14.68
Feed conversion ratio				
DM/gain (g/g)	8.46^{A} ± 0.203	6.90^{B} ± 0.047	5.90^{C} ± 0.006	5.43^{D} ± 0.005

Control= Without treatment; T1= Sodium selenite treatment; T2= Vitamin E and Selenium treatment. T3= Selenized yeast treatment . Means and Standard error (S.E) followed by superscript letters different within the same row are significantly different at P<0.01

Effect of different sources of selenium on blood analysis:

A-Whole-blood Se concentrations

Data in Table (3) showed that Se concentrations in whole blood were not significantly different among groups at the beginning of the experiment. However, after one month, Se concentrations of whole blood increased gradually until the end of the experiment in all supplemented groups (T1, T2 and T3).

Also, the whole-blood Se concentrations in T3 and T2 were higher (P<0.01) than that in T1 group. Differences among the experimental dietary treatments respecting the Se concentrations of whole blood were statistically significant over 1 to 5 months of sampling. The highest value of Se concentrations was recorded in T3 followed by T2, T1 and the lowest value was recorded in control group. Se concentration increased by 176%, 141% and 100% for T3, T2, T1, respectively compared with control group. Our results are in agreement with those recorded by Gresakova *et al*. (2013) who found that fourteen weeks feeding diets supplemented with Se either from inorganic or organic source resulted in greater whole blood Se levels compared to animals without supplementation. Additionally, some researchers showed that organic Se was more effective than inorganic Se in increasing blood Se levels in sheep, calves and cows (Van Ryssen *et al*., 1989 and Nicholson *et al*., 1991; Knowles *et al.,* 1999 and Gunter *et al.,* 2003). The results of other experiments demonstrated that cattle fed Se-yeast have higher concentrations of Se in whole blood, serum or plasma and milk those fed inorganic se (Ortman and pehrson, 1997 and Gunter *et al*., 2003). Similar results were recorded by (Kholif and Kholif, 2008) who found that blood serum Se concentration was greater for buffalos fed Se enriched yeast than control. Also in cows fed organic Se , blood Se circulating through the mammary gland was removed about 1.5 times more efficiently than in cows receiving inorganic one (Aspila, 1991).

Table 3. Effect of different Se sources on the whole-blood Se concentrations (mg/L) and GSH-Px activity (Units/L) in Lambs

Month	Blood Se concentrations			
	Control	T1	T2	T3
At the beginning	0.112 ±0.001	0.112 ±0.001	0.111 ±0.001	0.111 ±0.001
1	0.086^{D} ±0.002	0.184^{C} ±0.003	0.209^{B} ±0.005	0.243^{A} ±0.005
2	0.095^{D} ±0.004	0.207^{C} ±0.011	0.244^{B} ±0.007	0.284^{A} ±0.003
3	0.103^{D} ±0.003	0.220^{C} ±0.011	0.278^{B} ±0.006	0.312^{A} ±0.003
4	0.107^{D} ±0.002	0.240^{C} ±0.008	0.304^{B} ±0.005	0.354^{A} ±0.002
5	0.112^{D} ±0.001	0.266^{C} ±0.008	0.331^{B} ±0.007	0.388^{A} ±0.003
	Blood GSH-Px activity			
At the beginning	245.56 ±6.06	243.95 ±10.50	244.61 ±5.27	238.44 ±9.92
1	157.69^{C} ±7.00	284.88^{B} ±8.16	346.30^{A} ± 8.22	346.03^{A} ±6.90
2	200.54^{C} ±8.86	337.23^{B} ±11.03	404.81^{A} ±9.33	405.77^{A} ±13.99
3	245.29^{C} ±12.83	381.48^{B} ±12.78	455.42^{A} ±12.90	457.01^{A} ±11.08
4	263.63^{C} ±8.16	413.6^{B} ±12.12	481.76^{A} ±8.75	485.43^{A} ±8.74
5	278.63^{C} ±12.77	431.61^{B} ±9.91	518.19^{A} ±11.67	521.86^{A} ±10.50

Control= Without treatment; T1= Sodium selenite treatment; T2= Vitamin E and Selenium treatment. T3= Selenized yeast treatment. Means and Standard error (S.E) followed by different superscript letters within the same row are significantly different at P<0.01.

