Assiut Vet. Med. J. Vol. 46 No. 91, October 2001

Animal Prod.Dept, Fac. of Agric.,
Minia University, Minia, Egypt

# SOME PHYSIOLOGICAL REACTIONS OF MALE LAMBS SUBJECTE TO VITAMIN E AND SELENIUM INJECTION DURING SUMMER CONDITIONS

(With 4 Tables)

By

***E.B. SOLIMAN, M.A.A. El-BARODY and S.T.M. FAHMY***

(Received at 30/9/2001)

## بعض الاستجابات الفسيولوجية لذكور الحملان للحقن بفيتامين ه و السيلنيوم تحت ظروف الصيف

*عصام بسيوني سليمان ، محمد عبد الفتاح احمد البارودي ، سمير توفيق محمد فهمي*

أجريت هذه الدراسة علي عدد ١٨ ذكر من الحملان الأوسيمي (عمر ٣ شهور) بهدف تقييم أستجابتها الفسيولوجية للحقن بفيتامين ه + السيلينيوم) تحت ظروف الصيف الحارة (يوليو الي سبتمبر ٢٠٠٠)٠ قسمت الحيوانات عشوائيا الي ثلاثة مجموعات متساوية٠ أستخدمت المجموعة الأولي للمقارنة (كنترول) وقد تم حقنها بمحلول فسيولوجي (٠,٩ % كلوريد صوديوم) بمعدل ٠,٥ مل /رأس؛ بينما تم حقن المجموعتين ( الثانية و الثالثة) بالفيتسيلين بمعدل ٠,٢٥ مل/ رأس ، ٠,٥٠ مل/ رأس علي التوالي٠ وقد تم الحقن بمعدل كل أسبوعين و أستمر لمدة ١٠ أسابيع٠ وقد تم تسجيل أوزان الجسم أسبوعيا وتم حساب معدلات زيادة الوزن اليومية وتم تسجيل معدلات أستهلاك الغذاء يوميا وتم حساب معدلات الكفاءة التحويلية للغذاء٠ وتم أيضا تسجيل درجة حرارة المستقيم و معدل التنفس ومعدل النبض عند الساعة ٨ صباحا و الساعة ٢ ظهرا٠ أيضا تم أخذ عينات دم كل أسبوعين لقياس بعض مكونات الدم٠ وقد أوضحت النتائج أن حيوانات المجموعة الثالثة سجلت قيم أعلي معنويا في كلا من معدل الزيادة اليومية، كفاءة التحويل الغذائي وكذلك درجة حرارة المستقيم و معدل النبض مقارنة بالمجموعة الثانية و الكنترول٠ أوضحت النتائج أيضا أن المجموعة الثانية و الثالثة سجلت قيم أعلي معنويا في معدلات التنفس، مكونات الدم (عدد كرات الدم الحمراء- الهيموجلوبين- النسبة المئوية للمكونات الخلوية) وكذلك في تركيزات البلازما من السيلينيوم وفيتامين ه مقارنة بالمجموعة الكنترول٠ أ ظهرت حملان المجموعة الثانية و الثالثة زيادة معنوية في العدد الكلي لكرات الدم البيضاء متضمنا زيادة في كلا من الكرات الليمفاوية والكرات حمضية الصبغ وأنخفاض في نسبة الكرات المتعادلة بينما لم تتأثر كلاً من الكرات الاحادية و الكرات القاعدية الصبغ٠ نستنتج من هذه الدراسة أن حقن الحملان النامية بالفيتسلين تحت ظروف الصيف الحارة ربما يعتبر وسيلة الي تحسين معدل النمو وكذلك

بعض الأستجابات الفسيولجية الخاصة بالتحمل الحراري وتحسين القدرة المناعية لنعاك الحملان.

