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EFFECTS OF DIFFERENT LEVELS OF DIETARY ENERGY, VITAMIN A AND VITAMIN E ON REPRODUCTIVE PERFORMANCE OF EWES

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SUMMARY

This trial was conducted to determine the effects of different levels of dietary energy, vitamin A and vitamin E on the reproductive performance of different ages of Merino ewes and the growth performance of lambs. It was determined that live weight and live weight gain of the Merino ewes which consumed energy at 50 and 100% over maintenance before and during breeding were significantly (P<0.01) higher. Gestation length of the subgroups that consumed vitamin A and vitamin E at 50 and 100 % over maintenance were significantly (P<0.05) reduced. Twinning rate increased significantly (P<0.01) in the groups that consumed dietary energy, vitamin A and vitamin E at 50 and 100% over maintenance. The effect of sex on birth weight and live weight of the lambs at various periods was significant (P< 0.01). The effect of birth type on live weights, except weaning weight, was also significant (P<0.01). The effect of age of dam on birth weight and subsequent live weights of lambs was not significant. In conclusion, it has been determined that under conditions existing in Turkey, it is possible to alter reproductive efficiency of sheep by manipulating energy, vitamin A and vitamin E contents of the diets.

Keywords: Ewe, energy, vitamin A, vitamin E, reproductive performance

INTRODUCION

Flushing is a management tool used in sheep whereby increased feed levels before breeding are used to increase reproductive performance (Coop, 1966; Gunn, 1983; Rhind *et al.*, 1989). Factors such as initial live weight, body condition, live weight gain of ewes during the flushing period, timing and duration of flushing and the characteristics and amount of feed affect success rates (Robinson, 1977; Doney, 1979). Flushing is more effective in ewes who have low initial weight at the beginning of the flushing period than the ones that have higher initial weight (Rattray *et al.*, 1983; Smeaton *et al.*, 1984). Research has shown that the best results were obtained by feeding high energy diets (Smith *et al.*, 1983; Secchiari *et al.*, 1988). Poor body condition at breeding or poor nutrition might be the cause of low conception rates and the extension of the lambing period (Doney and Gunn, 1981). Flushing for 3 to 4 weeks before breeding is sufficient (Gunn *et al.*, 1984; Crocker *et al.*, 1985), and the increased feed must be continued during breeding (Coop, 1966;

Milne *et al.*, 1986). Supplementary feeding of ewes increases the multiple birth rate, pregnancy rate at first oestrus, number of breedings per pregnancy and sterility rate (Kirchgeßner, 1970; Folch *et al.*, 1987).

Researchers have noted that either flushing did not influence lambs at birth or, if limited differences between lambs were observed, those differences disappeared before weaning (Karberg *et al.*, 1985; Lanza *et al.*, 1986). Vitamin A and Vitamin E content of feeds significantly affect reproductive performance (Maynard *et al.*, 1985; McDowell, 1989).

Energy, vitamin A and vitamin E affect reproduction and growing performance of ruminants, but there is little use of nutrition in Turkey to improve reproductive performance of sheep. Therefore, this study was conducted to determine the effects of different amounts of dietary energy, vitamin A and vitamin E on the reproductive performance of ewes and the growing performance of their lambs under environmental and management conditions that exist in Turkey.

MATERIALS AND METHODS

Animals and management

Merino ewes used in this study were 3 (n = 105),4 (n = 75) or 5 (n = 45) years old. Concentrate feed (CF) and meadow hay (MH) were used in the experiment (Table 1). Amounts of feed supplied to experimental groups A, B and C per head were 0.2 kg CF + 1.4 kg MB, 0.8 kg CF + 0.8 kg MB and 1.4 kg CF + 0.2 kg MH, respectively. vitamin A (60% vitamin A acetate and 40 % vitamin A palmitate) and vitamin E (DL -alfa tocopherol acetate) were added to the diets.

