Growth, feedlot performance and carcass characteristics of Karakas and crossbred lambs (F_1) (Ile de France x Akkaraman (G_1) x Karakas) under rural farm conditions in Turkey

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Abstract

In this study the possibilities of using the Ile de France x Akkaraman (G_1) genotype ($IDFAG_1$) in improving the growth performance and carcass characteristics of fat-tailed Karakas sheep raised in rural farm conditions in the Van Region of Eastern Anatolia, Turkey, were investigated. The aim was to obtain some preliminary results for future studies which will be designed to develop a genotype which has the ability to adapt to the region's conditions, has a high yield and quality meat, grows fast, has a high feed conversion ability and a thin fat tail. Growth and feedlot performances and carcass characteristics of Karakas (KAR) and crossbred (IDFAK) lambs obtained from the mating of $IDFAG_1$ rams with Karakas ewes were evaluated. A total of 97 KAR and IDFAK lambs reared under farm conditions was evaluated for growth characteristics. For the evaluation of feedlot performance and carcass characteristics, 10 KAR and seven IDFAK single-born male lambs weaned at two months of age were subjected to a finishing diet for 70 days and slaughtered. Least squares means of the weights of KAR and IDFAK lambs at birth and at six months were 3.2 ± 0.08 and 3.5 ± 0.08 kg and 29.6 ± 1.24 and 30.2 ± 1.41 kg, respectively. The means of untailed cold carcass weight and untailed dressing percentage of KAR and IDFAK lambs were 13.2 ± 0.39 and 14.3 ± 1.10 kg and 39.7 ± 0.42 and 44.3 ± 1.10%, respectively. Although feed efficiency and many carcass characteristics did not differ between groups, the carcasses of the IDFAK lambs contained a higher percentage of intramuscular fat that is desirable for consumers in Eastern Anatolia. Encouraging results have been obtained to suggest that $IDFAG_1$ rams could be used to improve the productivity of Karakas sheep. Nevertheless, more detailed and larger scale experiments are needed to confirm the results on growth and carcass characteristics of crossbred lambs under different farm conditions.

Keywords: Crossbreeding, growth, slaughter, carcass, rural farm
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Introduction

It is known that Turkey has a rich livestock population but that the productivity of the animal is low. This is mainly due to high numbers of the native breeds with a low productivity, as well as the traditional extensive production methods (Aşkın & Cengiz, 1993). Ninety six percent of the sheep population consists of native breeds, whereas only 4% is pure Merino and its crosses. Of the native breeds, 87.3% are fat-tailed whereas the thin tailed breeds comprise only 12.8% (Aşkın & Cengiz, 1993; Macit *et al.,* 2001).

Eastern Anatolia is one of the regions of Turkey with the greatest density of sheep. In some cases sheep breeding is the only possible form of agricultural production in this region. The traditional extensive production methods, poor environmental conditions, economic limitations, lack of organisations among producers and genotypic characteristics of sheep breeds are restrictive factors for optimum production. Almost the entire sheep population of the region is fat-tailed animals. The fat-tailed Karakaş sheep is a subtype of Akkaraman sheep raised in the Van and Bitlis provinces of Eastern Anatolia. The Karakaş sheep is favourably characterised by the ability to tolerate extreme temperatures, poor feeding conditions and diseases. They can walk long distances from shed to plateau and have a strong flocking instinct (Karaca *et al.,* 1993; Gökdal, 1998). Karakaş sheep are characterized by a white body coat with black and brown stains around the eyes, legs and mouth or a white body with a black head. These sheep are kept in simple and generally insufficient sheds through the cold season until lambing in February-March. During this period they are fed mainly dry hay. During the rest of the year (6-7 months) the flocks are taken out to graze on pastures and stubble. Traditional breeders normally rear this type of sheep, which grazes mostly on the

