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EFFECT OF VITAMIN E AND SELENIUM SUPPLEMENTATION ON GROWTH PERFORMANCE, DIGESTIBILITY, CARCASS TRAITS AND BLOOD COMPONENTS OF BOUSCAT RABBITS.

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ABSTRACT

Sixty growing Bouscat rabbits 5 weeks old (30 male+30 females) with an average body weight of (575.33+ 12.23g) were divided at random into three comparable groups and fed the following diets. 1) Basal diet without vitamin E and selenium supplementation and served as a control (G_1). 2) Basal diet+10 mg vitamin E+1mg selenium (G_2). 3) Basal diet+20 mg vitamin E+2mg selenium (G_3). Live body weight, daily weight gain, feed intake and feed conversion were recorded at different age studied. Digestibility of nutrient, nutritive values, carcass traits and blood components were estimated.

The results cleared that, live body weight , daily weight gain and feed conversion were not affected significantly by vitamin E and selenium supplementation. The rabbits of G2 significantly recorded the highest ($P<0.01$) daily feed intake through 5-13 and 9-13 weeks of the age.

Supplementation with vitamin E and selenium did not significantly affect digestibility of various nutrient and feeding values. The feeding values as TDN and DCP of G_2 were the highest, followed by G_3, then (G_1). Dry matter (DM) intake as g/head/day or g/kgw$^{0.75}$ or kg/kg body weight of the rabbits fed G_2 increased than that of the other two groups.

Concentration of globuline, total lipids, alanine and activity of aminotrnsferase (ALT) and alkaline phosphatase were affected significantly ($P < 0.05$) by vitamin E and selenium supplementation. The alkaline phosphatase activity was increased with increasing the level of vitamin E and selenium supplementation, meanwhile total protein, albumine, urea-N, creatinine concentration and AST activity did not affected significantly by vitamin E and selenium supplementation. The carcass % increased with increasing vitamin E and selenium supplementation, while the kidney and liver percent was decreased with increasing vitamin E and selenium supplementation.

Supplementation of 20 mg vitamin E + 2 mg selenium may be recommended to meet the loss of vitamin E during the diet pelleting and unsuitable storage and to improve productive performance of Bouscat rabbits.

Key words: Vitamin E and selenium, growth performance ,digestibility, blood components, carcass, rabbits.

INTRODUCTION

All vitamins and minerals are required for production and reproduction, because of their cellular roles in metabolism, maintenance and growth. However, these nutrients also, may have specific roles and requirements in reproductive tissues.

Vitamin E and selenium are widely distributed in all natural feeds, such as wheat germ oil, oil seeds by–products, grains by-products, all leaf forages, rice polishing, barley grains, oats, rye, sorghum, wheat grains, corn grain meal, corn gluten meal and yeast.

The relationship between vitamin E and selenium has been was established since, 1950s, when researchers found that selenium prevented exudative diathesis in vitamin E deficient chicks and liver necrosis in vitamin E deficient rats. Subsequent researches demonstrated that deficiency of both vitamin E and selenium cause reproductive disorders in farm animals such as retained placenta, abortion, metritis, mastitis, and infertility (Larsen, 1993; Wu *et al*., 1995; Shetaewi, 1998 b; Meshreky and Metry , 2000; Shashi *et al*., 2002 and Hemingway, 2003).

Vitamin E is one of the fat soluble vitamins. It acts as an intracellular antioxidant and participates in synthesis of vitamin C and regulation of DNA metabolism (Scott *et al*. 1982, Banerjee, 1988 and Nour El-Din, 2000). It also prevents the oxidation of unsaturated fatty acids, present in cell membranes (Diplock, 1985 and Liebler, 1993). Moreover, vitamin E provides disease resistance by protecting leukocytes and macrophages during phagocytosis and increasing immunity responses (Reddy *et al.* , 1987).