## SUMMARY

Eighteen males of Ossimi lambs, averaged three months of age and 20.3 ± 1.53 kg body weight, were used in this study to evaluate their physiological reactions to vitamin E plus selenium injection during hot summer conditions (Jul-Sept, 2000). They were randomly allocated into three equal groups (six lambs in each) of similar initial body weights. The first group (G1) served as control and injected with 0.50 ml/head of saline solution (0.9% NaCl). The second (G2) and third (G3) groups were recieved viteselen injection intramusculraly with 0.25 and 0.50 ml/head, respectively. Each ml of viteselen contained 150 mg vitamin E and 1.67 mg sodium selenite for veterinary use. The viteselen was injected biweekly and continued for 10 weeks, the experimental period. Body weights were recorded weekly and feed intake was recorded daily. Daily weight gain and feed conversion were calculated. Rectal temperature (RT,°C) and respiration rate (RR, rpm) were recorded weekly at 8 a.m. and 2 p.m. Blood samples were analyzed for hemoglobin (Hb), packed cell volume (PCV), red blood cell (RBC) and total white blood cell counts (WBC). Differential leucocyte percentages were estimated. Plasma concentrations of vitamin E and selenium were assayed. The results showed that lambs of G3 had a higher daily weight gain , feed conversion, rectal temperature and pulse rate than the control and. Lambs of G2 and G3 recorded higher respiration rates than control. Blood RBCs, Hb and PCV increased for Lambs of G2 and G3 compared with control. Lambs of G2 and G3 exhibited higher dose-dependent increase in their plasma concentrations of selenium and vitamin E than control. Lambs of G2 and G3 had higher values of leucocytes total count, showing a marked increase in both of lymphocytes and eosinophils accompanied with a drop in percentages of neutrophils. Meanwhile, percentages of basophils and monocytes did not change in injected lambs. These results indicated that injection of vitamin E plus selenium might have a useful role to enhance growth performance, adaptive and immune responses of growing lambs under hot summer conditions.

***Key Words*** : *Vitamin E, Selenium, Lambs, Hot conditions, Physiological reactions.*

## INTRODUCTION

Vitamin E and selenium are essential nutrients that share common biological activities. Vitamin E is essenicial for sheep but it dosent appear to be stored in the body in appreciable concentrations (Rammell, 1983). The requirements of vitamin E considerably depend on selenium levels and physiological status of sheep (NRC, 1985). Vitamin E (alpha-tocopherol) is recognized as an important biological antioxidant, and it defend the body's intracellular against the adverse effects of reactive oxygen and free radicals (Rammell, 1983). So, vitamin E plays an important role in maintaining the integrity of biological cell membrane. Its mode of action is closely associated with selenium in metabolism (Makimura et al., 1993).

Selenium has been identified as an integral part of the enzyme glutathione peroxidase which assists in preventing cell membrane damage and eliminate the effect of free radicals damage resulting from fatty acid peroxidation (Rotruke et al., 1973). Selenium function is inextricably entwined with that of vitamin E. Dietary supplementation with vitamin E (20 IU/kg feed) was successuful in preventing nutritional muscular dystrophy (NMD) in rapidly growing early-weaned lambs (Sharman, 1973). Selenium and vitamin E have been shown to prevent NMD in young ruminants, specifically, white muscle disease of lambs and calves (Norton and McCarthy, 1986).

Antioxidants such as vitamin E and selenium are very important in protecting the animal's tissues from oxidative destruction and this protective benefit also improved immune response which decreases infectious disease incidences. Oral supplementation of vitamin E to ewes during late gestation decreased mortality rate by as much as 50 % in the early part of lambing season (Kott et al., 1998). Additionaly, Gentry et al. (1992) observed that lambs being born to ewes injected with vitamin E in late gestation had greater serum immunoglobulin G (IgG) levels than lambs born to ewes not injected.

Supplementation of vitamin E alone improved the adaptive response of rabbits to hot conditions keeping efficient metabolic activities (Hassanein et al., 1995). Also, the complementary role of vitamin E and selenium supplementation had a helpful role in growth and reproductive performance of rabbits under subtropical conditions (Abdel-Samee and El-Masry, 1997). Furthermore, in a recent study on

buffalo calves, vitamin E and selenium injection exhibited helpful signs in improving their growth performance and metabolic processes as well as adaptive response under cold winter conditions (El-Barody et al., 2000). Therefore, the present work aimed to evaluate the beneficial effects of vitamin E plus selenium injection by monitoring some physiological reactions of growing Ossimi lambs under hot conditions in summer.

## MATERIAL AND METHODS

This experiment was carried out during the months of summer conditions (July, August and September, 2000) at the Animal Production Department Farm, Faculty of Agriculture, Minia University. Eighteen Ossimi male lambs, averaged three months of age and 20.3 ± 1.53 kg body weight, were used in this study. The animals were randomly allocated within three equal groups of six in each. The first group (G1) served as control and injected with 0.5 ml/head of sterile saline solution (0.9 % Nacl). The second (G2) and the third (G3) groups were received viteselen injection intramusculraly with 0.25 ml/head (containing 0.02 mg selenium+3.75 IU vitamin E/head/day) and 0.50 ml/head (containing 0.04 mg selenium+7.5 IU vitamin E/head/day), respectively. Each ml of viteselen contained 150 mg vitamin E and 1.67 mg sodium selenite for veterinary use and manufactured by the Egyptian Co. for Chemicals and Pharmaceuticals. The viteselen was injected biweekly and continued for 10 weeks as experimental period. The average initial body weight of the experimental lambs in G1, G2 and G3 were 20.77±1.53, 20.31±1.53, and 19.68±1.53, kg, respectively. Body weights were recorded weekly before drinking and feeding. Feed intake was recorded daily. The animals were housed in closed stable and fed on concentrate mixture and wheat straw ad lib. Feeds were offered twice a day at 8 a.m and 2 p.m. The concentrate mixture contained 30 % yellow corn, 45 % wheat bran, 17 % decorticated cotton seed meal, 5% molasses, 2.0 % limestone and 1.0 % common salt. The calculated feeding value of the concentrate mixture was 66.15 % TDN and 17.14 % crude protein. The calculated concentrations of selenium and vitamin E in the concentrate mixture fed were 0.17 ppm and 17.78 IU/kg DM, respectively. The NRC (1985) requirements of growing lambs for selenium and vitamin E are 0.1–0.2 ppm and 20-25 IU/kg DM, respectively. Drinking water was available all