B- Whole-blood GSH-Px activities:

The effect of different Se Sources on the whole-blood GSH-Px is presented in Table (3). As expected, GSH-Px activity was not differed significantly among groups at the beginning of the experiment. The activities of GSH-Px in whole blood were higher (P<0.01) in all of the supplemented groups during the experimental period than in the control. Moreover, the GSH-Px activities in T3 and T2 were higher (P<0.01) than in T1 group. However, the differences in the GSH-Px activities between T3 and T2 groups were not significant. When the basal diet was fed only (control T0), the GSH-Px activity was declined sharply from the start of the experiment to one month and then increased steady throughout the experimental period. Our results indicated that selenized yeast and vitamin E and selenium were more effective than sodium selenite in increasing blood GSH-Px activities in lambs. Similarly, Awadeh *et al*. (1998) reported that selenized yeast was more effective than sodium selenite in raising the blood GSH-Px activity of cows. Furthermore, Rock *et al*. (2001) reported that lambs born to ewes fed with selenized yeast had higher concentrations of Se and activities of GSH-Px in blood than lambs born to ewes fed with sodium selenite. Also, results in Table (3) indicated that organic Se sources (selenized yeast and vit. E and Se) were more effectively than inorganic Se source (sodium selenite) in increasing blood Se concentrations and blood GSH-Px activities of lambs. The possible causes are as follows:

(1) In selenized yeast, the Se is present predominantly (94 ± 5%) in the form of protein-bound L-selenomethionine. Other Se compounds include, in percentage of total Se as the following: SeCys (0.5%), selenocystathionine (0.5%), methyl selenocysteine (0.5%), *g*-glutamyl Se Methyl selenocysteine (0.5%), Se-adenosyl-selenohomocysteine (2–5%), and inorganic Se (1%). Selenomethionine can be sequestered in the general protein pool as a methionine like compound. Consequently, the half-life of Se from selenomethionine is greater than the half-lives of other common chemical forms of dietary Se. Swanson *et al*. (1991) also reported that the half-life of Se in selenomethionine in human was twice that of Se in selenite. Furtherly, Aspila (1991) found that organic Se is more efficient in increasing plasma Se content and Se supplemented animals maintain plasma Se level longer when depleted . He added that about twice as much selenium was eliminated in urine after dosing with inorganic selenium as after dosing with organic selenium.

(2) Se from selenomethionine and selenite was absorbed with similar efficiency (Koenig *et al*., 1997). However, urinary excretion of Se was greater in lambs fed with selenite compared with those fed with selenomethionine (Ehlig *et al*., 1967).

(3) In ruminant, much of the dietary in organic Se was reduced to insoluble forms, such as elemental Se or selenides by ruminal micro-organisms, and most of the Se was excreted in the feces (Cousins *et al.,* 1961). Highly significant correlation between blood Se level and blood GSH-Px activity has been reported in cattle (Pavlata *et al.,* 2000 and Calamari *et al*., 2010).

The present results are in agreement with Qin *et al*. (2007) results, who reported that higher Se level and GSH-Px activity in the blood of lambs fed the diet supplemented with selenium yeast rather than sodium selenite. Similar effect was also found by Hassan *et al*. (2015) who found a significant increase in GSH-PX as Se-algae level that increased in the diet of rabbits. The interaction between the Se source and dietary Se level indicated that feed Se maintain erythrocyte GSH-Px activity better than inorganic Se when cows are depleted (Aspila, 1991). Pehrson *et al*. (1989) have demonstrated in heifers that organic Se increases erythrocyte GSH-Px activity more efficiently than inorganic Se. Generally, when dietary Se intake is low, the correlation between dietary Se and erythrocyte GSH-PX is poor (Whanger *et al.,* 1977)

Table 4. Effect of different Se sources on plasma concentrations of IL-1 and IL-2 (ng/mL) in Lambs

Month	Plasma concentration of IL-1			
	Control	T1	T2	T3
At the beginning	0.290 ±0.001	0.295 ±0.003	0.298 ±0.002	0.290 ±0.002
1	0.275^{B} ±0.005	0.364^{A} ±0.005	0.367^{A} ±0.008	0.370^{A} ±0.015
2	0.265^{B} ±0.005	0.409^{A} ±0.003	0.413^{A} ±0.009	0.416^{A} ±0.009
3	0.257^{B} ±0.005	0.465^{A} ±0.005	0.468^{A} ±0.019	0.470^{A} ±0.013
4	0.252^{B} ±0.005	0.552^{A} ±0.021	0.556^{A} ±0.007	0.558^{A} ±0.005
5	0.247^{B} ±0.005	0.581^{A} ±0.003	0.583^{A} ±0.004	0.588^{A} ±0.002
	Plasma concentration of IL-2			
At the beginning	2.480 ±0.180	2.416 ±0.173	2.434 ±0.192	2.436 ±0.132
1	2.017^{B} ±0.244	3.067^{A} ±0.180	3.097^{A} ±0.022	3.102^{A} ±0.075
2	1.765^{B} ±0.142	3.473^{A} ±0.208	3.475^{A} ±0.059	3.479^{A} ±0.147
3	1.570^{B} ±0.116	3.486^{A} ±0.138	3.695^{A} ±0.174	3.705^{A} ±0.235
4	1.386^{B} ±0.103	3.675^{A} ±0.049	3.782^{A} ±0.134	3.787^{A} ±0.051
5	1.209^{B} ±0.096	3.860^{A} ±0.030	3.881^{A} ±0.124	3.889^{A} ±0.044

