Praca oryginalna *Original paper*

Fattening performance and carcass traits in crossbred ram lambs

NECMETTİN ÜNAL, HALİL AKÇAPINAR, MELİK AYTAÇ*, FATİH ATASOY

Ankara University Faculty of Veterinary Medicine Department of Animal Breeding, 06110 Dışkapı Ankara, Turkey
*Lalahan Livestock Research Institute, Lalahan Ankara, Turkey

Ünal N., Akçapınar H., Aytaç, M., Atasoy F.

Fattening performance and carcass traits in crossbred ram lambs

Summary

Fattening performance and carcass compositions were compared between Akkaraman (A), Kıvırcık x Akkaraman F_2 (KAF_2), Kıvırcık x (Kıvırcık x Akkaraman) first backcross (KAB_1), Chios x Akkaraman F_2 (CAF_2) and Chios x (Chios x Akkaraman) fist backcross (CAB_1) ram lambs. After weaning at 3 months of age, the lambs were fed ad – libitum concentrate and 300 g of alfalfa hay per lamb, per day. Six lambs of each genotype were slaughtered at 45 kg live weight and the carcasses were evaluated. The average daily weight gain and feed conversion efficiencies were 284, 271, 279, 282, 274 g and 4.92, 4.81, 4.76, 4.89, 5.01 for A, KAF_2, KAB_1, CAF_2 and CAB_1, respectively. Corresponding values for cold dressing percentages were 49.28, 48.89, 48.18, 49.15 and 46.79, respectively. The weight of various fat depots differed (P<0.001 or P<0.01) among genotypes, but the weight of major cuts as a percentage of carcass weight did not differ significantly among genotypes except for percentage loin (P<0.05). It was concluded that there were no statistically significant differences for fattening performance among genotypes and that KA crossbred lambs had a higher percentage of loin and a lower percentage of bone in some of the major cuts. Also, there was a tendency for genotypes with lower tail fat weight to have a higher depot fat.

Keywords: Sheep, Crossbreeding, Fattening, Carcass traits

Sheep breeding has an important place in the economy and nutrition of people in Turkey. In 2004, a total of 25 million heads of sheep in the country yielded 267 thousand tons of meat which was about 44.3% of the total red meat production (6).

There are many breeds of sheep in Turkey. The breeds are multipurpose in the production of milk, meat and wool and, except for Chios and Kıvırcık, have low levels of production. The Akkaraman is the most numerous local breed in Turkey and is raised in Central Anatolia where a steppe climate prevails. It is a fat tailed breed raised for milk, meat and wool, but with low levels of production for all three products. The Chios is a semi-fat tailed breed well known for its high milk yield, high prolificacy and early sexual maturity. The Kıvırcık is a thin tailed breed noted for meat quality. Chios and Kıvırcık breeds are raised in the western coastal and northern-western region of the country. They are poorly adapted in other parts of the country (1).

In a terminal crossbreeding program, local breeds ewes are usually mated to rams of a more prolific breed to produce crossbred ewes, which are subsequently mated to a terminal sire (7). It is important to practice crossbreeding for lamb production in Turkey. For this purpose, Chios and Kıvırcık were crossed with Akkaraman breed to produce crossbred ewes (4). Before using a terminal sire, it is necessary to evaluate the crossbred genotypes in terms of anticipated production traits such as fattening performance and carcass traits.

The aim of the study was to investigate fattening performance and carcass characteristics of Akkaraman (A), Kıvırcık × Akkaraman F_2 (KAF_2), Kıvırcık × (Kıvırcık × Akkaraman) first backcross (KAB_1), Chios × Akkaraman F_2 (CAF_2) and Chios × (Chios × Akkaraman) first backcross (CAB_1) crossbred ram lambs slaughtered at 45 kg live weight.

Material and methods

The study was conducted at Lalahan Livestock Research Institute, in Ankara. The Institute is located at 33 N latitude and 40 E longitude, 800 m above sea level. A typical steppe climate prevails in the location.

The crossbreeding study was started at Ulaş State Farm in Sivas, in 1995 (4). The rams and ewes of Akkaraman and crossbred genotypes were obtained from this state farm in 1998. Both Research Institute and State Farm are located in similar climatic and topographic conditions.

After lambing, routine lamb management including iodine treatment of the navel, Vitamin E-selenium injection, ear tagging was practised. The lambs suckled their dams with additional concentrates and alfalfa hay until 3 months of age.