outskirts of the villages, on stubble, on canal banks and by the roadside. Milking is initiated one month before weaning of the lambs and practiced as once a day milking. After weaning at 3-4 months of age, the ewes are milked twice daily for two months and then once a day during the following months. Adult body weight in females ranges from 46.4 to 53.0 kg (Karaca *et al*., 1996; Gökdal, 1998; Gökdal *et al*., 2000). Karakaş sheep do not reach the adequate commercial weight at the end of the pasture period and are characterised by a low growth rate and poor carcass characteristics under intensive and extensive conditions (Demirulus & Karaca, 1994; Aygün *et al*., 1998; Gökdal, 1998; Gökdal *et al.,* 2003). It has been reported that birth weights, weaning weights and marketing weights of Karakaş lambs are 3.31 - 3.93 kg, 26.03 - 27.19 kg and 30.6 kg, respectively (Demirulus & Karaca, 1994; Gökdal, 1998; Ülker *et al.,* 1999). The daily live weight gains until weaning of Karakaş lambs were 146.0 - 174.6 g (Demirulus & Karaca, 1994; Gökdal, 1998; Ülker *et al.,* 1999). Information related to various aspects of native breeds is essential for planning breeding programs to improve the meat production and carcass characteristics. Thus, growth performance of Karakaş and other native fat-tailed sheep breeds of Turkey in semi-intensive or extensive production conditions were widely studied (Eliçin & Kesici, 1972; Karaca *et al.,* 1990; Demirulus & Karaca, 1994; Gökdal, 1998; Gökdal *et al.,* 1999; Macit *et al.,* 2002). Growth and carcass characteristics can be genetically improved either by selection within the native breeds or by crossing with "developed" mutton breeds.

Ile de France x Akkaraman (G_1) genotype, developed in Polatlı Farm Station near Ankara, Turkey, is a back-cross of Ile de France rams with Ile de France x Akkaraman F_1 ewes. They are characterised by a high meat production, large body weight, fast growing rate, high quality carcass, good adaptation ability and are usually thin tailed. Various studies have been conducted in order to improve meat production and carcass quality of Turkey's native sheep breeds via crossbreeding. In the studies done to determine fattening performance and carcass characteristics of Ile de France x Akkaraman (F_1) and their back-crosses (G_1), it has been observed that these crossbred lambs performed better than Akkaraman lambs, mainly due to less adaptation problems (Cengiz *et al.,* 1989; Eliçin *et al.,* 1989; Cengiz, 1994).

This research has been carried out to determine the growth and carcass characteristics of Karakaş and crossbred lambs (F_1) (Ile de France x Akkaraman (G_1) x Karakaş) under rural farm conditions. The aim of this study was to obtain some preliminary results for future studies which will be designed to develop a genotype which has the ability to adapt to the region's conditions, has a high yield and quality meat, grows fast, has a high feed conversion ability and a thin fat tail.

Materials and Methods

This study was carried out with 97 lambs, consisting of Karakaş (KAR, n = 48) and crossbred (F_1) lambs (IDFAK, n = 49) (Ile de France x Akkaraman (G_1) rams ($IDFAG_1$) x Karakaş ewes), reared under rural farm conditions in Erçek town, Van, Turkey. After the synchronisation treatment (40 mg Medroxyprogesterone acetate (MAP) impregnated sponge (Vetimex, Bladel, Netherlands) for 14 days + 500 I.U. PMSG at sponge withdrawal) during the breeding season, the ewes were inseminated artificially using either fresh KAR or $IDFAG_1$ semen. All animals were housed during winter and were fed mostly on straw. No supplementary feeding was supplied to the ewes during the gestation period. The lambs were born from mid-February to mid-March 2001. All lambs were weighed within 24 h of birth and their birth weight, birth type, genotype, sex, dam age and birth date were recorded. The body weights of the lambs were recorded at two-weekly intervals until an average of six months of age. The lambs were kept with their dams for five days after which they were separated from their dams and suckled twice a day. They were kept in a barn with an indoor lot and fed hay and straw. After mid-April, ewes were grazed on pastures, milked once a day and suckled after milking until weaning. The lambs were weaned at an average of 116 days of age. After weaning, 10 KAR and 7 IDFAK single-born male lambs were allocated to a finishing experiment.