On the other hand, selenium is a vital component of the enzyme glutathione peroxidase, which reduces cytosolic peroxides and free radicals, i.e. selenium protects the cell from oxidative damage (Pehrson, 1993) and selenium influences the absorption and retention of vitamin E (Banerjee, 1988). Thus, vitamin E and selenium together protect the cell from the destructive oxidation reactions. The complementary functions of selenium and vitamin E have been hypothesized to suggest that supplementation with one can reduce, but not eliminate the requirement for the other (Van Saun *et al*., 1989). Recently, it was discovered that the deiodinase enzymes which convert T_4 (thyroxine, the thyroid prohormone) into T_3 (triiodothyronine, the cellularly active hormone) and also convert T_3 into T_2 , thereby degrading it, are selenium enzymes (formed with the amino acid cysteine). This discovery has led to a lot of research studies on the effects of selenium, iodine and their interactions. It has been found that without selenium, the thyroid gland becomes damaged (Behne *et al*., 1992 and Wu *et al*., 1995).

For rabbits nutrition, there are insufficient data in the literature to permit a sound recommendations for the optimum level of vitamin E and selenium in the diet. Although, several studies showed that level of vitamin E in the diet decreases with unsuitable storage, pelleting, infecting the diet with molds and presence of unsaturated fatty acids, iron and copper (Dove and Ewan,1987), a level of 40 mg per kg of diet is still suggested (NRC, 1977). Food and drug administration (FDA, 1987) has approved dietary selenium as feed additive up to 0.3 mg/kg DM of diet for all major food-producing animals.

The objective of the present study aimed to investigate the effect of adding two levels of vitamin E and selenium in the drinking water on growth performance, digestibility, some blood serum components, and carcass traits of Bouscat rabbits.

MATERIALS AND METHODS

The experimental works of the present study was carried out at a commercial (Private) farm at Khatara, Sharkia Governorate.

In this respect, 60 growing Bouscat rabbits 5 weeks old (30 males+ 30 females) with an average initial body weight of (575.33± 12.23 g)were divided into 3 comparable groups, which to weight were subjected to evaluate the following treatments:

1. The 1st group fed a basal diet without vitamin E or selenium supplementation and served as control (G_1)
2. The 2nd group fed the same basal diet + 10 mg vitamin E + 1 mg selenium (G_2).
3. The 3rd group fed the same basal diet + 20 mg vitamin E + 2 mg selenium (G_3).

The ingredients and chemical composition of the basal diet are shown in Table 1.

Vitamin E and selenium were added to drinking water in the form of commercial preparation (vitamin E and selenium), purchased from Mena Vet. Co. Sadat City, Egypt. Rabbit were housed (each 2 together) in wire cages (60 x 55 x 40 cm) provided with feeders and stainless nipple. Feeds and water were offered to rabbits *ad libitum* during the experimental period. Fresh drinking water either free or supplemented with vitamin E and selenium were replaced daily. The animals were kept under the same environmental and managerial conditions. The basal diets was formulated in one of feed mills to meet the nutrient requirements of rabbits according to NRC (1977). Live body weight, daily weight gain, feed intake and feed conversion were recorded at four weekly intervals.

Digestibility trials was carried out at the 11th week of age using 3 male rabbits from each experimental groups. The rabbits were housed individually in metabolic cages. The trial lasted 10 days, 4 days as a preliminary period followed by 6 days as a collection period. Daily feces of each rabbit were taken and oven dried at 65 ^{0}C for 48 hour, then ground and stored until the time of chemical analysis. Chemical analysis of samples of feed and feces were performed according to A. O. A. C. (1990). The metabolizable energy (ME) of the diet were calculated according to the equation described by Kalogen (1985) as follows:

ME (kcal/kg diet DM)= (0.588+0.164 x)239, where x is a dry matter digestion coefficient of tested diet. The values of TDN were calculated according to the classic formula of Cheeke *et al*. (1982).

At 13 weeks of age, 3 rabbits from each experimental group were randomly slaughtered. Blood samples were taken from each rabbit at the time of slaughtering. Blood serum was separated by centrifugation at 3000 r.p.m. for 15 minutes and stored frozen (-20^{0}c) in plastic vials until performance of the biochemical tests. Levels of serum total protein, albumen, total lipids, urea-N, creatinine, aspartate aminotransferase (AST) and alanine aminotrnsferase (ALT) were determined using a calorimetric assay kits, following the methodology suggested by the procedures.

