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GROWTH PERFORMANCE, HEMATOLOGY AND SERUM PROFILES OF COARSE-WOOL LAMBS AS INFLUENCED BY SUPPLEMENTAL VITAMIN E.

(With 5 Tables & 1 Figure)

By

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تأثير فيتامين هـ *E* على النمو ومكونات مصل الدم في حملان الصوف الخشن

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أستخدم في هذه الدراسة ٣٠ من حملان الصوف الخشن في متوسط عمر ٤٤ يوما ووزن ٤٩ر٨ كجم وتم توزيعها على ثلاثة معاملات كالتالي : المجموعة الضابطة (A) وهذه لم تعطي فيتامين هـ إضافي والمعاملة (L) وكانت تعطي ١٠٠ مجم فيتامين هـ إضافي لكل رأس في الأسبوع أما المعاملة (H) فكانت تعطي ٢٠٠ مجم فيتامين هـ إضافي للرأس في الأسبوع · وقد إستمرت التجربة لمدة ٥٦ يوما قبل فطام الحملان ، ١١٢ يوما بعد الفطام ، وقد تم أخذ عينات دم من الحملان في الأيام ٢٨ ، ٥٩ ، ٩٠ ، ١١٧ ، ١٤٩ من بداية التجربة · وقد كانت النتائج كالتالي : بعد فطام الحملان وجد أن حملان المجموعة (L) كانت تستهلك غذاء أكثر وتنمو أسرع وبكفاءة أكثر من حملان المجموعات (A) أو (H) لكن الفروق كانت غير معنوية وكانت المتوسطات العامة للعدد الكلي لكرات الدم الحمراء ، تركيز الهيموجلوبين ونسبة الخلايا المصمتة HeMatocrit والعدد الكلي لكرات الدم البيضاء أكثر في حملان المجموعة (L) عنه في حملان المجموعات (A) أو (H) وقد ظهرت فروقا معنوية في تلك الصفات في أيام ٢٨ ، ٥٩ ، ١١٧ من التجربة · وقد كان تركيز الألبيومين في مصل الدم يميل إلى الإنخفاض في دم حملان المجموعة (L) من المجموعة (H) أو (A) · أما تركيز البروتين الكلي والجلوبيولين في مصل الدم فقد كان أعلى معنويا في المجموعة (H) عن المجموعة (A) بينما كان متوسطا في المجموعة (L) وتركيز الجلوكوز في مصل الدم كان يميل إلى النقص أما تركيز الكوليسترول فكان يميل الى الزيادة في الحملان المعطاة فيتامين هـ وقد حدثت زيادة معنوية في الجلوكوز بعد ١٤٩ يوما من بداية التجربة في المجموعة الضابطة (A) ، أما الكوليسترول لقد كان مرتفعا بحوالي ٢٨٪ في المجموعة (H) عن المجموعة (L) ، ب ٣٤٪ عن المجموعة الضابطة (A) ·

SUMMARY

Thirty coarse-wool lambs (BW 8.49±0.15 Kg, age 44±1.7 d) were divided into three treatment groups: a control group (A) with no dl-alpha-tocopheryl acetate (vit E) supplement; a supplemented group (L) receiving

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100 mg of vit E supplement/head per week, and another supplemented group (H) receiving 200 mg vit E supplement/head per week. The trial included 56 d pre-weaning and 112 d post-weaning. Blood samples were collected at 0900 h at days 28, 59, 90, 117 and 149 of the experiment. During the post-weaning period, lambs of the L group tended to eat more and to gain faster and more efficiently than either A or H groups; but differences were not significant. The overall means of total erythrocyte count, hemoglobin concentration, hematocrit and total leukocyte count were consistently higher in L lambs compared with A or H lambs. significant differences in hematologic parameters occurred only at days 28, 59 and 117 of the experimental period. Serum total bilirubin level tended to be lower in L lambs (0.12 mg/dl) than H (0.16 mg/dl) or A (0.18 mg/dl) lambs, respectively. Lambs of H group had more ($P < .05$) serum total protein and globulin concentration than A group, whereas those of L group were intermediate. Serum glucose level tended to decrease and cholesterol tended to increase in vit E-supplemented lambs (L and H). At day 149 serum glucose level was higher ($P < .05$) in the control compared with vit E-supplemented lambs and cholesterol was elevated by 28-34% in H compared with L and A lambs ($P < .05$).