Ewes were assigned to three main feed level groups (A, B and C) each consisting of 75 ewes, and then those groups were each divided into five vitamin level subgroups, each consisting of 15 ewes (Table 2). Group A was fed at maintenance energy (NRC, 1985) while groups B and C, respectively, were fed at 50 and 100 % of energy over the maintenance. Subgroups Al, Bl and Cl were fed maintenance levels (NRC, 1985) of vitamins A and E, and other subgroups were fed 50 and 100 % over maintenance (Table 2). Equal numbers of animals from each age group were designated to the experimental groups and subgroups, and care was taken to equalise average initial live weight of the groups (initial weight = 66.2 kg). Feed level treatments started 3 weeks before the breeding period started and continued for 3 weeks during breeding.

Statistical analysis

Statistical analyses of continuous data were carried out by using the General Linear Model (GLM) procedures of the Statistical Analysis Systems Institute (SAS, 1989). The results are presented as least-squares means. The whole statistical model included the effect of age of dam on live weight and pregnancy duration of dams as well as the effect of birth type, sex and age of dam on live weight of lambs.

Table 1. Ingredient and chemical composition of concentrate feed (CF) and meadow hay (MH)

Item	CF	MH
Ingredient composition of CF		
Barley	54	--
Wheat	30	--
Sunflower meal	12	--
Calcium carbonate	3	--
Salt	0.5	--
Mineral premix	0.10	--
Chemical composition*		
Dry matter (DM; %)	86.98	90.00
Organic matter (OM; %)	85.04	84.82
Crude protein (CP; %)	12.63	13.59
Ether extract (BE; %)	2.42	2.00
Crude fibre (CF; %)	4.54	32.15
N free extract (%)	65.45	37.08
Ash (%)	1.94	5.18
Vitamin A (mg/kg)	108.8	7.93
Vitamin E (mg/kg)	1646.8	--
DCP+ (g/kg)	99.3	106.3
ME++ (Kcal/kg)	3037	1426

* Analyzed, (AOAC, 1984)
\+ Digestible crude protein
++ Metabolic energy, calculated (Blaxter, 1967)

Table 2. Energy, vitamin A and vitamin E content of diets

Group	Energy (Kcal/kg)	Vitamin A (IU)	Vitamin E (IU)
A1	2300.1(MR)	3055.0 (MR)	17.0 (MR)
A2	2300.1 (MR)	4582.5 (MR+ 50 %)	17.0 (MR)
A3	2300.1(MR)	6110.0(MR+100%)	17.0(MR)
A4	2300.1 (MR)	3055.0 (MR)	25.5 (MR + 50 %)
A5	2300.1 (MR)	3055.0 (MR)	34.0 (MR + 100 %)
B1	3466.4 (MR + 50 %)	3055.0 (MR)	17.0 (MR)
B2	3466.4(MR+50%)	4582.5(MR+50%)	17.0(MR)
B3	3466.4(MR+50%)	6110.0(MR+100%)	17.0(MR)
B4	3466.4 (MR + 50 %)	3055.0 (MR)	25.5 (MR + 50 %)
B5	3466.4 (MR + 50 %)	3055.0 (MR)	34.0 (MR + 100 %)
C1	4632.6(MR+ 100%)	3055.0(MR)	17.0(MR)
C2	4632.6(MR+100%)	4582.5(MR+50%)	17.0(MR)
C3	4632.6(MR+100%)	6110.0(MR+100%)	17.0(MR)
C4	4632.6 (MR + 100 %)	3055.0 (MR)	25.5 (MR + 50 %)
C5	4632.6 (MR + 100 %)	3055.0 (MR)	34.0 (MR + 100 %)

MR, Maintenance requirement (NRC, 1985)