Table 1. Ingredients and chemical analysis of the basal diet.

Items	%
Composition of the diet	
Yellow corn grains	23.00
Wheat bran	31.00
Clover hay	30.00
Soybean meal	14.00
Limestone	1.00
Bone meal	0.25
[1] Premix	0.25
Sodium chloride (common salt)	0.50
Chemical analysis:	
Dry matter (DM)	89.91
Organic matter (OM)	81.05
Crude protein (CP)	16.55
Ether extract (EE)	4.08
Crude fiber (CF)	13.13
Nitrogen free extract (NFE)	47.29
Ash	8.86
[2] Calcium	0.88
[3] Phosphorus	0.64
[4] Methionine + cystine	0.56
[5] Iodine (ppm)	0.83
[6] Selenium (ppm)	0.24
Vitamin E (ppm)	68.00

[1]One kilogram of premix contained: Vit. A 4000000 IU, Vit. D_3 50000 IU, Vit. E 16.7 gm, Vit. K_3 0.67 gm, Vit. B_1 0.67 gm, Vit. B_2 2.0 gm, Vit. B_6 0.67 gm, Vit. B_{12} 3.33 mg, Choline chloride 400 gm,

Biotin 0.07 gm, Niacin 16.7 gm, Pantothenic acid 6.7 gm, Folic acid 1.7 gm, Magnesium 133.3 gm, Copper 1.7 gm, Iodine 0.25 gm, Selenium 33.3 mg, Iron 25 gm, Manganese 10 gm and Zinc 23.3 gm.
[2,3,4] The values were calculated according to NRC (1977).
[5] Iodine was calculated according to Kalashnikov and Klemenov (1985).
[6] Selenium was calculated according to Ensminger *et al*. (1990).

Data of the experiment were statistically analyzed according to Snedecor and Chochran (1982), using SPSS system (1998). The differences between means were tested using Duncan' s New Multiple Rang Test (Duncan,1955).

RESULTS AND DISCUSSION

Growth performance:

Data in Table 2 indicated that there were no significant differences in live body weight daily weight gain or feed conversion among the experimental groups. The rabbits gained over 8 weeks (5-13 weeks old) 1601.43, 1652.29 and 1652.00 g for G_1, G_2 anG_3, corresponding to 28.60,29.51 and 29.50 g, respectively. However, feed intake significantly increased in G_2 (0.01) starting from 9[th] week of age up to the end of the experiment at the 13[th] week of age as compared to either G_1 or G_3, Table 2. Then respective increase in feed intake was 8.36 and 8.05 %, respectively.

Table 2. Effect of supplementation of Vitamin E and selenium on growth performance (X±SE) of growing Bouscat rabbits.

Items	Experimental groups		
	G_1(Control)	**G_2**	**G_3**
No. of rabbits	20	20	20
Initial body weight at 5 weeks(g):	575.00±18.81	562.00±15.31	588.00±20.60
Live body weight at age 9 weeks	1477.86±35.57	1443.33±59.46	1532.35±54.45
Live body weight at age 13 weeks	2176.43±26.59	2214.29±58.65	2240.00±61.07
Daily weight gain (g) from age:			
5-9 weeks	32.78±1.45	31.48±1.99	33.47±1.68
9-13 weeks	24.95±1.03	27.81±1.65	25.27±1.37
5-13 weeks	28.60±0.52	29.51±0.88	29.50±1.04
Daily feed intake (g/day) from age:			
5-9 weeks	114.14±2.13	119.14±1.52	114.06±2.02
9-13 weeks	157.11±2.29 [b]	170.25±3.22 [a]	157.56±3.55 [b]
5-13 weeks	135.63±1.56 [b]	144.69±1.48 [a]	135.81±1.90[b]
Feed conversion ratio (g feed/g gain) from age:			
5-9 weeks	4.41±0.38	4.10±0.54	3.66±0.82
9-13 weeks	5.41±0.33	5.46±0.32	5.23±0.45
5-13 weeks	4.74±0.30	4.90±0.50	4.60±0.35

Means in the same row having different superscript differ significantly (P<0.01).