For the finishing experiment, a total of 10 KAR and 7 IDFAK single-born male lambs raised on the same farm was placed on a finishing diet for 70 days after weaning. At the beginning of the finishing period, the live weights of all lambs (body weight at three consecutive days after weaning) were recorded. The animals were fed a concentrate diet *ad libitum* and 250 g clover hay/animal/day. The concentrate diet contained 90.0% dry matter and 168 g crude protein, 88.8 g crude ash and 98 g crude fat/kg feed. The hay contained 91.2% dry matter and 139 g crude protein and 375 g crude fibre/kg feed. Live body weights of all animals were recorded every two weeks. Daily concentrate consumption of each group was recorded. At the end of the finishing period, all lambs were slaughtered. Final body weights of all animals were recorded at three consecutive days after 12 h fasting and then after 24 h fasting prior to slaughter (Eliçin *et al*., 1989; Ertuğrul *et al*., 1989). All slaughtered animals were bled and skinned. Internal fat, deposited on the top of the

kidneys (peri-nephric fat) and around the gastro-intestinal tract (gut fat), was separated and weighed. The tail was cut off at its articulation. Tail, genitalia and cannons were excluded. The carcass was chilled for 24 h at +4 °C and weighed. The cold carcass was split into two symmetrical parts along the backbone and the left half was used for carcass measurements (carcass length, leg depth, leg width, rump width, chest depth, shoulder width). The left half of the carcass was divided in cuts, according to the procedure of Colomer-Rocher *et al*. (1987) and weighed. The surface area of a cross section of the *M. longissimus thoracis* (MLD) between the 12^{th} and 13^{th} rib was measured by tracing it onto acetate paper and measuring the area using a planimeter. Dressing percentage was calculated as a ratio of 24 h fasting weight prior to slaughter and cold carcass weight. Proportional weights were calculated as the ratio of the heart, lungs and liver weights relative to slaughter weight. The proportional weights of the testes and internal fat were calculated relative to warm carcass weight and those of the other organs and carcass cuts relative to the cold carcass weight, according to the procedure of Cengiz *et al*. (1989). The proportion of the muscle, bone and fat in the carcass was estimated by physical dissection and weighing of these tissues in the rib area between the 6^{th} and 12^{th} rib (More-O'Ferrall & Timon, 1977).

Body weights of lambs at six months of age were calculated by linear interpolation. The effects of some environmental factors on growth characteristics have been considered. Effects of age of dam, sex, type of birth and genotypes on lamb weights were investigated. Data were analysed using least-squares procedures (SAS, 1998). Significant differences between means were detected using Duncan's multiple range tests (Düzgüneş *et al.,* 1987). In the finishing experiment, the mathematical model included fixed effect due to group and random effect due to residual error (SAS, 1998). The Student's T-test was used to detect significant differences between means. Daily feed consumption and feed conversion efficiency were calculated on a group basis.

Results and Discussion

The growth curves of the KAR and IDFAK lambs based on adjusted monthly weight under rural farm conditions are given in Figure 1.

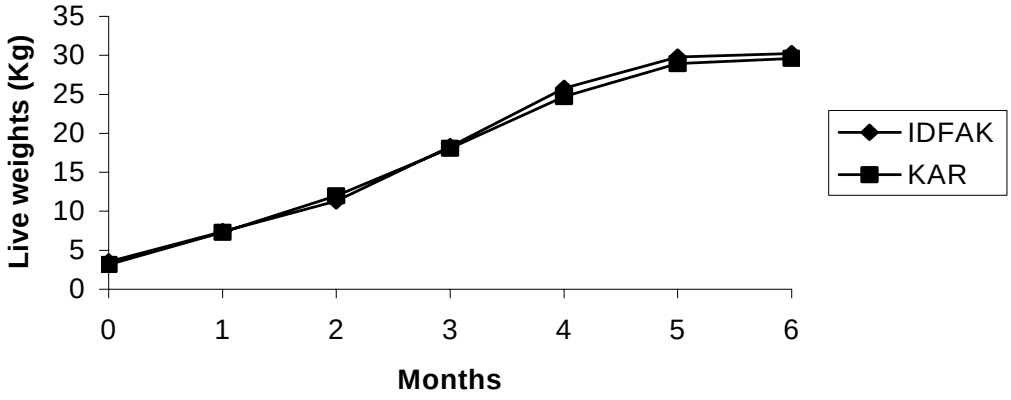

Figure 1 Adjusted growth curves from birth to six months of age of Karakaş (KAR) and crossbred lambs (IDFAK) ((Ile de France x Akkaraman (G_1) x Karakaş) lambs under rural farm conditions