RESULTS AND DISCUSSION

Live weight and gestation length of ewes

Dietary energy levels are significant from the point of live weight gain of ruminants. As expected, increased energy consumption was enhanced live weight gains of ewes in this study too. Live weight of the groups consuming 50 and 100 % more energy were significantly higher than the group consuming maintenance energy ($P < 0.01$). In addition, gestation length of these groups was significantly ($P < 0.01$) shorter than the maintenance group (Table 3). The results are in close agreement with the findings of Doney and Gunn (1981) who found that insufficient nutrition would increase gestation length. Gestation length of ewes consuming Vitamins A and E at 50 and 100 % above the maintenance was significantly shorter than the maintenance group ($P<0.01$). However, the influence of dietary Vitamins A and E above maintenance on live weights of ewes was not significant. Although live weight differences of the groups were insignificant, live weight and total live weight gain of the supplementary vitamin feeding (especially Vitamin E) groups at feeding period was higher (Table 3). Moreover, the effect of dam age on live weight and gestation length was not significant, and there were no interactions between energy and vitamin levels of the diets.

Table 3. Average live weight (L W) and pregnancy duration

Treatment	Initial LW (kg)	LW before Mating (kg)	LW at end of feeding (kg)	L W at Parturation (kg)	Pregnancy duration (day)
Feed level	.	.	.	.	.
A	66.2[a]	67.8[a]	69.68	64.4[a]	151.3[d]
B	66.2[a]	69.5[b]	72.6[b]	67.2[b]	150.3e
C	66.2[a]	71.6[c]	75.2[c]	70.0[c]	149.1[f]
Age					
3	66.0[a]	69.4[a]	72.2[a]	67.1[a]	150.1[a]
4	66.2[a]	69.8[a]	72.6[a]	67.1[a]	150.1[a]
5	66.4[a]	69.8[a]	72.6[a]	67.4[a]	150.5[a]
Error	0.07	0.09	0.08	0.06	0.10

a,b,c Means of the subgroups in the same row without a common superscript differ ($p< 0.01$)
d,e,f Means of the subgroups in the same row without a common superscript differ ($p < 0.05$)

Reproductive performance

Feeding ewes diets high in energy and vitamins A and E before and during breeding significantly ($P < 0.01$) increased number of lambs per ewe (NLE) and weaned lambs per ewe (WLE), and decreased number of breedings per pregnancy (NBP), but influences on other reproductive characteristics were insignificant (Table 4). The interactions among energy, Vitamin A and Vitamin E for NLE, NBP, WLE were significant ($P < 0.001$). vitamin levels beside dietary energy levels especially over maintenance have positive effects on reproductive performance of ewes also. In this study, vitamin A and vitamin E at 50 and 100% over the maintenance, at the groups consumed 50 and 100% of energy over the maintenance, increased the reproductive performance. It has been determined that in comparison with each other both vitamins enhanced the reproductive performance, however especially vitamin E was more effective. The results confirmed the manners which state that vitamin A and

vitamin E are effective on the reproductive performance. Therefore, it is possible to alter reproductive performance by manipulating vitamin A and vitamin E levels of the diets, but the response depends on energy levels of the diet. No abortions or dead births (stillbirth) were observed in any of the groups. Reproductive performance data from this study are in accordance with those reported by Kirchgessner (1970), Maynard *et al.* (1985), Folch *et al.* (1987) and McDowell (1989) who all worked with different breeds.

Table 4. Reproductive performance of the groups (number of lambs per ewe, NLE; number of breedings per pregnancy, NBP; weaned lambs per ewe, WLE)

Group	n	NLE	NBP	WLE
A1	15	1.14	1.07	1.07
A2	15	1.21	1.21	1.07
A3	15	1.13	1.13	1.07
A4	15	1.20	1.20	1.20
A5	15	1.27	1.20	1.27
B1	15	1.43	1.14	1.29
B2	15	1.40	1.13	1.40
B3	15	1.43	1.14	1.36
B4	15	1.40	1.13	1.27
B5	15	1.47	1.13	1.47
C1	15	1.53	1.07	1.53
C2	15	1.50	1.14	1.50
C3	15	1.73	1.00	1.67
C4	15	1.64	1.00	1.64
C5	15	1.79	1.07	1.79
Energy	**	**	**	
Vitamin A	**	**	**	
Energy x Vitamin A	***	***	***	
Vitamin E	**	**	**	
Energy x Vitamin E	***	***	***	
Error	0.132	0.045	0.158	