times and the buckets were cleaned every day and fresh water was filled in.

Thermal and cardiorespiratory responses of lambs including rectal temperature (RT, °C) respiration rate (RR, r.p.m) and pulse rate (pulse/min) were recorded weekly at 8 a.m and 2 p.m., where ambient temperature (AT,°C) and relative humidity (RH-%) were recorded. The averages of AT and RH during the experimental period were (24.00±0.47°C, 68.00±3.14%) and (36.00±1.24°C, 46.00±1.69 %) at 8 a.m and 2 p.m, respectively.

Heparenized blood samples were collected biweekly at 8.30 a.m from each lamb before animals axcess to feed or drink. Whole blood samples were analyzed for hematological parameters such as hemoglobin (Hb, gm/dl), packed cell volume (PCV, %), red blood cell counts (RBCs, $x10^6/mm^3$) and total white blood cell counts (WBCs, $x10^3/mm^3$). The Hb concentrations were determined by Shali's method and the PCV percentages were determined using microhematocrit tubes with a microhematocrit centrifuge at 12000 rpm for 3 minutes. The RBCs and WBCs were counted under the microscope using the hemocytometer. Stained blood films with Lieshman's stain were prepared for estimating the differential leucocyte percentages (Dacie and Lewis, 1991). Plasma samples were obtained by centrifugation of blood samples at 3000 r.p.m for 10 min, and stored at -20°C until assayed for vitamin E and selenium. Plasma vitamin E (alpha-tocopherol) was determined by modification of the colorimetric procedure of Christie et al. (1973). The analysis of plasma selenium concentrations was performed using the fluorometric procedure described by Olson et al. (1975) as modified by Whetter and Ullrey (1978).

The data were statistically analyzed by least square means analysis of variance using General Linear Models (GLM) procedure of the statistical analysis system (SAS, 1992). The model used to analyze the different traits studied was as follows :

$$Y_{ij} = \mu + T_i + e_{ij}.$$

(for growth performance, thermal and cardio-respiratory traits and blood constituents).

Where: $\mu$= overall mean; $T_i$ = effect of the $i^{th}$ treatments (1=G1 2=G2 and 3=G3 and $e_{ij}$ = random error particular to the $ij^{th}$ observation and assumed to be indepently and randomly distributed ($\sigma^2 e$).

Duncan's Multiple Range Test was used to detect the differences among means of experimental groups (Duncan, 1955).

## RESULTS

**1. Growth performances:**

Results presented in Table 1 show that male lambs received 0.50 ml/head of viteselen injection (G3) had a higher ($P<0.01$) daily weight gain (DWG) by 30.75 % compared with those of control (193.54 vs. 148.02 g/day), and by 20.64 % compared with those of G2 (193.54 vs. 160.43 g/day). Also, DWG tended to increase by 8.38 % for lambs of G2 compared with control (160.43 vs. 148.02 g/day). Feed conversion (FC) was improved ($P<0.05$) by 22.9 % for lambs of G3 compared with control (7.37 vs. 9.52). Also, FC was better for lambs of G2 than the control (8.76 vs. 9.52). Differences in feed intake for lambs due to viteselen injection were not significant but tended to increase by 3.73 % for lambs of G3 compared with control.

**2. Thermal and cardiorespiratory responses :**

The results indicated that lambs of G3 recorded higher ($P<0.01$) values of RT and PR compared with those of G2 and control either at 8 a.m. or 2 p.m. (Table, 2). The increases in RT and PR for lambs of G3 were 0.37 C (0.93%), 9.44 pulse/min (15.38 %) at 8 a.m. and 0.39 C (0.98 %), 10.0 pulse/min (14.2 %) at 2 p.m. compared with the values of the control group. Meanwhile, there were significant ($P<0.01$) differences in RR among the three gorups of control, G2 and G3. The control had the lowest ($P<0.01$) RR followed by G2 and G3 either at 8 a.m or 2 p.m.