After weaning at 3 months of age, 90 ram lambs weighing about 20 kg were fattened until 45 kg of live weight. Feeding during fattening consisted of a concentrate mixture available

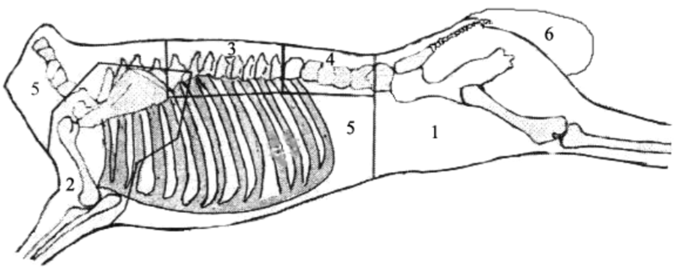

Fig. 1. Cuts of lamb carcass: 1 – Leg, 2 – Foreleg, 3 – Back, 4 – Loin, 5 – Neck + Breast + Flank, 6 – Tail

ad libitum and 300 g of alfalfa hay per lamb per day. Composition of concentrate feed was 70% barley, 12% wheat bran, 15% sunflower meal, 1.5% limestone, 1% salt and 0.5% vitamins-minerals. All lambs had free access to water.

Body weights of animals were taken weekly. The lambs were fed in groups and the amount of concentrate consumed per group in a day was determined. At the end of experiment, 6 lambs of each genotype whose weight were closest to 45 kg were slaughtered. Feed was withheld overnight before slaughter, with free access to water. After slaughter, head, skin, feet, offal and testicles were removed and weighed. Lungs, trachea, heart and liver were weighed as one piece. The weights of spleen and kidney were recorded. Digestive tract was weighed full and empty. Omental and kidney-pelvic fats were separated and weighed. The carcasses were chilled at 4°C for 24 hours before dissecting. Carcasses were cut according to procedure reported by Akçapınar (Fig. 1) (2). After removing fat tail, each carcass was halved and left side was cut into five primal cuts, namely: leg, foreleg, back, loin and neck + breast + flank. *M. Longissimus dorsi thoracic* (MLD tho) was cut between 12^{th} and 13^{th} rib and loin eye area (cm^2) was drawn on parchment and than area was measured with a planimeter. Back fat thickness over MLD tho was measured on the 12^{th} rib with a calliper. The dissection (lean, fat and bone) of the cuts was carried out manually. The percentages of lean, bone and fat of chilled carcass weight was calculated.

The SPSS package program (5) was used for statistical analysis of the data. The differences among genotypes for fattening performance, slaughter characteristics and carcass traits of the lambs were assessed by analysis of variance and Duncan's multiple range test.

Results and discussion

The results of daily weight gain and feed conversion efficiency and slaughtering age are shown in table 1. Akkaraman lambs had the highest daily weight gain while KAB_1 lambs had the best feed conversion efficiency. The differences for traits of fattening performance among genotypes were not significant.

Carcass weights and non-carcass components and fat deposits of lambs in the genotypes are presented in table 2. The figures in the table shows that CAB_1 had the lowest dressing percentage and chilled dressing percentage, but differences among the genotypes were not significant. The differences among genotypes in non-carcass components were also not significant. KAB_1 produced the highest mean values for omental fat and kidney + pelvic fat and back fat thickness, but the lowest mean value for tail fat weight. Akkaraman lambs showed the reverse trend. The differences among the genotypes for fat deposits were highly significant ($p < 0.01$ or $p < 0.001$). Akkaraman lambs had the highest MLD tho area, but differences among genotypes were not statistically significant.

Table 3 presents data for lean, fat and bone contents in carcass and individual cuts. Percentages of cuts to carcass were not statistically different among genotypes except in loin to carcasses ($p < 0.05$). Loin to carcass percentages in KAB_1 was the highest.

When fattening characteristics of A, KA and CA crossbred lambs are evaluated, all genotypes seemed to have similar values for daily weight gain and fattening length. However, KAB_1 lambs had the best value for feed conversion efficiency. The feed consumption of CAB_1 group was the highest. Kıvırcık breed is highly efficient for feed conversion among Turkish native breeds (3, 12, 15). The results in the present study for daily weight gain are in agreement with the previous reports on Akkaraman lambs (3, 8) and on Morkaraman lambs (10) and on Chios × Kıvırcık F_1 lambs (11) slaughtered at 45 kg. However, the findings in this study are higher than those reported on Akkaraman lambs (14) and on Kıvırcık lambs (3) slaughtered at the same live weight.