There was little difference in growth rates between the two genotypes and their growth curves were almost parallel (Figure 1). Means for the birth weight and body weight at different ages of KAR and IDFAK lambs are presented in Table 1. The birth weights were higher ($P < 0.01$) in IDFAK lambs compared to KAR lambs. No significant differences were present for daily weight gain from birth to 6 months of ages. The IDFAK lambs tended to be heavier than the KAR lambs at weaning (at 116 days) and 6 months of age ($P > 0.05$). The observation that live weights of the KAR and the IDFAK lambs were similar to or lower than live weights obtained in previous reports (Demirulus & Karaca, 1994; Gökdal, 1998; Gökdal *et al.,* 1999; Ülker *et al.,* 1999), could be attributed to lower mature live weights (40.7 kg) of dams in the studied flock. Live weights of mature Karakaş ewes varied widely (46.4 - 53.0 kg) according to the region and conditions (Karaca *et al.,* 1996; Gökdal, 1998; Gökdal *et al.,* 2000). Alternatively, the absence of significant differences

between groups might be attributed to the relatively low number of animals used in the study. Analysis of the factors affecting lamb weights (Table 1) showed that genotype, age of dam, sex of lamb and type of birth, significantly affected lamb weights at the various stages. Several of these effects are already well known, for example, that lamb weights are higher for single and male lambs (Gatenby *et al*., 1997; Gökdal, 1998; Aygün & Bingöl, 1999; Gökdal *et al.,* 1999). Age of dam had a non-significant effect on all the weight traits studied, except on birth weight ($P < 0.05$). Significant differences ($P < 0.05$) were detected among dam's age using Duncan's multiple range tests at birth and weaning. The lambs of three year old dams had the lowest body lamb weights ($P < 0.05$). Similar findings have been reported by Aygün & Bingöl (1999) and Gökdal (1998). Male lambs were heavier than female lambs at birth and weaning ($P < 0.05$). Similar differences have been well documented by a number of other researchers (Mavrogenis, 1996; Aygün & Bingöl, 1999; Gökdal *et al.,* 1999; Macit *et al.,* 2001). The effect of sex on live weight might be attributed to different physiological functions in the two sexes, mainly of hormonal mediation. As expected, birth status also had a highly significant effect on all growth traits ($P < 0.01$; Table 1). Single lambs were heavier than multiples. The higher birth weight and weight gain of single lambs may be due to better nutrition of the single lambs both at pre-natal and post-natal period. The effects of birth status on lamb weights found in this study are in agreement with those reported by a number of researchers (Gökdal, 1998; Gökdal *et al.,* 1999; Macit *et al.,* 2001).

Table 1 Mean (± s.e.) (kg) growth performances of Karakaş (KAR) and crossbred lambs (IDFAK) ((Ile de France x Akkaraman (G_1) x Karakaş) in rural farm conditions