Control= Without treatment;T1= Sodium selenite treatment; T2= Vitamin E and Selenium treatment; T3= Selenized yeast treatment. Means and Standard error (S.E) followed by different superscript letter within the same row are significantly different at P<0.01

C-Plasma concentrations of Interleukin-1 and Interleukin-2:

The effect of different Se sources on plasma concentrations of Interleukin-1 (IL-1) and Interleukin-2 (IL-2**)** are presented in Table (4). There were no significant differences in plasma IL-1 and IL-2 concentrations among the experimental groups at the beginning of the experiment in comparison with the control group. Also, in control group the mean concentration of IL-1 in plasma gradually dropped from 0.290 ng/mL at the beginning to 0.247 ng/mL at the end of the trail. The corresponding values for IL-2 were 2.480 ng /mL and 1.209 ng /mL. At one month of experimental period, concentrations of IL-1 and IL-2 in plasma of all the supplemented groups were significantly (P<0.01) higher than those in the control one. The highest values of plasma IL-1 and IL-2 concentrations were recorded in T3 followed by T2, T1 and the lowest values were recorded in the control group.

Interleukins play very important roles in animal immune function (Grimble, 1998). Ru-duan *et al*. (1992) showed that Se was able to increase the production of IL-1 by macrophages and IL-2 by lymphocytes in the presence of lectin. Also, Johnson

et al. (2000) reported that sodium selenite increased the production of IL-1 in lipopolysaccharide that stimulated splenic macrophages. Similarly, Safir *et al*. (2003) observed that secretion of IL-1 from J774.1 macrophages exposed to 10 µg/mL liposaccharide that was enhanced upon Se supplementation. Moreover, Brown *et al*. (1985) reported that Se at 10 ng /mL enhanced IL-2 production nearly two fold from a primate lymphoid cell line in serum-free media. The amounts of IL-2 and IL-1 produced by lymphocytes and macrophages, removed from Se-deficient or Se-supplemented animals did not differ significantly (Kiremidjian-Schumacher *et al*. 1990). Koller *et al*. (1986) also indicated that the activity of IL-1 produced by macrophages was unaffected by Se exposure. The results of our study indicated that supplementation of Se in the lamb's diet improved IL-1 and IL-2 levels in plasma. Moreover, there were no significant differences for IL-1 and IL-2 levels in plasma of lambs supplemented with organic or inorganic Se source.

These results are in agreement with those of Qin *et al*. (2007) who found that there are no significant differences for IL-1 and IL-2 levels in lambs supplemented with organic or inorganic Se. Further studies are needed to document the mechanisms of Se regulating the plasma IL-1 and IL-2 levels in vivo and to explain why there are no significant differences for IL-1 and IL-2 levels in lambs supplemented with organic or inorganic Se. Generally, levels of Se and Vit. E above the generally accepted requirements enhances the immune response in several species. Both Vit. E and Se protect leukocytes and macrophage during phagocytosis, the mechanism by which mammals immunologically kill invading bacteria (McDowell, 1992).

CONCLUSIONS

From these findings could be concluded that the supplementation of Selenium in the ration especially in the selenized yeast form led to improve the productive performance and physiological responses as a result of positive effect on glutathione peroxidase (GSH-Px) and interleukins (IL-1& IL-2) concentrations and consequently improved immune responses of lambs.

Also, form these results could be noted that the using selenium as antioxidant improved immune responses and metabolizable efficiency. Therefore, the results recommended to using selenized yeast form in the lamb rations especially for small farmers and holders under Upper Egypt conditions.