The lambs from different genotypes had similar chilled carcass weight. Chilled dressing percentages obtained in this study are similar to those reported for Akkaraman (2, 8, 14) and for crossbred lambs of Chios and Kıvırcık with Merino and for Morkaraman which all were slaughtered at 45 kg live weight (9, 11, 15).

It looks that crossbreeding between Chios and Kıvırcık rams with Akkaraman ewes had some effects on deposition site of fat. The data indicated that KA and CA crossbred lambs had a higher weight of omental and kidney-pelvic fat than A breed and that KAB_1 lambs had the highest weight of omental and kidney-pelvic fat. Likewise, these data indicated that KA and CA crossbred lambs had a lower tail fat weight than A lambs and that KAB_1 lambs had the lowest tail fat weight. Fat in whole body was increased while tail fat weight was decreased. The results in this study are also in agreement with the report on Morkaraman and Kıvırcık × Morkaraman B_1 lambs (9). Kıvırcık × Morkaraman B_1 lambs, because of the genetic contribution of thin tailed Kıvırcık breed, had lighter tail weight than Morkaraman lambs slaughtered at 44 kg (0.61 vs. 3.70 kg), but higher pelvic and omental fat (1.01 vs. 0.52 kg). In fact, the results in this study are in the line with the general understanding that different genotypes of sheep have different trends in terms of distribution of body fat.

The MLD tho area of Akkaraman lambs was higher than those of Kıvırcık and Chios crossbred lambs, but differences among genotypes were not significant. MLD tho areas in the present study were in agreement with those reported for some of native breeds (2, 8, 10, 13, 14).

The percentages of cuts to carcass weights in A, KA and CA crossbred lambs were similar except in loin. The KAB_1 lambs had the highest value for loin. The KAB_1 lambs had also the highest value for lean to carcass and the lowest value for bone in loin. Loin eye muscules consist of the most valuable meat in carcass. Even though

Tab. 1. Means (± S. E.) for fattening performances of lambs

Parameters	Genotypes					P
	A (n = 20)	KAF_2 (n = 10)	KAB_1 (n = 20)	CAF_2 (n = 20)	CAB_1 (n = 20)	
Initial weight (kg)	20.02 ± 0.30	20.37 ± 0.33	20.27 ± 0.38	19.95 ± 0.27	20.17 ± 0.42	–
Final weight (kg)	45.10 ± 0.82	45.25 ± 1.12	44.98 ± 1.41	45.06 ± 0.86	44.80 ± 0.90	–
Daily weight gain (g)	284 ± 9	271 ± 12	279 ± 7	282 ± 8	274 ± 10	–
Daily concentrate consumption (kg)	1.398 ± 0.112	1.303 ± 0.093	1.327 ± 0.101	1.379 ± 0.095	1.374 ± 0.127	–
Feed conversion efficiency[a]	4.921 ± 0.243	4.808 ± 0.280	4.758 ± 0.195	4.890 ± 0.233	5.013 ± 0.290	–
Age at slaughter (days)	88.31 ± 2.14	91.81 ± 2.49	88.57 ± 2.82	89.04 ± 3.12	89.89 ± 2.76	–

Explanation: – Not Significant ($p > 0.05$), a: Feed consumed per 1 kg live weight gain. A – Akkaraman, KAF_2 – Kıvırcık × Akkaraman F_2, KAB_1 – Kıvırcık × (Kıvırcık × Akkaraman) first backcross, CAF_2 – Chios × Akkaraman F_2, CAB_1 – Chios × (Chios × Akkaraman) first backcross

Tab. 2. Means (± S.E.) for slaughter characteristics of lambs (n = 6 for each genotype)