Traits		Birth weight		Weaning weight		6^{th} month weight		Daily weight gain
	N	mean ± s.e.	n	mean ± s.e.	n	mean ± s.e.	n	mean ± s.e.
Genotype		**						
KAR	49	3.18 ± 0.08	27	25.4 ± 0.93	22	29.6 ± 1.24	22	0.146 ± 0.006
IDFAK	48	3.54 ± 0.08	26	26.4 ± 1.14	25	30.2 ± 1.41	25	0.147 ± 0.007
Dam age		*						
2	36	3.51 ± 0.09bc	23	25.4 ± 1.07b	20	30.0 ± 1.44	20	0.148 ± 0.007
3	16	3.08 ± 0.13c	10	24.3 ± 1.42b	9	28.1 ± 1.77	9	0.137 ± 0.007
4	22	3.40 ± 0.12a	11	26.9 ± 1.54a	11	31.0 ± 1.69	11	0.152 ± 0.009
≤ 5	23	3.47 ± 0.11ab	9	26.9 ± 1.52ab	7	30.6 ± 2.04	7	0.149 ± 0.010
Sex		**		*				
Male	46	3.62 ± 0.08	10	27.5 ± 1.42	7	31.9 ± 1.94	7	0.157 ± 0.010
Female	51	3.10 ± 0.08	43	24.3 ± 0.73	40	28.0 ± 0.89	40	0.136 ± 0.004
Birth type		**		**		**		**
Single	59	4.15 ± 0.07	30	29.1 ± 1.02	26	32.7 ± 1.36	26	0.158 ± 0.007
Multiples	38	2.57 ± 0.09	23	22.7 ± 1.09	21	27.2 ± 1.36	21	0.135 ± 0.007

*P < 0.05; ** P < 0.01. a, b, c: Mean values with different letters are significantly different at P < 0.05

Daily live weight gains from birth to six months in KAR and IDFAK lambs did not differ ($P > 0.05$). Birth status had a highly significant effect on daily live weight gains ($P < 0.01$; Table 1). Single lambs had higher growth rates than multiples. Similar findings were reported for Karakaş lambs raised in rural farm conditions (Gökdal *et al.,* 1999). Daily live weight gain from birth to six months in Karakaş lambs under rural farm conditions has been reported as 0.128 g (Gökdal, 1998). The results obtained from the present study on lamb weights at various ages during the first six months and daily live weight gains for the two genotypes were in agreement with those reported for the other Turkish native breeds (Bingöl, 1998; Macit *et al.,* 2001; Macit *et al.,* 2002). In the studies done to determine growth, fattening performance and carcass characteristics of Ile de France x Akkaraman (F_1) and their crosses (F_1 and G_1) (Yalçın & Aktaş, 1976; Cengiz *et al.,* 1989; Eliçin *et al.,* 1989; Cengiz, 1994) it has been observed that these crossbred lambs performed better than Akkaraman lambs.

Growth performances of the KAR and IDFAK male lambs in the fattening experiment are given in Figure 2.

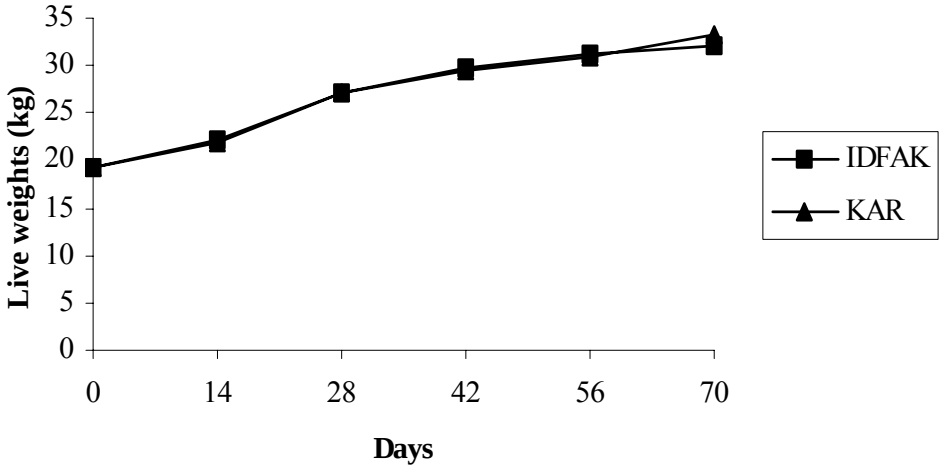

Figure 2 Live weights of Karakaş (KAR) and crossbred lambs (IDFAK) ((Ile de France x Akkaraman (G_1)) x Karakaş) lambs at various stages of the finishing period under rural farm conditions