INTRODUCTION

Vitamin E (vit E) is a powerful antioxidant that prevents peroxidative damage to the cell membrane and subcellular organelles by free radicals. Evidence exists that vit E plays a specific role in the metabolism of Se and sulphur containing amino acids and in the synthesis of heme (CHRISTENSEN, 1983). Improved disease resistence has been observed with Se and vit E suplementation (DROKE & LOERCH, 1989; SMITH et al., 1985 and REDDY et at., 1986). Premature infants fed formulas with inadequate vit E develop hemolytic anemia (MAYNARD et al., 1979). In calves and lambs, the most widely recognized vit E deficiency disorder is white muscle disease or muscular dystrophy. Affected animals are often weak and die of pneumonia, starvation or heart failure (SCOTT, 1986). But in lambs that are only marginally deficient in vit E and (or) Se, clinical symptoms are very subtle and hardly noticeable. GORE et al. (1990) reported that both overall body weights and individual muscle weights were lighter (P .05) in lambs receiving a Se-E deficient diet. Lethargy and inappetence were also observed in these lambs. Several factors affect vit E requirements of animals. These include stress conditions induced by confinement, disease, weaning and interactions with certain other nutrients such as Se, polyunsaturated fatty acids, and other fat soluble vitamins (REDDY et al., 1985 and HIDIROGLOU & WILLIAMS, 1986). Many sheep rations, therefore, believed adequate in vit E may be inadequate. The objective of the present study was to investigate the effects of supplemental dl-alpha-tocopheryl acetate on growth performance, hematology and serum profiles of lambs under normal management conditions.

MATERIAL and METHODS

On December 12, 1990 a study was initiated in the Experimental Farm of the Department of Animal Production to determine pre- and post-weaning responses of lambs to supplemental vitamin E (vit E). Thirty coarse-wool lambs (16 males and 14 females) of a local breed in Upper Egypt (Saidi) were utilized in this study. Average age of lambs at the start of the trial was 44±1.7 and average body weight (BW) was 8.49±0.15 Kg. Lambs were divided by sex and BW into three groups of 10 lambs each, and three treatments were randomly assigned to them. Treatments included: a control group (A) with no vit E supplement; a supplemented group (L) receiving 100 mg of vit E supplement (dl-alpha-tocopheryl acetate)/head per wk, and another supplemented group (H) receiving 200 mg of vit E supplement/head per wk. Vitamin E was administered orally to individual lambs once a week in the form of capsules each containing 100 mg of dl-alpha-tocopheryl acetate (Pharco Pharmaceuticals; Alexandria, Egypt).

The trial included 56 d pre-weaning and 112 d post-weaning. During the pre-weaning period, lambs of all treatments were depended mainly upon their mothers milk to obtain their nutrient requirements. They were weaned at an average age of 100 d and averge BW was then 12.31±0.15 Kg. After weaning, lambs of each treatment were assigned to four pens (i.e. 2,2,3 and 3 lambs per pen/treatment). Weaned lambs continued to receive their dietary treatments of vit E as they were before weaning i.e. 0, 100 or 200 mg vit E supplement/head per wk for A, L and H treatment groups, respectively. All treatment groups received ad libitum a pelleted commercial concentrate diet consisting of wheat bran, corn, cottonseed meal, soybean meal, molasses, flax straw, rice hulls, limestone and salt. Chemical analysis showed that the concentrate diet contained 10.24% moisture, 15.23% crude protein, 3.28% ether extract, 15.1% crude fiber, 50.24% nitrogen free extract and 5.91% ash.

Feed was offered to lambs ad libitum and refusals were recorded daily over the 112 d post-weaning period. feed intake per pen was calculated. Body weights were obtained (after an overnight fast) at 14-d intervals throughout the experimental period. Average daily gain (ADG) and feed efficiency (gain/intake) were calculated.