**3. Hematological parameters:**

Results in Table 3 indicated that hematological pararmeters in terms of blood RBCs, Hb and PCV had increased ($P<0.01$) in injected lambs than control. The lambs of control had the lowest values of RBCs, Hb and PCV followed by those values of G2 and G3.

**4. Plasma selenium and vitamin E :**

Results presented in Table 3 reveal that lambs of G2 and G3 exhibited higher ($P<0.01$) dose-dependent increase in their plasma concentrations of vitamin E and selenium than those of the control. The differences in G2 and G3 from control were 47.62 and 85.71 % for selenium and 14.64 and 42.37 % for vitamin E. Plasma concentrations of

both selenium and vitamin E were higher (P<0.01) for Lambs of G3 than those of G2 (25.8 and 24.2 % for selenium and vitamin E, respectively).

**5. Immunological responses :**

The total count of leucocytes was increased (P<0.01) for Lambs of G2 and G3 compared with those of control (Table. 4). Lambs of G2 and G3 showed a marked increase (P<0.01) in both of lymphocytes and eosinophils compared with the control which accompanied with a drop (P<0.01) in percentages of neutrophils. Meanwhile, percentages of basophils and monocytes did not change due to viteselen injection. The N:L ratio showed a consistent decrease (P<0.01) associated with increasing the dose of viteselen injection.

**Table 1 :** Effect of viteselen injection on growth performance of lambs (means±S.E.M).

| Items | Treatments | | | ± SEM |
|---|---|---|---|---|
| | G1 | G2 | G3 | |
| IBW (kg) | 20.77 | 20.31 | 19.68 | 1.53 |
| FBW (kg) | 27.94 | 28.16 | 29.12 | 1.43 |
| DWG (g) ** | 148.02 b | 160.43 b | 193.54 a | 7.44 |
| FI (kg/head/day) | 1.34 | 1.35 | 1.39 | 0.04 |
| FC (kg feed/kg gain) * | 9.52 a | 8.76 ab | 7.37 b | 0.48 |

a,b means within the same row having different superscripts significantly different.
* (P<0.05). ** (P<0.01). Intial body weight (IBM)-Final body weight (FBW)-Daily weight gain (DWG)-Feed intake (FI)-Feed conversion (FC).

**Table 2:** Effect of viteselen injection on rectal temperature (RT), respiration rate (RR) and pulse rate (PR) of lambs (means±S.E.M).

| Items | Treatments | | | ±SEM |
|---|---|---|---|---|
| | G1 | G2 | G3 | |
| R.T (°C) | | | | |
| 8 a.m | 39.50 b | 39.60 b | 39.87 a | 0.029 |
| 2 p.m | 39.60 b | 39.69 b | 39.99 a | 0.023 |
| R.R (r.p.m) | | | | |
| 8 a.m | 52.92 c | 58.06 b | 63.19 a | 0.92 |
| 2 p.m | 66.28 c | 71.97 b | 77.92 a | 1.33 |
| P.R (pulse/min) | | | | |
| 8 a.m | 61.39b | 62.11b | 70.83a | 0.74 |
| 2 p.m | 70.42b | 73.00b | 80.42a | 0.90 |

a,b,c means within the same row having different superscripts significantly different (P<0.01).

Table 3: Effect of viteselen injection on hematological parameters and plasma constituents of selenium and vitamin E of lambs (means±S.E.M).

| | Treatments | | | |
|---|---|---|---|---|
| | G1 | G2 | G3 | ± S.E.M |
| Hematological parameters: | | | | |
| RBC ($x10^6/mm^3$) | 9.92 b | 11.4 a | 12.58 a | 0.15 |
| Hb (g/dl) | 9.83 c | 11.75 b | 13.33 a | 0.17 |
| PCV (%) | 29.58 c | 35.00 b | 38.00 a | 0.29 |
| Plasma constituents: | | | | |
| Selenium (µg/ml) | 0.021 c | 0.031 b | 0.039 a | 0.001 |
| Vitamin E (µg/ml) | 3.21 c | 3.68 b | 4.57 a | 0.06 |

a,b,c means within the same row having different superscripts significantly different (P<0.01).

Table 4: Effect of viteselen injection on total leucocytes and its differential cell percentages of lambs (means±S.E.M).

| Items | Treatments | | | |
|---|---|---|---|---|
| | G1 | G2 | G3 | ±S.E.M |
| Total leucocytes ($10^3/mm^3$) | 6.94 b | 8.52 a | 9.53 a | 0.17 |
| Neutrophils (%) | 32.61 a | 26.06 b | 24.61 b | 0.53 |
| Eosinophils (%) | 4.17 b | 4.83 a | 4.89 a | 0.15 |
| Basophils (%) | 1.00 | 1.00 | 1.00 | 0.00 |
| Lymphocytes (%) | 59.72 b | 65.72 a | 67.06 a | 0.53 |
| Monocytes (%) | 2.50 | 2.39 | 2.44 | 0.12 |
| N:L ratio | 0.54 a | 0.42 b | 0.34 c | 0.008 |

a,b,c means within the same row having different superscripts significantly different (P<0.01).