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أداء النمو والاستجابة المناعية للحملان متأثرة بإضافة مصادر مختلفة من السيلينيوم فى العليقة

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الهدف من هذه الدراسة تقييم خصائص النمو فى الحملان وكذلك الاستجابه المناعية المتأثرة باضافة مصادر مختلفة من السيلينيوم. اجريت هذه التجربة فى مزرعة الانتاج الحيوانى البحثية التابعة لكلية الزراعة جامعة سوهاج- سوهاج. تم فى هذه التجربة استخدام ٢٤ حمل تتراوح اعمارهم من ٧-٨ شهور وكان متوسط اوزانهم ٢٤.٢٧± ٠.١٥ كجم و تم تقسيم هذه الحيوانات عشوائيا الى اربعة مجموعات متساوية (٦ حملان فى كل مجموعة). تم تركيب العليقة الاساسية لتغطية الاحتياجات الغذائية للحملان طبقا لمقررات NRC (١٩٨٥) فيما عدا عنصر السيلينيوم. استمرت هذه التجربة لمدة ٢٥ اسبوع بالإضافة إلى اسبوعين اقلمة للحيوانات فى بداية التجربة. تم تغذية الحملان فى المجموعة الاولى على العليقة الاساسية وبدون اى اضافات (الكنترول) بينما تم تغذية الحملان فى المجموعات T1 وT2 وT3 على العليقة الاساسية مضاف اليها ٠.١مليجرام لكل كجم من المادة الجافة فى صورة سيلينات الصوديوم و فيتامين E والسيلينيوم وخميرة السيلينيوم على الترتيب. تم وزن الحيوانات فى بداية التجربة ثم شهريا قبل تقديم العلف والماء طول فترة التجربة لتقدير معدل النمو. تم حساب كل من الزيادة الكلية فى الوزن ومتوسط الزيادة اليومية خلال فترة التجربة كما تم حساب كفاءة التحويل الغذائى. تم اخد عينات الدم صباحا (قبل التغذية و تقديم الماء) من الوريد الوداجى فى انابيب مضاف اليها الهيبارين وكان حجم العينة ١٠ مل وذلك فى الايام صفر، ٣٠، ٦٠، ٩٠، ١٢٠، ١٥٠ يوم خلال اجراء التجربة. وقد تم تقدير تركيز السيلينيوم فى عينة الدم الكاملة وأيضاً النشاط الانزيمى ل (GSH-PX) تم تقديره فى عينة الدم الكاملة كما تم تقدير تركيز Interlukins (IL-1, IL-2) فى البلازما.

وقد اظهرت النتائج وجود اختلافات معنوية و ان المعاملات T1, T2, T3 ادت الى زيادة وزن الجسم فى نهاية فترة التجربة بمقدار ٢٤.١٧ ، ١٨.٢٤ ، ٨.٥٣% على التوالى مقارنة بمجموعة الكنترول كما اظهرت النتائج ايضا ان المعاملات T1, T2, T3 ادت الى زيادة متوسط الوزن المكتسب بنسبة ٥٦.٢٨، ٤٣.٧٦، ٢٢.٨١ % على التوالى مقارنة بمجموعة الكنترول. اما فيما يخص معدل التحويل الغذائى اظهرت النتائج وجود اختلافات معنوية بين المعاملات افضل قيمة تم تسجيلها فى المعاملة الثالثة (T3) يليها المعاملة الثانية (T2) بينما اقل قيمة تم تسجيلها فى المعاملة الاولى (T1) والكنترول. وأظهر المتوسط العام لتركيز السيلينيوم فى الدم فروق معنوية بين المجاميع المختلفة وسجلت T3 اعلى قيمة في تركيز السيلينيوم ويليها T2 و T1 بينما اقل قيمة كانت في الكنترول. علاوة على ذلك فان نشاط (GSH-PX) فى T3 و T2 كان مرتفعا معنوياً عن T1 والكنترول. كما أظهرت النتائج عدم وجود فروق معنوية في تركيز إنزيم (GSH-PX) بين المعاملتين T3 و T2 بالاضافة الى ذلك اظهرت النتائج ان تركيز IL-1 , IL-2 فى البلازما زادت فى كل المعاملات اثناء فترة التجربة عن الكنترول.وكان تركيز كل من IL-1, IL-2 فى البلازما اعلى فى المعاملة T3 يليها T2 ثم المعاملة T1 بينما سُجلت اقل قيمة فى الكنترول.

نستنتج من هذه الدراسه ان اضافة السيلينيوم الى علائق االحملان النامية خاصة فى صورة خميرة السيلينيوم يؤدى الى تحسين الخصائص الانتاجية والفسيولوجية في الأغنام كنتيجة للتأثير الإيجابي على المناعه فى الحملان وعلى نواتج التمثيل الغذائي في الدم . وتوصى الدراسه بأضافه السلنيوم بصورة المختلفه وخصوصا فى صورة خميرة السيلينيوم فى المزارع الصغيرة وصغار المربين فى جمهورية مصر العربيه