	Genotypes					P
	A	KAF_2	KAB_1	CAF_2	CAB_1	
Slaughter weight[1] (kg)	45.43 ± 0.47	45.12 ± 0.42	45.23 ± 0.40	45.33 ± 0.36	45.10 ± 0.16	–
Hot carcass weight with tail (kg)	22.95 ± 0.45	22.57 ± 0.33	22.29 ± 0.17	22.69 ± 0.23	21.77 ± 0.22	–
Cold carcass weight with tail (kg)	22.39 ± 0.40	22.06 ± 0.15	21.79 ± 0.17	22.28 ± 0.19	21.11 ± 0.34	–
Dressing percentage	50.52 ± 0.32	50.02 ± 0.41	49.28 ± 0.36	50.06 ± 0.51	48.25 ± 0.24	–
Chilled dressing percentage	49.28 ± 0.13	48.89 ± 0.33	48.18 ± 0.27	49.15 ± 0.17	46.79 ± 0.28	–
Non-carcass components (as % of slaughter weight)						
Head	4.07 ± 0.36	4.23 ± 0.27	4.60 ± 0.41	4.50 ± 0.36	4.54 ± 0.45	–
Feet	1.87 ± 0.11	2.06 ± 0.15	2.17 ± 0.12	1.92 ± 0.13	1.77 ± 0.16	–
Skin	13.12 ± 0.56	11.44 ± 0.61	10.90 ± 0.49	11.71 ± 0.63	12.08 ± 0.52	–
Heart + trachea + lungs + liver	4.03 ± 0.17	4.39 ± 0.23	4.47 ± 0.18	4.41 ± 0.16	4.65 ± 0.19	–
Spleen	0.23 ± 0.09	0.26 ± 0.07	0.28 ± 0.07	0.30 ± 0.06	0.31 ± 0.08	–
Kidney	0.28 ± 0.06	0.27 ± 0.07	0.30 ± 0.05	0.30 ± 0.08	0.24 ± 0.07	–
Testicles	0.50 ± 0.06	0.58 ± 0.02	0.53 ± 0.04	0.46 ± 0.03	0.48 ± 0.03	–
Digestive tract (full)	22.10 ± 1.10	21.50 ± 1.25	22.02 ± 0.95	21.20 ± 1.35	22.76 ± 2.10	–
Digestive tract (empty)	10.30 ± 0.75	9.33 ± 0.86	9.99 ± 0.91	9.40 ± 0.78	10.70 ± 1.10	–
Distribution of fat						
Omental fat weight (g)	510 ± 26^{a}	650 ± 32^{b}	713 ± 36^{c}	585 ± 0.19^{ab}	620 ± 0.17^{b}	**
Kidney + pelvic fat weight (g)	134 ± 21^{a}	190 ± 19^{b}	289 ± 22^{c}	158 ± 20^{ab}	196 ± 17^{b}	**
Tail fat weight (kg)	3.68 ± 0.03^{a}	1.44 ± 0.05^{bc}	1.12 ± 0.04^{b}	2.19 ± 0.06^{c}	1.52 ± 0.06^{bc}	***
Back fat thickness over MLD tho (mm)	3.50 ± 0.21^{a}	5.20 ± 0.16^{b}	6.30 ± 0.11^{b}	4.30 ± 0.22^{ab}	4.80 ± 0.17^{b}	*
MLD tho area (cm^2)	14.67 ± 0.74	14.15 ± 1.14	13.02 ± 0.57	14.07 ± 1.44	12.78 ± 1.02	–

Explanation: 1 – Slaughter weights of genotypes were not corresponded with final weights of genotypes because data for final weights were recorded from 90 lambs, but data for slaughter weights were obtained from 30 lambs. a, b, c – Means in row with different superscripts are significantly different ($p < 0.05$). – : Not Significant ($p > 0.05$), * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

the differences were not statistically significant except fat percentage in leg, KA crossbred lambs had generally the highest fat content in carcass cuts. In addition, there was a tendency for genotypes with lower tail fat weight to have a higher percentage of fat in carcass cuts. Similar results were reported in the literature (9). In general, ewes raised for milk production tend to deposit more fat in internal sites while those raised for meat production deposit in the carcass depots. Similarly, the fact that CA crossbred lambs deposited less carcass fat than KA crossbred lambs may be attributed to the high milk production of Chios breed.

Differences among the genotypes for the percentages of lean, fat and bone to whole chilled carcasses were not statistically significant. However, KA lambs produced carcasses with higher fat and lower bone contents compared to the other genotypes.