## DISCUSSION

In the present study, injection of vitamin E plus selenium to growing male lambs enhanced their growth performance under hot conditions in summer. This benefit is clearly seen at dose 0.50 ml/head of viteselen injection. These injected animals recorded higher average daily weight gains and better feed conversion rates. Such improvement may be attributed to the higher efficiency of feed utilization observed for those lambs. These results reinforce the data outlined by some earlier studies dealt with the effect of vitamin E and selenium on animal growth performance. Injection of vitamin E alone into ram lambs produced greater average daily gains compared with ram lambs not receiving the

injection (Norton and McCarthy, 1986). More recent study (Shetaewi et al., 1992) indicated that coarse-wool lambs supplemented with vitamin E had higher daily gains and feed efficiency. In cattle, vitamin E addition to supply 400 IU/head//day seems beneficial for increasing weight gain (Galyean et al., 1999). It increased daily gain by 38.4 % and feed intake by 3.6 % (Hays et al., 1987). Eventhough, selenium supplementation alone had no effect on weight gain of buffalo calves (El Ayouty et al., 1996), its function is inextricably involved with that of vitamin E. The mode of action of vitamin E is closely associated with selenium in metabolism and vitamin E can make up for selenium deficiency to a certain degree (Makimura et al., 1993). In addition, injection of vitamin E plus selenium in weanling buffalo calves increased their daily gain, feed intake and feed conversion in cold conditions as observed by El-Barody et al. (2000). They attributed such improvements to the enhanced efficient metabolic activities accompanied with increased thyroid activity by which the general metabolism is controlled. Taken together, the enhanced metabolic processes in response to vitamin E plus selenium supplementation may involve in the increasing animal daily gain (Lee et al. 1979). This may account for the trend towards higher daily gains of injected lambs attained in the present study.

However, the present results are not in line with those of Droke and Loerch (1989) working on steers and noticed that injection of vitamin E plus selenium did not alter their growth rate and feed efficiency. Also, it disagree with Quigley and Bernard (1995) who failed to observe any effect of vitamin E added to colostrum on growth performance of neonatal calves. Such discrepancy could be ascribed to the differences in the levels of selenium and/or vitamin E supplementation, mode of administration and experimental animal species used.

Results obtained in this study revealed considerable changes in thermal and cardiorespiratory reactions for lambs given injection of vitamin E plus selenium under hot conditions. This observation indicate that vitamin E and selenium might play an important role in thermoregulation. It appears that the increase in RR for lambs of G2 was sufficient to maintain their body temperature. The increase in RR may be associated with higher values of blood hematological components recorded for injected lambs. These results are in good agreement with some works reported that vitamin E supplementation improved the

adaptive responses either in thermoneuteral conditions or exposed to heat stress. In rabbits, Hassanein et al. (1995) noticed that vitamin E Supplmentation (50 mg/head/day) improved the adaptive response of rabbits to hot conditions keeping efficient metabolic activity which indicated by high thyroid activity and higher values of hematological parameters and RR, but there was no effect on RT. In buffalo calves, injection of vitamin E and selenium induced an increase in RT and RR under cold winter conditions (El-Barody et al., 2000). The increase in PR for injected lambs in this study may be denote a rise in their metabolic activities. Similar observation was reported by El-Sheikh et al. (1981) in sheep. In fact, pulse rate is known to be affected by various factors which are difficult to interpret (Khalil, 1990).

The present results show that blood hematological pararmeters such as RBCs, Hb and PCV were changed up for growing lambs of G2 and G3. These observations are compatible with some studies investigated the effect of vitamin E alone on blood hematology. Shetaewi et al. (1992) showed that supplementation of vitamin E (100 mg/head/week) in lambs diet constantly increase RBCs, Hb and PCV. Also, rabbits supplemented with vitamin E (50 mg/head/day) exhibited higher values of Hb, PCV and RBCs count under hot conditions (Hassanein et al., 1995). On the other hand, several works revealed that supplementation of selenium alone had no marked effect on RBCs count, Hb and hematocrit in differernt species including sheep (Oh et al., 1976) and buffalo calves (El-Ayouty et al., 1996). Accordingly, the positive effect of vitamin E plus selenium injection on blood hematological parameters seen in the present study, might be attributed to the vitamin E which may act to keep efficient metabolic activity, reflecting the improvement gained in growth performance and the increase in blood hematological components observed for those injected lambs under the conditions of this study. Furthermore, these hematological changes could be linked to an increase in the oxygen carrying capacity of the blood accompanied with an increase in the RR of lambs injected with vitamin E plus selenium. Indeed, the hematological changes have an important role in adjusting the different functions of animal to existing environmental conditions (Samak et al., 1986).