Blood Sampling and Procedures:

Blood samples were collected from all lambs at five periods after initiating the experiment i.e. at d 28, 59, 90, 117 and 149. During each of these days, blood samples were collected at 0900 h by jugular venipuncture using a clean dry plastic syringe and then (after removing the needle) transferred to: 1) dry clean glass vials containing the dipotassium salt of EDTA at a final concentration of 1 mg/ml of blood, 2) centrifuge tubes and allowed to clot at room temperature. Serum was then separated by centrifugation at 3000 rpm for 15 min. Serum was subsequently decanted into glass vials and stored at -20°C. Noncoagulated blood was used for estimation of total number of red blood cells (RBC), white blood cells (WBC), hemoglobin (Hb) using electronic cell counter and its diluter. Packed cell volume (PCV), was estimated according to the standard methods of hematology (SCHALM, 1961). Serum albumin, glucose and cholesterol

concentrations were estimated using assay kits supplied by bioMerieux, France. Serum total protein was determined using assay kits supplied by Bio-Analytics, Florida. Serum urea nitrogen (BUN) and bilirubin were determined using assay kits supplied by Diamond Diagnostic, Egypt.

Statistical Analysis:

Data were analyzed by least-squares analysis of variance using the General Linear Model (GLM) procedures of the Statistical Analysis System (SAS, 1987) for personal computers. Pen means for post-weaning average daily gain (ADG), average daily feed intake and feed efficiency (gain/feed) were analyzed by split-plot ANOVA for repeated measurements (GILL and HAFS, 1971) with effects of treatment, pen within treatment, period (14-d intervals) and treatment x period interaction. Pen within treatment was used as the error term to test treatment effects across time periods. Blood data and pre-weaning ADG for individual lambs (no pen means) were analyzed also by ANOVA for repeated measurements. Whenever a treatment x period interaction was detected (P 0.10), treatment effects within periods were examined by one-way ANOVA, and means were compared using the least-significant test (SAS, 1987).

RESULTS

I- Lamb Performance:

Body weight changes are graphically presented in Figure 1. At the start of the experiment, BW means were nearly similar for the three treatment groups: 8.67; 8.86 and 8.32±0.67 Kg for A, L and H treatment groups, respectively. Treatment did not affect (P 0.10) BW of lambs.

Preweaning ADG (Table 1) in all treatment groups was higher during the first mo of the experiment than the second mo probably due to decreased milk production of their dams during the second mo. Means of pre-weaning ADG did not differ among treatments.

Post-weaning ADG across all treatments was 107.5±4.0 g/head. Lambs of the L treatment gained the highest (115 g/d) during the post-weaning period and those of H treatment gained the lowest (100 g/d), whereas those of the A group gained intermediate (108 g/d). However, differences were not significant (Table 2).

In all treatment groups average daily feed intake (Table 2) was low during the first mo of the feeding period (d 57-84), then it began to increase grdually with the increase in lambs'age (Table 2). Lambs of the L group tended to eat more than those of A or H groups during most of the feeding intervals.

Feed efficiency did not differ (P > .10) among treatments (Table 2). Best feed efficiency means were obtained during the first mo post-weaning. Efficiency was then diminished with the increase in age of lambs until the end of the trial. The overall means showed that lambs of L treatment tended to be more efficient than those of A or H treatment.

Table 1. Pre-weaning Average Daily Gain for Control (A) and Vitamin E-supplemented (L,H) Lambs.

	Average daily gain (g/head/d)			
Period[a] (days)	Treatment[b,c,d] A	L	H	S.E.
0 - 28	77	73	83	12
29- 56	67	51	61	12
Overall	72	62	72	09

[a]Day 0 = 44 + 1.7 d of age.
[b]Values are least-squares means of 10 animals/treatment. S.E = standard error.
[c]Treatments: A, L and H = 0, 100 and 200 mg vitamin E supplement/head/wk, respectively.
[d]No significant differences were detected among treatments (P>.10).

Table 2. Post-weaning Feed intake, Average Daily Gain and Feed Efficiency for Control (A) and Vitamin E-supplemented (L,H) Lambs.