In conclusion, the results showed that there were no statistically significant differences for fattening performance among genotypes and that KA crossbred lambs had a higher percentage of loin and a lower percentage of bone in some of the major carcass cuts. Also, there was a tendency for genotypes with lower tail fat weight to have a higher depot fat. It may also be stated that further studies are needed to evaluate the crossbred genotypes for the use of terminal sires in commercial breeding.

Tab. 3. Means (± S.E.) for carcass traits excluding tail (n = 6 for each genotype)

	Genotypes					P
	A	KAF_2	KAB_1	CAF_2	CAB_1	
Proportion of carcass cuts (out of 100)						
Leg	36.13 ± 0.70	34.25 ± 0.95	34.72 ± 0.83	35.04 ± 0.71	34.15 ± 0.89	–
Foreleg	19.49 ± 0.45	17.81 ± 0.41	18.21 ± 0.38	18.52 ± 0.51	19.71 ± 0.47	–
Back	9.55 ± 0.34	10.54 ± 0.38	9.59 ± 0.35	10.11 ± 0.37	10.36 ± 0.39	–
Loin	7.35 ± 0.24^a	9.52 ± 0.23^b	10.19 ± 0.25^b	8.70 ± 0.29^{ab}	8.37 ± 0.25^{ab}	*
Neck + Breast + Flank	27.48 ± 0.51	27.88 ± 0.49	27.49 ± 0.57	27.63 ± 0.59	27.41 ± 0.54	–
Composition of carcass cuts (out of 100)						
Lean in leg	63.32 ± 1.47	62.18 ± 1.56	59.83 ± 1.90	64.55 ± 1.25	60.36 ± 1.43	–
Fat in leg	15.43 ± 0.41^a	17.34 ± 0.47^{ab}	22.67 ± 0.43^b	13.40 ± 0.44^a	15.43 ± 0.47^a	*
Bone in leg	21.25 ± 0.49	20.34 ± 0.55	20.37 ± 0.52	22.05 ± 0.53	24.21 ± 0.54	–
Lean in foreleg	61.34 ± 1.71	61.28 ± 1.60	62.84 ± 1.57	62.98 ± 1.63	63.49 ± 1.67	–
Fat in foreleg	13.44 ± 0.47	15.88 ± 0.50	13.66 ± 0.43	12.43 ± 0.52	13.49 ± 0.56	–
Bone in foreleg	25.21 ± 0.54	22.84 ± 0.59	21.86 ± 0.60	24.59 ± 0.56	23.02 ± 0.51	–
Lean in back	48.71 ± 0.91	42.58 ± 0.87	44.85 ± 0.95	50.26 ± 0.91	47.18 ± 0.97	–
Fat in back	22.64 ± 0.52	25.84 ± 0.56	24.74 ± 0.49	19.17 ± 0.57	23.59 ± 0.59	–
Bone in back	28.65 ± 0.61	31.58 ± 0.66	30.41 ± 0.67	30.57 ± 0.59	29.23 ± 0.61	–
Lean in loin	52.48 ± 0.57^a	56.91 ± 0.61^b	59.47 ± 0.63^b	53.94 ± 0.66^{ab}	54.49 ± 0.57^{ab}	*
Fat in loin	23.40 ± 0.47	24.47 ± 0.52	23.68 ± 0.56	24.24 ± 0.53	23.72 ± 0.55	–
Bone in loin	22.70 ± 0.43^a	18.09 ± 0.41^{ab}	16.84 ± 0.39^b	21.82 ± 0.41^a	22.44 ± 0.45^a	*
Lean in neck + breast + flank	47.17 ± 0.43^{ab}	51.50 ± 0.49^a	51.60 ± 0.56^a	48.81 ± 0.42^{ab}	43.67 ± 0.40^b	*
Fat in neck + breast + flank	18.24 ± 0.41	23.28 ± 0.40	20.28 ± 0.47	20.73 ± 0.45	21.74 ± 0.46	–
Bone in neck + breast + flank	34.80 ± 0.71^a	25.22 ± 0.67^b	28.11 ± 0.73^b	30.46 ± 0.76^{ab}	34.59 ± 0.69^a	*
Composition of whole carcass (out of 100)						
Lean in carcass	56.17 ± 0.86	56.04 ± 0.93	56.02 ± 0.89	55.91 ± 0.97	54.14 ± 0.95	–
Fat in carcass	17.31 ± 0.51	20.59 ± 0.52	20.26 ± 0.56	20.23 ± 0.55	18.57 ± 0.59	–
Bone in carcass	26.52 ± 0.47	23.37 ± 0.42	23.89 ± 0.45	23.86 ± 0.48	27.29 ± 0.49	–