In this study, injection of vitamin E and selenium to growing lambs induced an increase in their plasma concentrations of both vitamin E and selenium in a dose-dependent fashion. These results in lambs are

consistent with similar observations in many studies working on cow calves (Reddy et al., 1986 and Hidiroglou et al., 1995), cows (Hogan et al., 1992) and buffalo calves (El-Barody et al., 2000). lambs received injectable vitamin E alone at birth exhibited higher plasma tocopherol levels than control lambs that (Norton and McCarthy, 1986). However, in cows, injection of vitamin E and selenium had no effect on serum vitamin E but selenium supplements increased serum selenium concentrations (Cuesta et al., 1994).

The present results revealed an immunological response for lambs injected with vitamin E and selenium. These lambs exhibited an increase in total count of leucocytes. Similar observation was reported with supplementation of vitamin E (100 mg/head/week) in lambs diet (Shetaewi et al., 1992). This means, same trend of leucocyte counts for lambs either fed or injected with vitamin E. The injected lambs showed a marked increase in both of lymphocytes and eosinophils percentages accompanied by a drop in neutrophils. These results may indicate an increase in immune status of lambs injected with vitamin E plus selenium, and their higher total leucocyte counts may also reflected their adaptability to the adverse effects of hot conditions or heat stress. lymphocytes play the key role in all animal immune reactions (Zahran et al., 1995). Indeed, the increase in percentages of lymphocyte for injected lambs could be attributed to the action of vitamin E. Accordingly, in a study on lymphocyte proliferative responses to vitamin E and selenium, they interacted to enhance lymphocyte function in cattle (Pollock et al., 1994). Also, exposure of peripheral blood lymphocytes to vitamin E and selenium treatment in *in vitro* study enhanced proliferation of lymphocytes in cattle, suggesting that such result may optimize resistance to disease by enhancing the lymphocyte populations (Ndiweni and Finch, 1995). In addition, Reddy et al. (1986) found that injection of vitamin E alone increased lymphocytes in calves. But, supplementation of suckling buffalo calves with different levels of selenium alone did not alter the percentages of their lymphocytes and neutrophils (El-Ayouty et al., 1996). So, it appears that the usefulness of selenium to the immune system of animals is increased by giving vitamin E (Nockles, 1988). In this respect, Hogan et al., (1992) observed that neither phagocytic index nor percentage of neutrophils differed between vitamin E-injected and non-injected cows. But, in an *in vitro* study on calves, Eicher et al., (1994) noticed that neutrophil phagocytosis improved with

supplementation of vitamins A, E and A plus E. Such differences in neutrophils respone could be due to the different levels of vitamin E used, additional selenium supplementation, and animal species used.

As far as the beneficial effects of vitamin E upon the immune system of animal are concerned, this study showed an increase in plasma levels of alpha-tocopherol, total leucocyte counts and percentage of lymphocytes for growing lambs in respone to vitamin E plus selenium injection. It has been suggested that the mechanisms by which vitamin E may exert its effect on the immune system could be included increased serum alpha-tocopherol, immunoglobin M and enhancing cell-mediated immunity via increased lymphocytes stimulation index (LSI), since LSI mainly represents the cell-mediated immune response (Reddy et al., 1986). It has been proposed that vitamin E requirements should not be based entirly on growth rate studies or on the amounts required to prevent clinical malnutrition deficiencies but also on the amounts of vitamin E needed to attain optimal health and immune competence (Reddy et al., 1986). Such observations on immune response to vitamin E should be considered and helpful in designing preventive health programmes (Cravens and Vaden, 1994).

Collectively, the injection of vitamin E plus selenium appears to provide for additional increases in plasma vitamin E and selenium levels for growing lambs in presented study. The concentrations of these antioxidants should be taken into account because the metabolism of them can be interfered and the effects of selenium and vitamin E as antioxidants are partially mutually replaceable (Jukola et al., 1996). Such increments in plasma selenium and vitamin E may accelerate the physiological and anabolic processes which may appeared as a widespread tissue anabolism (Lee et al., 1979), and also may reflect an increase in animal growth performance and immune status via altering plasma factors, raising the possibility for protection against pathogenes (Reddy et al., 1986 and Nemec et al., 1994).