	Feed intake[a] (g/head/d)				Average daily gain (g/head/d)				Feed efficiency, (gain/feed)%			
Period[b] (days)	Treatment[c,d,e] A	L	H	S.E	Treatment[c,d,e] A	L	H	S.E	Treatment[c,d,e] A	L	H	S.E.
57-84	452	480	451	50	147	145	114	15	32.5	30.2	25.3	2.8
85-112	903	970	836	50	133	140	124	15	14.7	14.4	14.8	2.8
113-140	1193	1244	1173	50	79	108	91	15	6.6	8.7	7.8	2.8
141-168	1164	1147	1166	50	72	67	70	15	6.2	5.8	6.0	2.8
57-168	928	960	907	100	108	115	100	11	11.6	12.0	11.0	2.2

[a]Dry matter basis.
[b]Period 0 to 56 were pre-weaning i.e no data for feed intake or efficiency
[c]Values are least-squares means of four replicate pens. S.E = standard error.
[d]Treatments: A, L and H = 0, 100 and 200 mg vit E supplement/head/wk, respectively.
[e]No significant differences were detected among treatments (P>.10).

ii- Hematologic Picture:

Interactions were detected between day of sampling and both RBC and Hb concentration (Table 3). At d 28 of the experiment, H lambs had lower ($P < 0.05$) RBC count (6.81×10^6/cubic mm) compared with A (9.48×10^6/cubic mm) or L (9.69×10^6/cubic mm). Means were similar at later sampling days ($P < .10$). The overall mean of RBC count was slightly higher in L lambs compared with A or H lambs.

Some differences in Hb concentration were noted among treatment means within sampling days (Table 3). At d 59, L lambs had higher ($P < .05$) Hb concentration than A or H lambs. At d 117 both L and H lambs were higher ($P < .05$) than A lambs. Changes in Hb concentrations were generally in parallel with RBC count to a great extent.

Means of packed cell volume (PCV) were higher at d 28 and 59 of the experiment compared with other sampling days (Table 3). Treatment did not significantly affect PCV. Total white blood cell counts, too, did not differ ($P > .10$) among treatments (Table 3).

Table 3. Red Blood Cell Counts, Hemoglobin, Packed Cell Volume and White Blood Cell counts in Control (A) and Vitamin E-Supplemented (L,H) Lambs[a,b,c].

Day of Experiment	Red Blood Cells[d] RBC (10^6/mm^3)			Hemoglobin[d] Hb (g/dl)			Packed Cell Volume PCV (%)			White Blood Cells WBC (10^3/mm^3)		
	Treatment			Treatment			Treatment			Treatment		
	A	L	H	A	L	H	A	L	H	A	L	H
28	9.48[e]	9.69[e]	6.81[f]	15.89	15.36	14.70	39.4	42.4	40.4	15.70	16.57	16.13
59	7.90	9.54	8.91	10.92[e]	11.94[f]	10.59[e]	41.4	40.0	42.2	13.55	14.08	14.58
90	7.50	7.22	7.14	11.21	10.87	10.54	34.3	36.8	33.9	11.15	10.13	9.34
117	9.94	10.04	9.46	11.60[e]	13.61[f]	12.66[f]	32.0	34.0	31.9	13.39	14.65	13.32
149	11.90	11.12	11.41	12.99	13.87	14.15	32.4	34.8	31.8	15.33	15.32	14.04
Overall	9.34	9.50	8.76	12.52	13.13	12.53	35.9	37.6	36.0	13.82	14.15	13.48

[a]Values are least-squares means of 10 samples.

[b]Treatments A, L and H = 0, 100 and 200 mg vitamin E supplement/head/wk, respectively.

[c]Standard errors of the means within days = .67 for RBC, .52 for Hb, 1.4 for PCV and .92 for WBC and the corresponding values for the overall means are .28, .27, .77 and .38, respectively.

[d]A treatment x day interaction was detected for RBC ($P<.10$) and Hb ($P<.09$); means were examined within days.

[e,f]Means of the same subclass in the same row not having a common superscript differ ($P<.05$).

III- Serum Profiles:

Lambs of H treatment had more (P .05) serum total protein and globulin concentrations than A treatment (Table 4). Lambs of L treatment had intermediate means. Serum albumin and BUN did not differ significantly among treatments.