Live weights of lambs

Feeding ewes different levels of dietary energy, vitamin A and vitamin E did not affect live weights of lambs ($P<0.05$, Table 5). The results of lambs birth weight confirmed the manner which states that level of nutrition at the last period of gestation is effective on birth weight rather than the nutritional level at breeding period. These results are similar to those of Karberg *et al.* (1985) and Lanza *et al.* (1986) who found that supplementary feeding of dams had no effect on live weights of lambs.

The effects of the birth type and sex on live weights of lambs were significant ($P<0.01$). Single lambs were heavier than twins and triples, and the influence of the birth type on live weights of lambs, except birth weight, was significant ($P<0.01$, Table 5). However, live weight differences between single and twin lambs decreased with increasing age. Thus, the effect of birth type by 60 days age was insignificant.

Table 5. Average live weight of lambs at different ages (days) summarized by birth type and sex of lamb

		Age (days)				
Treatment	n	0	15	30	45	60
Birth type						
Single	124	5.79^{a}	9.77^{a}	13.88^{a}	17.02^{a}	20.46^{a}
Twin	178	4.74^{b}	8.60^{b}	12.36^{b}	16.42^{b}	20.18^{a}
Triple	6	3.86^{c}	7.34^{c}	11.42^{c}	15.74^{c}	20.01^{a}
Sex						
Male	151	5.28^{a}	9.09^{a}	13.30^{a}	17.21	21.10^{a}
Female	157	4.32^{b}	8.10^{b}	11.80^{b}	15.58^{b}	19.34^{b}
Error	0.219	0.242	0.387	0.423	0.509	

a,b,c Means of the subgroups in the same row without a common superscript differ ($p< 0.01$)

Effect of sex on live weights of lambs was also significant ($P < 0.01$)-. Male lambs were heavier than females, however there was a tendency for a decrease in live weight difference with increasing age.

The results of the effects of birth type and sex on birth weight and live weights of lambs were as expected. Live weight differences caused by birth type and sex tended to decrease with increasing age of lamb.

In conclusion, it has been determined that it is possible to alter reproduction efficiency of sheep by manipulating energy, Vitamin A and Vitamin E content of the diets. However, especially under farm conditions, the importance of nutrition is not taken in consideration sufficiently by sheep producers in Turkey and other parts of the world. The results of the experiment will have both technical and economical contributions to the sheep industry in Turkey and enhance new scientific studies in this area.

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تأثير المستويات المختلفة من الطاقة وفيتامينات أ، هـ على الصفات التناسلية للنعاج

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أجريت هذه الدراسة لتحديد تأثير التغذية على مستويات مختلفة من الطاقة وفيتامينات أ ، هـ على الأداء التناسلي لنعاج المارينو فى الأعمار المختلفة. وكذلك دراسة خصائص النمو للحملان .

وقد أثبتت النتائج أن النعاج التي غذيت قبل وأثناء التلقيح على مستويات مرتفعة من الطاقة (١٠٠،٥٠%) كانت أعلى في وزن الجسم ومعدل النمو اليومي مقارنة بمجموعة المقارنة. كما كان للمعاملات تأثيراً معنوياً على إنخفاض فترة الحمل (٠,٠٥ %) وزيادة نسبة التوائم (٠,٠١ %) وقد أثبتت النتائج أن لجنس المولود تأثير على وزن الميلاد (٠,٠١%).

ويمكن استنتاج أنه تحت الظروف التركية يمكن التحكم في الكفاءة التناسلية عن طريق محتوى الطاقة والفيتامينات في العليقة .