The present results showed that injection of vitamin E plus selenium into growing lambs under hot conditions in summer may be useful to enhance their growth performance, adaptive and immune responses. These injected lambs appear to be physiologically adjusted to these conditions.

## REFERENCES

*Abdel-Samee, A.M. and El-Masry, K.A. (1997):* Effects of varying copper levels or selenium with vitamin E supplementation on growth and reproductive performances of New Zealand White rabbits under subtrolpical conditions. Egypt. Poult. Sci., 17: 133-149.

*Christie, A.A.; Dean, A.C. and Millburn, B.A. (1973):* The determination of vitamin E in food bycolorimetry and gas-liquid chromatography. Analyst, 98: 161.

*Cravens, R.L. and Vaden, P. (1994):* Selected trace elements, vitamins, and virus antibody titres in Mexico-origin steers. Agri. Practice., 15- 17-19.

*Cuesta, P.A.; McDowell, L.R.; Kunkle, W.E.; Wilkinson, N.S. and Martin, F.G. (1994):* Effects of hight doses of selenium and vitamin E injected into cows prepartum on milk and serum concentrations of these nutrients. International J. Anim. Sci., 9: 2, 275.

*Dacie, S.J. and Lewis, S.M. (1991):* Practical haematology. 7th Ed., Churchill Livingstone.

*Droke, E. A. and Loerch, S.C. (1989):* Effects of parental selenium and vitamin E on performance, health and hormonal immune response of steers new to the feedlot environment. J. Anim. Sci., 67: 1350-1359.

*Duncan, D.B. (1955):* Multiple range test and multiple F-test. Biometrics, 11, 1-42.

*Eicher, S.D.; Morrill, J.L. and Blecha, F. (1994):* Vitamin concentration and function of leukocytes from dairy calves supplemented with vitamin A, vitamin E and beta-carotene in vitro. J. Dairy Sci., 77: 560-565.

*El-Ayouty, S.A.; Metri, G.H.; Gabr, A.A. and Abd El-Hady, M.A.A. (1996):* Selenium nutrition of suckling buffalo calves. Egypt. J. Anim. Prod., Suppl. issue, 33: 123-136.

*El-Barody, M.A.A.; Soliman, E.B. and Rabie, Zenat, B.H. (2000):* Physiological responses of Buffalo and Friesian calves to vitamin E and selenium injection in cold conditions. J. Agric. Sci., Mansoura Univ., 25 : 755-769.

*El-Sheikh, A.S.; Ibrahim, I.I.; Salem, M.H.; Mohamed, A.A. and Yousef, M.K. (1981):* Physiological adaptation of sheep to Sahara desert. Egypt. J. Anim. Prod., 21: 99-108.

*Galyean, M.L.; Perino, L.J. and Duff, G.C. (1999):* Interaction of cattle health-immunity and nutrition. J. Anim. Sci., 77: 1120-1134.

*Gentry, P.C.; Ross, T.T.; Otting, B.C. and Birch, K.D. (1992):* Effects of supplemental D-alpha tocopherol on pre-weaning lamb performance, serum and colostrum tocopherol levels and IgG titers. Sheep and Goats Res. J., 8: 95-100.

*Hassanein, A.M.; Ashour, G.; Gad, H.M. and Saeed, A.M. (1995):* Adapative and reproductive performance of rabbits. 3- role of vitamin E in environmental adaptation. Egypt. J. Anim. Prod., 32: 91-102.

*Hays, V.S.; Gill, D.R.; Smith, R.A. and Ball, R.L. (1987):* The effect of vitamin E supplementation of performance of newly received stocker cattle. Anim. Sci. Res. Rep., Oklahoma Agric. Exp. station, No. 119: 198-201.

*Hidiroglou, M.; Batra, T.R. ; Ivan, M. and Markham, F. (1995):* Effects of supplemental vitamins E and C on the immune responses of calves. J. Dairy Sci., 78: 1578-1583.

*Hogan, J.S.; Weiss, W.P.; Todhunter, D. A.; Smith, K.L. and Schoenberger, P.S. (1992):* Bovine neutrophils responses to parenteral vitamin E. J. Dairy Sci., 75: 399-405.

*Jukola, E; Hakkarainen, J.; Saloniemi, H. and Sankari, S. (1996):* Blood selenium, vitamin E, vitamin A, and ß-carotene concenrtations and udder health, fertility treatments and fertility. J. Dairy Sci., 79: 838-845.

*Khalil, M.H. (1990):* Effects of wool coat lenght and water deprivation on seasonal changes in some physiological and hematological parameters. Egypt. J. Anim. Prod., 27: 227-240.