Feed conversion was 4.74 g feed/g gain in the control group. It tended to slightly increased to be 4.90 g ration/g gain in G_2 versus a slight decrease to 4.60 g ration/g gain in G_3. Thus it could be concluded that the feed conversion was improved by the highest rate of vitamin E and selenium supplementation. Abdel-Samee and El-Masry (1997) reported that NZW growing rabbits supplemented with Vitamin E + selenium showed higher gain (P < 0.01) than unsupplemented group. The disagreement of our results with that obtained by other researchers may be due to the differences in the levels used of vitamin E and selenium and the route of supplementation, in the drinking water or in the ration.

Digestibility of nutrient and nutritive value:

Digestibility of nutrients and feeding values from the data are shown in Table 3. It is noticed that the DM intake expressed as g/head/day or g/kgw$^{0.75}$ or kg/kg body weight of the rabbits of G_2 supplemented with 10 mg vitamin E +1 mg selenium increased than that of control group or G_3 supplemented with 20 mg vitamin E +2 mg selenium. However, supplementation with vitamin E and selenium did not significantly affect digestibility of various nutrients or feeding value. It clearly appears that supplementation rabbits with 10 mg vitamin E +1 mg selenium recorded the best value of DM, OM, and NFE digestibility, meanwhile G_3 (20 mg vitamin E +2 mg selenium) recorded the best value of CP and EE digestibility coefficients.

The feeding values as TDN and DCP of G_2 was the highest values, followed by G_3, and the least was the control group. It concluded that supplementation of vitamin E and selenium increased the digestibility of DM, OM and CP than that of the control diet. While the digestibility of CF and EE showed an opposite trend. Also the nutritive values as TDN and DCP (g/kg w$^{0.75}$) increased than that of the control group.

Carcass traits:

Data in Table 4 showed that supplementation with vitamin E and selenium did not significantly affect the dressed weight %, carcass weight %, digestive tract weight %, head and kidney weight %, liver weight % and heart weight %. The carcass % increased with increasing vitamin E and selenium supplementation level, while digestive tract, head, kidney, liver and heart % were decreased. Similar results were reported by Shetaewi (1998), who found that vitamin E supplementation did not affect hot carcass weight of NZW rabbits. Also, Meshreky *et al*. (2002) found that percentages of dressing, liver and kidney weights decreased (P < 0.05) in male rabbits injected with vitamin E plus selenium as compared to the control rabbits. It could be noticed that, the kidney and liver percent decreased with increasing vitamin E and selenium supplementation which may be due to effect of vitamin E and selenium as antioxidant (Scott *et al*. 1982, Diplock, 1985, Banerjee, 1988, Liebler, 1993, and Nour El-Din, 2000).

Table 3. Digestion coefficient and nutritive values of growing rabbits fed diet supplemented with vitamin E and selenium.

Items	G_1 (Control)	G_2	G_3
Nutrients digestibility (%)			
Number of animals:	3	3	3
Average initial weight:			
Kg	2.88±0.15	2.60±0.09	2.41±0.14
kg $W^{0.75}$	2.21±0.09	2.05±0.01	1.94±0.09
Dry matter intake:			
kg/kg BW	4.96±0.21	5.59±0.19	5.35±0.29
G/head/day	124.62±6.38	145.10±4.18	130.17±5.43
G/kg $W^{0.75}$	64.69±2.47	70.80±2.31	67.30±2.19
Digestion coefficient (%):			
DM	57.57±1.35	61.30±2.63	61.17±1.44
OM	63.91±0.43	64.95±1.87	64.86±0.91
CP	69.28±0.25	69.62±2.43	69.71±0.42
CF	33.80±0.45	32.13±1.85	30.16±2.31
EE	83.34±2.19	72.06±1.79	70.59±0.87
NFE	71.40±1.42	72.06±1.79	70.59±0.87
Nutritive values:			
TDN			
G/head/day	89.31±3.56	88.85±3.38	80.53±3.66
G/kg $W^{0.75}$	40.55±1.85	44.48±0.58	41.61±1.23
DCP (%)			
G/head/day	17.36±0.64	17.89±0.12	61.11±0.76
G/kg $W^{0.75}$	7.89±0.33	8.73±0.05	8.33±0.31
DE(kcal)	1805.96±76.86	1697.25±66.19	1669.57±61.78