There were no differences in live weights between the KAR and IDFAK lambs during the finishing period and growth curves of the two genotypes were almost parallel until the end of the 70 day period (Figure 2). Growth performance and mean feed consumption of groups during the finishing period are presented in Table 2. Total and average daily weight gains during the finishing period were similar for the lambs of both groups. The final live weights of KAR lambs at the end of the finishing period appeared to be higher than that of the IDFAK lambs, but were not significant ($P > 0.05$). Feed conversion efficiency and daily concentrate consumption of the two groups were similar. These findings are consistent with those of Eliçin *et al.* (1989) and Cengiz *et al.* (1989) who found no differences in feed conversion efficiency between Akkaraman and Ile de France x Akkaraman (F_1) lambs. In contrast, it has been reported that the feed conversion efficiency of Akkaraman lambs was positively affected by crossbreeding with Ile de France rams (Cengiz, 1994).

Table 2 Mean (± s.e.) weight gain and feed consumption of Karakaş (KAR) and crossbred (IDFAK) ((Ile de France x Akkaraman (G_1) x Karakaş) lambs during the finishing period

	Groups	
Trait	KAR lambs	IDFAK lambs
Initial weight (kg)	19.4 ± 0.88	19.1 ± 1.65
Final weight (kg)	33.3 ± 1.21	32.1 ± 2.01
Total weight gain (kg)	13.9 ± 1.03	13.0 ± 0.98
Average daily weight gain (g)	197.7 ± 14.75	186.7 ± 14.03
Daily feed consumption (kg)	1.18	1.26
Feed conversion efficiency	5.98	6.77

Carcass measurements of the two groups of lambs in the fattening experiment are presented in Table 3. Except for chest depth and shoulder width, there were no differences in carcass measurements between the two groups. The values for chest depth were higher in the KAR lambs ($P < 0.01$), while the values for shoulder width were higher in the IDFAK lambs ($P < 0.01$). Although the means of the groups did not differ ($P > 0.05$), the area of the *M. longissimus thoracis* (MLD) of the IDFAK lambs tended to be higher than KAR lambs. It has been reported in studies on other fat-tailed sheep breeds that the MLD area was positively affected by crossbreeding with mutton breeds (Eliçin *et al.,* 1989; Cengiz, 1994). In the current study there were no differences ($P > 0.05$) in the depth of the MLD and fat thickness over the MLD.

Table 3 Mean (± s.e.) slaughter and carcass characteristics in Karakaş (KAR) *vs*. (Ile de France x Akkaraman (G_1)) x Karakaş crossbred lambs (IDFAK)

Trait	Groups	
	KAR	IDFAK
Carcass measurements (cm)		
Chest depth	25.6 ± 0.32	23.6 ± 0.36**
Leg depth	9.1 ± 0.37	8.6 ± 0.45
Shoulder width	14.8 ± 0.25	16.1 ± 0.40**
Rump width	18.6 ± 0.43	18.6 ± 0.61
Leg width	7.3 ± 0.20	6.9 ± 0.18
Carcass length	68.2 ± 1.52	68.0 ± 1.23
M. longissimus thoracis depth	2.80 ± 0.10	3.14 ± 0.32
M. longissimus thoracis area (cm²)	13.8 ± 1.11	16.5 ± 1.24
Fat thickness over MLD (mm)	1.68 ± 0.13	1.66 ± 0.10
Carcass weight (kg) and dressing percentage (%)		
Slaughter weight	33.3 ± 1.22	32.2 ± 2.03
Warm carcass weight	16.3 ± 0.60	15.7 ± 1.22
Cold carcass weight	16.0 ± 0.60	15.3 ± 1.22
Untailed cold carcass weight	13.2 ± 0.39	14.3 ± 1.10
Dressing percentage	48.2 ± 0.50	47.2 ± 1.16
Untailed dressing percentage	39.7 ± 0.42	44.3 ± 1.10**
Fat weights (kg)		
Kidney and pelvic fat weight	0.10 ± 0.01	0.18 ± 0.03*
Internal fat weight	0.14 ± 0.01	0.17 ± 0.03
Tail weight	2.84 ± 0.24	0.96 ± 0.22**
Wholesale cuts (kg)		
Leg weight	2.25 ± 0.06	2.40 ± 0.17
Back-loin weights	1.02 ± 0.03	1.10 ± 0.09
Forearm weight	1.23 ± 0.03	1.35 ± 0.10
Shoulder weight	0.38 ± 0.02	0.39 ± 0.02
Neck weight	0.55 ± 0.02	0.56 ± 0.05
Flank-chest weights	1.08 ± 0.05	1.26 ± 0.12