*Kott, R.W.; Thomas, V.M.; Hatfield, P.G.; Evans, T. and Davis, K.C. (1998):* The influence of vitamin E supplementation during late pregnancy on lamb mortality and ewe productivity. J. Am. Vet. Med. Assoc. 212: 997-1000.

*Lee, Y.H.; Layman, D.K. and Bell, R.R.(1979):* Selenium-dependent and non-selenium dependent glutathione peroxidase activity in rabbit tissue. Nutr. Rep. Int., 20: 573-578.

*Makimura, S.; Kodama, A.; Kishita, M.; Takagi, H. and Adachi, K. (1993):* Secondary antibody response to Haemophilus somonus antigen in breeding Japanese black cattle fed selenium-deficient and alpha-tocopherol-fortified diets. J. Vet. Med. Sci., 55: 871-873.

*Ndiweni, N and Finch, J.M. (1995):* Effects of in vitro supplementation of bovine mammary gland macrophages and peripheral blood lymphocytes with alpha-tocopherol and sodium selenite: implications for udder defences. Vet. Immuol. & Immunopathol., 47: 111-121.

*Nemec, M.; Bulter, G.; Midiroglou, M. ; Farnworth, E.R. and Nielsen, K. (1994):* Effect of supplementing gilts diets with different levels of vitamin E and different fats on the humoral and cellular immunity of gilts and their progeny. J. Anim. Sci., 72: 665-676.

*Nockels, C.F. (1988):* Immuno-enhancing vitamins for cattle. Agri. Practice 9:10-13.

*Norton, S.A. and McCarthy, F.D.(1986):* Use of injectable vitamin E and selenium-vitamin E emulsion in ewes and suckling lambs to prevent nutritional muscular dystrophy. J. Anim. Sci., 62: 497-508.

*NRC, (1985):* Nutrient requirements of sheep. 6th Ed., Washington, D.C. Nathional Academy Press.

*Oh, S.H.; Pope, A.L. and Hoekstra, W.G. (1976):* Dietary selenium requirement of sheep fed a practical-diet type as assessed by tissue glutathione peroxidase and other critiria. J. Anim. Sci., 42: 984-992.

*Olson, O.E.; Palmer, I.S. and Carry, E.E. (1975):* Modification of official fluorometric method for selenium in plants. J. Assoc. Off. Anal. Chem., 58:117.

*Pollock J. M.; McNair, J.; Kennedy, S.; Kennedy, D.G.; Walsh, D.M.; Goodall, E.A.; Mackie D.P. and Crockard A.D. (1994):* Effects of dietary vitamin E and selenium on in vitro cellular immune responses in cattle. Res. Vet. Sci., 56:100-107.

*Quigley, J.D. and Bernard, J.K. (1995):* Effects of addition of vitamin E to colostrum on serum alpha tocopherol and immunoglobulin concentrations in neonatal calves. Food & Agric. Immunol., 7: 295-298.

*Rammel, C.G. (1983):* Vitamin E status of cattle and sheep. 1: A background review. N.Z.Vet. J., 31: 179.

*Reddy, P.G.; Morrill, J.L.; Minocha, H.C.; Morill, M.B.; Dayton, A.D. and Frey, R.A (1986):* Effect of supplemental vitamin E on the immune system of calves. J. Dairy Sci., 69: 164-171.

*Rotruck, J.T.; Pope, A.L.; Ganther, H.E.; Swanson, A.; Hafeman, D. and Hoekstra, W.G. (1973):* Selenium : biochemical role as a component of glutathione peroxidase. Science, 179: 588.

*Samak, M.A.; hassan, G.A.; El-Nouty, F.D.; Abo Elezz, Z. and Badawy, A. (1986):* Seasonal differences in some blood components of Egyptian sheep and goats. Egypt. J. Anim. Prod., 26: 35-46.

*SAS (1992):* SAS/STAT Guide for personal computers. SAS Inst., Cary, N. C., USA.

*Sharman, G.A.M. (1973):* Deficiencies of vitamin E and selenium as factors limiting the intensification of sheep production. Acta. Agric. Scand. Suupl., 19:181.

*Shetaewi, M.M.; Daghash, H.A. and El-All, T.S.A. (1992):* Growth performance, hematology and serum profils of coarse-wool lambs as influenced by supplemental vitamin E. Assuit Vet. Med. J., 54:64.

Whetter, P.A. and Ullrey, D.E. (1978): Improved fluorometric method for determining selenium. J. Assoc. Off. Anal. Chem., 61: 927.

*Zahran, W.M.; El-Shahawy, G.A.; Gabry, M.S. and Mahmoud, M.B. (1995):* Histological changes induced by the trematode cynodiplostomum azimi on the lymph organs of the albino rat (Rattus norvegicus). Proc. Ist. Intern. Sci. Conf., 207-229.