Treatment x day interactions were detected for serum glucose (P .02) and cholesterol concentrations (P < .08). serum glucose was higher (P .05) in control lambs compared with vit E- supplemented lambs at the last sampling day (d 149) (Table 5). The overall means of serum glucose tended to be higher in control lambs compared with vit E-supplemented lambs with L lambs being the lowest. At d 149 serum cholesterol level was elevated by 28-34% (P .05) in H lambs compared with L and A lambs. The overall means of serum cholesterol concentration tended to be higher in L lambs (73.5 mg/dl) followed by H lambs (71.3 mg/dl), whereas A lambs had the lowest mean (67.1 mg/dl) (Table 5).

No significant differences in serum total bilirubin levels were detected among treatments; but means tended to be lower in lambs of the L group (0.12 mg/dl) than H (0.16 mg/dl) or A groups (0.18 mg/dl) (Table 5).

Table 4. Serum Total Protein, Albumin, Globulin and Urea Nitrogen (BUN) in Control (A) and Vitamin E-supplemented (L,H) Lambs[a,b,c,d].

Day of Experiment	Total Protein, g/dl			Albumin, g/dl			Globulin, g/dl			Urea nitrogen, mg/dl		
	Treatment			Treatment			Treatment			Treatment		
	A	L	H	A	L	H	A	L	H	A	L	H
28	5.75	6.64	6.07	3.68	3.70	3.14	2.07	2.94	2.93	21.5	18.8	20.5
59	6.01	5.88	6.88	3.81	3.59	3.36	2.21	2.30	3.53	31.3	30.5	31.7
90	6.09	5.91	6.52	3.56	3.60	3.71	2.53	2.30	2.80	19.0	17.9	22.0
117	6.20	5.84	6.34	3.43	3.25	3.41	2.77	2.59	2.93	21.7	21.1	23.4
149	5.46	5.63	6.35	3.28	3.34	3.48	2.17	2.29	2.87	17.3	16.8	18.4
Overall	5.90[d]	5.98[de]	6.43[e]	3.55	3.50	3.42	2.35[d]	2.48[d]	3.01[e]	22.1	21.0	23.2

[a]Values are least-squares means of 10 samples.

[b]Treatments A, L and H = 0, 100 and 200 mg vitamin E supplement/head/wk, respectively.

[c]Standard errors of the means within days = .37 for total protein, .17 for albumin, .37 for globulin and 1.5 for BUN and the corresponding values for the overall means were .21, .09, .17 and .89, respectively.

[d,e]Means of the same subclass in the same row not having a common superscript differ (P<.05).

Table 5. Serum Glucose, Cholesterol and Bilirubin Concentrations in Control (A) and Vitamin E-supplemented (L,H) Lambs[a,b,c].

Day of Experiment	Glucose,[d] mg/dl			Cholesterol,[d] mg/dl			Bilirubin, mg/dl		
	Treatment			Treatment			Treatment		
	A	L	H	A	L	H	A	L	H
28	89.7	80.4	84.3	102.7	124.0	91.8	.26	.22	.21
59	72.6	87.4	84.5	61.4	58.4	61.5	.11	.15	.08
90	73.8	55.6	67.3	42.9	50.2	44.2	.22	.08	.18
117	62.2	54.9	62.9	58.9	61.7	65.2	.12	.09	.14
149	95.7[e]	62.4[f]	74.6[f]	69.9[e]	73.2[e]	93.9[f]	.20	.08	.19
Overall	78.8	68.1	74.7	67.1	73.5	71.3	.18	.12	.16

[a]Values are least-squares means of 10 samples.

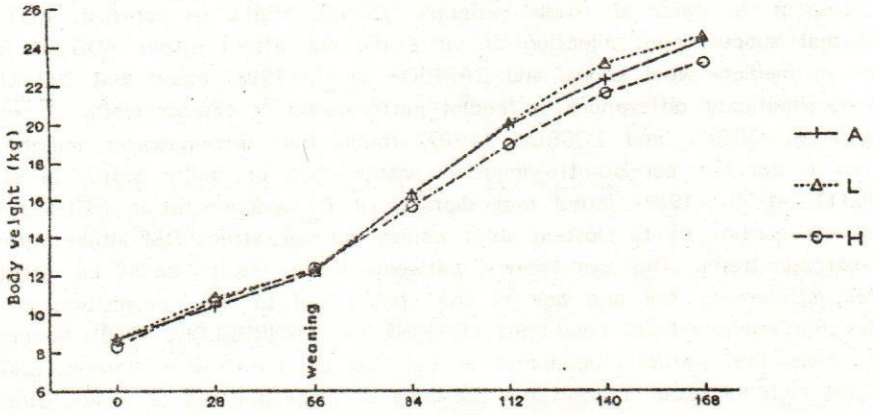
[b]Treatments A, L and H = 0, 100 and 200 mg vitamin E supplement/head/wk, respectively.