* Indicates difference from KAR group within the same row at $P < 0.05$
** Indicates difference from KAR group within the same row at $P < 0.01$

Slaughter and carcass characteristics of the two groups of lambs are presented in Table 3. Slaughter weight, warm carcass weight, cold carcass weight and dressing percentage of KAR lambs appeared to be higher than that of the IDFAK lambs, but not significant ($P > 0.05$). In contrast, Cengiz *et al.* (1989), Eliçin *et al.* (1989), Ertuğrul *et al.* (1989) and Cengiz (1994) reported significant increases in slaughter weight, carcass weight and dressing percentage of Ile de France x Akkaraman crosses (F_1 and G_1) compared to pure Akkaraman lambs under semi-intensive conditions. The mean untailed cold carcass weight of the IDFAK lambs was 1.15 kg heavier than KAR lambs ($P > 0.05$). Untailed dressing percentage of IDFAK lambs was higher than that of the KAR lambs ($P < 0.01$). These results are in agreement with those of Eliçin *et al*. (1989) and Cengiz (1994) who found that the reduced proportion of tail fat of crossbred lambs increased the marketable pieces of the carcass compared to fat-tail lambs. The carcasses of the IDFAK lambs had more kidney, pelvic ($P < 0.05$) and internal fat ($P > 0.05$) weights than those of KAR lambs. However, tail weights were higher ($P < 0.01$) in KAR lambs than in IDFAK lambs, and the amount of kidney, pelvic and internal fat in the IDFAK lambs was too low to affect carcass yield compared to the quantity of the tail fat.

The wholesale cuts of the left half of the carcasses are presented in Table 3. The leg, back-loin, forearm, shoulder, neck and flank-chest weights were similar for both groups. It has been reported that crossbreeding with mutton breeds increased the weights of valuable wholesale cuts in the carcass of fat-tailed sheep breeds (Eliçin *et al.,* 1989; Ertuğrul *et al.,* 1989; Cengiz, 1994).

Proportional yields of wholesale cuts of carcass and organs are presented in Table 4. There were significant differences in proportional yields of kidney, kidney and pelvic fat, tail, legs, back-loin, forearms, flank-chest, heart, lungs and liver and testes between the two groups. Except for the tail, these values were

higher ($P < 0.01$ and $P < 0.05$) in the IDFAK lambs than in the KAR lambs. Proportional yield of internal fat of IDFAK lambs appeared to be higher than that of the KAR lambs, but not significant ($P > 0.05$). An increase in fat around internal organs in response to decrease in the tail fat portion has been reported by Ertuğrul *et al.* (1989), Cengiz (1994), Cengiz & Arık (1994) and Gökdal *et al.* (2003). The results of the present study are in agreement with Ertuğrul *et al*. (1989) and Cengiz (1994) who reported that crossbreeding with thin-tailed breeds reduced the amount of total fat in a crossbred lamb's body.