Explanation: a, b – Means in row with different superscripts are significantly different ($p < 0.05$). – : Not Significant ($p > 0.05$), * $p < 0.05$

References

1. *Akçapınar H.*: Koyun Yetiştiriciliği. 2. Baskı, İsmat Matbaacılık. ISBN: 975-96978-1-5, Ankara 2000.
2. *Akçapınar H.*: Researches on the meat production and carcass characteristics of Dağlıç, Akkaraman and Kıvırcık lambs slaughtered at different weights. F. U. Vet. Fak. Derg. 1981a, 6, 165-184.
3. *Akçapınar H.*: Researches on the fattening performance of Dağlıç, Akkaraman and Kıvırcık lambs. A. Ü. Vet. Fak. Derg. 1981b, 28, 112-129.
4. *Akçapınar H., Özbeyaz C., Ünal N., Avcı M.*: The possibilities of developing dam and sire lines using Akkaraman, Sakız and Kıvırcık sheep breeds for lamb production I. Fertility in Akkaraman sheep, survival rate and growth characteristics of Sakız × Akkaraman F_1 and Kıvırcık × Akkaraman F_1 lambs. Turk. J. Vet. Anim. Sci. 2000, 24, 71-79.
5. *Anon.*: SPSS Statistical Package in Social Sciences for Windows. Statistical Innovations Inc., Chicago, USA 1993.
6. *Anon.*: Food and Agriculture Organization. Statistical Databases (www.fao.org) 2004.
7. *Gallivan C., Kemp R. A., Berger Y. M., Young L. D.*: Comparison of Finnish Landrace and Romanov as prolific breeds in a terminal-sire crossbreeding system. J. Anim. Sci. 1993, 71, 2910-2918.
8. *Kadak R.*: Akkaraman, Morkaraman ve İvesi ırkı kuzuların farklı kesim ağırlıklarında besi performansı ve karkas özelliklerinin karşılaştırılması. Doktaora Tezi, Fırat Üniversitesi Veteriner Fakültesi, Elazığ 1983.
9. *Küçük M., Bayram D., Yılmaz O.*: A study on growth, fattening performance and carcass characteristics of Morkaraman and Kıvırcık × Morkaraman backcrosses B_1 lambs. Turk. J. Vet. Anim. Sci. 2002, 26, 1321--1327.
10. *Macit M., Esenbuga N., Karaoğlu M.*: Growth performance and carcass characteristics of Awassi, Morkaraman and Tushin lambs grazed on pasture and supported with concentrate. Small Rumin. Res. 2002, 44, 241-246.
11. *Oğan M.*: Fattening performance and carcass characteristics of Chios × Kıvırcık crossbred F1 male lambs. Lalahan Hay. Aras. Enst. Derg. 2001, 41, 59-66.
12. *Özcan M., Altınel A., Yılmaz A., Akgündüz V.*: Studies on the possibility to improve lamb production by two-way and three-way crossbreeding among German Black Headed Mutton, Kıvırcık and Chios sheep breeds 2. Fattening and carcass characteristics of lambs. Turk. J. Vet. Anim. Sci. 2001, 25, 695-702.
13. *Sen A. R., Santra A., Karim S. A.*: Carcass yield, composition and meat quality attributes of sheep and goat under semiarid conditions. Meat Sci. 2004, 66, 757-763.
14. *Tekin M. E., Akmaz A., Kadak R., Nazlı M.*: The fattening and carcass characteristics of Akkaraman, Awassi and Turkish Merino male lambs. Hay. Aras. Derg. 1993, 3, 98-102.
15. *Yılmaz A., Özcan M., Ekiz B., Akgündüz M.*: Investigations on the possibility of improving the meat production by crossbreeding Turkish Merino, Chios and Kıvırcık sheep breeds 2. Fattening, slaughter and carcass characteristics of lambs. Turk. J. Vet. Anim. Sci. 2002, 26, 1333-1340.

Author Address: Assoc. Prof. Dr. Necmettin ÜNAL, Ankara University Faculty of Veterinary Medicine Department of Animal Breeding, 06110 Dışkapı Ankara Turkey; e-mail:unal@veterinary.ankara.edu.tr