[c]Standard errors of the means within days = 5.7 for glucose, 7.7 for cholesterol and .04 for bilirubin and the corresponding values for the overall means are 2.8, 4.1 and .02, respectively.

[d] A treatment x day interaction was detected for glucose (P<.02) and cholesterol (P<.08); means were examined within days.

[e,f]Means of the same subclass in the same row not having a common superscript differ (P<.05).

Figure 1. Effect of supplemental vitamin E on pre- and post-weaning body weight of lambs.



Days of experiment (d 0 = 44 ± 1.7 d of age)
A, L and H = 0, 100 and 200 mg vit E suppl./wk, respectively.

DISCUSSION

Results of lamb performance in the present study (Table 2), suggest that intake of vit E by control lambs (group A) might be inadequate for maximum growth potential because performance was imporoved, although not significantly, when lambs were dosed with 100 mg vit E/wk. Vitamin E content of the basal diet was not assayed, but it was estimated in the diet ingredients (CORT et al., 1983) and calculated to be about 5 mg/Kg of diet. Basal dietary intake of vit E in all treatment groups was assumed to be equal. According to NRC (1985) recommendations, early weaned lambs weighing about 10 Kg and with a moderate growth potential (200 g/d) should receive about 10 IU of vit E/d. The IU of vit E is defined as 1 mg of dl-alpha-tocopheryl acetate. Therefore, lambs of L and H groups received more than 1.4 times vit E requirements from the supplement, respectively in addition to that of the basal diet. These results suggest that 100 mg of supplemental dl-alpha-tocopheryl acetate/wk might increase post-weaning feed intake, ADG and feed efficiency of lambs under similar conditions. The lack of growth response of lambs receiving the higher level of vit E (H group) is unexplained and needs to be further investigated. LEE et al. (1985) found that supplemental vit E (450 IU/d) or vit E plus B-complex resulted in a significant improvement in performance of stressed beef calves. REDDY et al. (1985) found that new-born dairy calves given 1400 mg or 2800 mg dl-alpha-tocopheryl acetate orally and those given 1400 IU of dl-alpha-tocopherol by intramuscular injection at weekly intervals consumed 20 to 27% more calf starter and gained 18 to 25% more weight than unsupplemented calves. Norton and McCARTHY (1986) found that ram lambs receiving injectable vit E (100 IU) at birth produced greater ($P<.05$) ADG compared with ewe lambs receiving injectable E as well as ram and ewe lambs not receiving an injection. In chickens, the combined deficiency of vit E and Se results in impaired growth and efficiency of feed utilization with increased mortality. Supplemental vit E or Se restored normal chick performance with respect to each of these variables (COMB, 1981). In contrast, KOTT (1980) found that subcutaneous injection of vit E did not affect either ADG or feed efficiency of medium wool lambs, and CARRICA et al. (1986) found that 200 IU/d produced no significant differences in feedlot performance or carcass traits of beef steers. In addition, DROKE and LOERCH (1989) found that intramuscular injection of Se and vit E did not consistently improve performance or health status of steers and SCHAEFER et al. (1989) found that dietary vit E supplementation (370 IU dl-alpha-tocopheryl acetate/d) to Hostein steer calves did not affect DM intake, growth rate and carcass traits. The discrepancy between these results could be attributed to species differences, sex and age of the animal and to the composition of the diet besides the environmental conditions (JENKINS and HIDIROGLOU, 1972). Several studies have shown that natural tocopherol in the diet decreases with storage, grinding and pelleting, high moisture content, the presence of plant diseases or molds. Other dietary components such as unsaturated fatty acids, Fe and Cu can also oxidize natural tocopherol (YOUNG et al., 1975; MALM et al., 1976 and DOVE & EWAN, 1987). Furthermore, stress conditions induced by confinement, disease and weaning can increase

vit E requirements (REDDY et al., 1985). The study of vit E is further complicated by the fact that the body has a large ability to store it in the liver and in various organs and tissues (MAYNARD et al., 1979).