All the differences among means in the same row were not significant.
DE (kcalkg)= DCP x 8.25 g/kg +DEE x 9.51 g/kg + DCF x 4.20 g/kg +NFE x 4.20 g/kg (Schieman *et al*. (1972).

Table 4. Carcass traits of growing rabbits fed diet supplemented with vitamin E and selenium

Items	Experimental groups		
	G_1 (Control)	G_2	G_3
Preslaughter weight (g)	2000.00±150.98	2150.00±68.07	2196.67±54.87
Dressed weight (g)	1215.16± 89.01	1316.24±49.23	1357.17± 66.25
(%)	57.32	55.03	58.16
Carcass weight (g)	1006.67±121.29	1100.00±57.54	1153.33±56.96
(%)	50.33	51.16	52.56
Digestive tract weight (g)	350.00±28.78	396.67±21.86	386.637±3.33
(%)	17.50	18.45	17.60
Head weight (g)	113.33±8.82	126.67±8.82	116.67±4.71
(%)	5.67	5.89	5.31
Kidney weight (g)	23.50±3.25	17.57±1.70	17.17±0.82
(%)	1.18	0.82	0.78
Liver weight (g)	72.33±7.88	72.00±10.21	70.00±2.08
(%)	3.62	3.35	3.19
Heart weight (g)	5.97±0.47	5.73±0.52	6.93±0.39
(%)	0.30	0.27	0.32

*All the differences among means in the same row were not significant.

Blood serum components:

Data of blood analysis are shown in Table 5. It clearly appears that the total protein, albumin, urea-N, creatinine and AST were not affected significantly by vitamin E and selenium supplementation. The values of these parameters are within the normal range.

The globulin value of rabbit of G_3 (20 mg vitamin E +2 mg selenium) was significantly ($P < 0.05$) higher than that of G_2 (10 mg vitamin E +1 mg selenium). Total lipids ($P < 0.05$), ALT and alkaline phosphatase ($P < 0.01$)of rabbits of G_2 (10 mg vitamin E +1 mg selenium) and G_3 (20 mg vitamin E +2 mg selenium) were significantly higher than that control diet, but the differences in this respect between rabbits of G_2 and G_3 were insignificant. From the data in Table 5 it could be noticed that total lipids, urea-N, creatinine, AST, ALT and Alkaline phosphatase increased with increasing vitamin E and selenium supplementation from 10 mg vitamin E +1 mg selenium to 20 mg vitamin E +2 mg selenium. El-Husseiny *et al*. (1997) and Shetaewi (1998b) found an increase in blood plasma total protein in response to vitamin E supplementation. Also, Zeidan *et al*. (2001) and Gad Alla *et al.* (2002) reported that buck rabbits given vitamin E had higher values in blood total protein, albumin and globulin than those fed the control diet.On the contrary, Youssef *et al*. (2003) found that treatment of rabbits with vitamin E significantly decreased (P <

0.05) the activities of aspartate aminotransferase (AST), alanine aminotransferase (ALT).

Table 5. Effect of supplementation of vitamin E and selenium on some blood serum components (X±SE) of rabbits.