Means of total erythrocyte count (RBC), hemoglobin (Hb) concentration, packed cell volume (PCV) and white blood cells (WBC) (as shown in Table 3) are in agreement (except in a few cases) with those obtained in foreign breeds of sheep (HACKETT et al., 1957; SCHALM, 1961; ULLREY et al., 1965 and BLUNT, 1975) and in local breeds (ABD EL-ALL, 1983). The increase in the overal means of RBC count and PCV in L lambs compared with A or H lambs, although not statistically significant, might suggest that a moderate level of supplemental vit E could enhance red blood cell synthesis or decrease oxidative damage to the RBC membrane by free radicals which consequently increase the half-life of cells. COMBS (1981) noted that the combined deficiency of vit E and Se was associated with a very low vit E and glutathione peroxidase activities and that animals showed mild hemolytic anemia. The auther reported supplemental vit E significantly improved chick vit E status and returned PCV to within the normal range. The increases in Hb concentration in L lambs at days 59 and 117 ($P \leq .05$) and in the overall mean in general ($P > .10$) suggest that this dosage level (100 mg/wk) probably stimulated hemoglobin synthesis in these lambs. CAASI et al. (1972) reported a direct effect of vit E on the biosynthesis of heme. Thus, anemia which occurs in vit E deficiency may be due to improved erythropoiesis as well as to hemolysis (CHRISTENSEN, 1983). Excess vit E was of no value to H lambs in the present study. AGBOLA et al. (1988) found that 100 I.U. of supplemental dl-alpha-tocopheryl acetate per calf/d did not affect PCV or Hb concentration.

Means of serum constituents in the present study (Tables 4 and 5) are in agreement with those reported by HALLFORD and GALYEAN (1982); SHETAEWI & ROSS (1990) and SHETAEWI & ROSS (1991) in fine wool sheep.

The significant increase in serum glucose level in control lambs during the last sampling day (d 149) and the tendency of the overall increase in these lambs (16% higher than L lambs, Table 5) could be due to decreased rate of glucose uptake by cells, an effect mediated by the pancreatic hormone insulin. Whether or not vit E improves pancreatic function is, of course, questionable. On the other hand, REDDY et al. (1985) noted that blood glucose level tended to be higher in vit E supplemented calves compared with controls. Blood glucose level. However, in ruminants, unlike monogastric animals, has little clinical significance and sometimes is misleading because volatile fatty acids are the main source of energy for ruminants (HECKER, 1983).

The increase in serum cholesterol in vit E-supplemented animals could be due to increasing the activity of hydroxymethylglutaryl-CoA reductase, a complex regulatory enzyme whose activity is modulated over a hundredfold range. This enzyme regulates the rate limiting step in cholesterol biosynthesis in which hydroxymethylglutaryl-CoA isconverted to mevalonate (LEHNINGER, 1982). The relationship between cholesterol and vit E could be explained on the basis that vit E is deposited mainly

in the liver (GRIFO et al., 1959 and MAYNARD et al., 1979), an organ involved in cholesterol biosynthesis and degradation. However, AGBOLA et al. (1988) found that supplemental vit E significantly decreased serum and muscle cholesterol in Holstein bull calves. They suggested that dietary intake of vit E might have increased the activity of cholesterol 7-alpha-dehydroxylase, an enzyme involved in degradation of cholesterol to bile acid in liver resulting in lowering cholesterol. On the other hand, LEPINE et al. (1990) found that supplemental vit E in pigs did not consistently affect total serum cholesterol at any phase of growth.

The tendency of a lower serum total bilirubin in vit E-supplemented lambs compared with controls was probably the result of decreased rates of erythrocyte breakdown; because vit E maintains the intergrity of erythrocyte membrane by preventing peroxidation of lipids within the membrane.

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