Items	Experimental groups		
	G_1 (Control)	G_2	G_3
Total protein (g/dl)	5.41±0.12	5.33±0.23	5.41±0.24
Albumin (g/dl)	4.09±0.26	3.80±0.12	3.45±0.18
Globulin (g/dl)	1.88±0.41^{ab}	1.53±0.20^{b}	1.95±0.07^{a}
Albumin/ Globulin ratio	2.18±0.38^{ab}	2.48±0.31^{a}	1.77±0.09^{b}
Total lipid (mg/dl)	284.50±16.45^{b}	311.56±20.32^{a}	320.72±35.16^{a}
Urea- N(mg/dl)	21.18±5.58	22.47±6.31	23.35±7.81
Creatinine (mg/dl)	1.21±0.14	1.43±0.05	1.45±0.14
AST (μ /L)	8.01±0.54	6.06±0.20	10.3±0.77
ALT (μ /L)	14.19±0.50^{b}	18.64±1.12^{a}	18.74±0.11^{a}
Alkaline Phosphatase (μ /L)	12.29±0.52^{b}	20.56±1.26^{a}	23.84±0.13^{a}

Means in the same row having different superscript differ significantly (P<0.05).

In conclusion

Vitamin E and selenium are necessary for the normal growth, whereas it significantly increased the daily feed intake insignificantly increased the daily body gain and improved feed conversion specially by supplementation of 10 mg vitamin E +1 mg selenium) . Also, improved digestibility of most nutrient and feeding values, moreover improved liver transaminase and kidney function and carcass traits. Adding in the drinking water a level of 10 mg vitamin E + 1 mg selenium /liter may be recommended as a complementary level to compensate the loss of vitamin E during the diet pelleting and unsuitable storage and to improve productive performance of Bouscat rabbits.

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تأثير إضافة فيتامين هـ و السيلينيوم على معدل النمو ومعاملات الهضم وصفات الذبيحة ومكونات سيرم الدم في الأرانب البوسكات.

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استخدم في هذه الدراسة ٦٠ أرنب بوسكات نامي عمر ٥ أسابيع (٣٠ ذكر+٣٠ أنثي) بمتوسط وزن (٥٧٥.٣٣±١٢.٢٣ جرام) قسمت إلي ثلاث مجموعات متساوية وغذيت الأرانب علي العلائق الآتية:-

١- المجموعة الأولى على العليقة الأساسية بدون أي إضافة واتخذت للمقارنة.
٢- المجموعة الثانية على العليقة الأساسية بالإضافة الى١٠ مجم فيتامين هـ و ١ ملجم سيلينيوم لكل لتر من ماء الشرب.
٣- المجموعة الثالثة على العليقة الأساسية بالإضافة إلى ٢٠ مجم فيتامين هـ و ٢ ملجم سيلينيوم لكل لتر من ماء الشرب.

أتضح من نتائج هذه الدراسة أن معدل الزيادة اليومية في وزن الجسم ومعدل التحويل الغذائي (جرام غذاء مستهلك/جرام زيادة وزنية) لم تتأثر معنويا بإضافة فيتامين هـ و السيلينيوم . سجلت الأرانب بالمجموعة الثانية G_2 ١٠ مجم فيتامين هـ و ١ ملجم سيلينيوم لكل لتر من ماء الشرب زيادة معنوية (علي مستوي احتمال ١%) في الغذاء المأكول اليومي لكن لم تتأثر معنويا كل من معاملات الهضم والقيم الغذائية كمركبات كلية مهضومة (TDN) أو بروتين خام مهضوم (DCP) بإضافة فيتامين هـ و السيلينيوم. أيضا أرتفع تركيز الجلوبيولين ونسبة الجلوبيولين/الألبيومين ونشاط أنزيم AST and ALT و أنزيم الفوسفاتيز القاعدي علي مستوي احتمال ١% في سيرم الدم للأرانب التي أضيف لها فيتامين هـ و السيلينيوم وبالمثل ازدادت معنويا نسبة الدهون الكلية ولكن علي مستوي احتمال ٥%.

تشير النتائج إلي حدوث بعض التحسن في معدل الأداء الإنتاجي في الأرانب البوسكات التي أعطيت مستويات إضافية من فيتامين هـ و السيلينيوم. وبناء علي ذلك يمكن التوصية بإضافة ١٠ ملجم فيتامين هـ و١ ملجم من السيلينيوم لكل لتر من ماء الشرب كمستوي إضافي مكمل لتعويض الفقد في فيتامين هـ خلال عملية تصنيع العلائق و ظروف التخزين الغير مناسبة.