Table 4 Proportional yields (percentage ± s.e.) of wholesale carcass cuts and organs relative to cold carcass weights of Karakaş (KAR) and (Ile de France x Akkaraman (G_1)) x Karakaş crossbred lambs (IDFAK)

	Groups	
	KAR	IDFAK
Kidney	0.63 ± 0.02	0.72 ± 0.04*
Kidney and pelvic fat	0.63 ± 0.06	1.11 ± 0.15**
Tail	17.5 ± 0.99	6.2 ± 1.18**
Legs	28.2 ± 0.51	31.5 ± 0.55**
Back-loin	12.7 ± 0.17	14.4 ± 0.14**
Shoulder	4.8 ± 0.20	5.3 ± 0.31
Neck	6.9 ± 0.21	7.3 ± 0.22
Forearms	15.4 ± 0.29	17.7 ± 0.21**
Flank-chest	13.5 ± 0.38	16.3 ± 0.41**
Heart, lungs and liver[a]	4.2 ± 0.09	4.9 ± 0.20*
Testes[b]	0.76 ± 0.08	1.07 ± 0.11*
Internal fat[b]	0.89 ± 0.06	1.06 ± 0.11

[a] Relative to slaughter weight
[b] Relative to warm carcass weight
* Indicates difference from KAR group within the same row at $P < 0.05$;
** Indicates difference from KAR group within the same row at $P < 0.01$

Muscle, bone and fat components of the carcasses assessed from the 6th to 12th rib cut of KAR and IDFAK lambs are presented in Table 5. Estimated from the 6th-12th rib cut, the IDFAK lambs contained a higher proportion of intramuscular fat ($P < 0.05$) than the KAR lambs. Since intramuscular fat increases the taste of meat, consumers prefer carcasses with fat distribution between the meat fibres. The crossbreeding of fat-tailed sheep breeds with thin-tailed mutton breeds increased the percentage of intramuscular fat in the carcass, and thus the total fat content of the lamb carcass (Cengiz *et al.*, 1989). These results are in agreement with those of Cengiz *et al.* (1989) who reported that carcasses of Ile de France x Akkaraman (F_1) lambs tended to have a higher proportion of intramuscular and subcutaneous fat deposits and less tail fat than Akkaraman lambs and are thus more desirable to Turkish consumers. On the other hand, Cengiz (1994) noted that the level of the crossbreeding might affect the lean content of lamb carcasses. In the present study Ile de France x Akkaraman (G_1) x Karakaş (F_1) crosses produced desirable carcass characteristics such as an increase in intramuscular fat as reported by Güney & Biçer (1986), Cengiz *et al.* (1989), Cengiz (1994), Arık *et al.* (1996) and Gökdal *et al.* (2003).

Table 5 The proportion (percentage ± s.e.) of muscle, bone and fat in the carcasses of Karakaş (KAR) and (Ile de France x Akkaraman (G_1)) x Karakaş crossbred lambs (IDFAK), assessed in the 6th - 12th rib area

	Groups	
	KAR	IDFAK
	%	%
Muscle	44.3 ± 0.86	43.6 ± 1.12
Bone	26.6 ± 1.01	24.1 ± 1.59
Subcutaneous fat	11.0 ± 1.02	10.9 ± 1.51
Intramuscular fat	5.00 ± 0.70	8.29 ± 1.12*

* Indicates difference from KAR group within the same row at $P < 0.05$

Conclusions

In general, information related to the performance of native sheep breeds and their crosses with mutton breeds under rural farm conditions is insufficient. The preliminary results reported are from a study that forms part of a research program to develop a new sheep type using Karakaş ewes and Ile de France x Akkaraman (G_1) rams. Encouraging results in terms of growth performance and carcass quality of crossbred lambs were obtained. Although growth performance, feed efficiency and many carcass characteristics did not differ between groups, the carcasses of the crossbred lambs contained a higher percentage of intramuscular fat, which is considered desirable by consumers in Eastern Anatolia. Fat content of carcasses of crossbred lambs tended to increase and tail fat decreased significantly. Dressing percentage of untailed carcasses of cross lambs increased causing an increase in the proportion of wholesale cuts. However, the relatively small number of animals used in the study makes it difficult to obtain reliable estimates pertaining to growth performance and carcass characteristics of lambs. Therefore, more detailed and larger scale experiments are needed to confirm the results on growth and carcass characteristics of crossbred lambs under different farm conditions.

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References

Arık, İ.Z., Alarslan, Ö.F., Kor, A., Ertuğrul, M. & Polatsü, Ş., 1996. Farklı kaba yemlerle oluşturulan, arpaya dayalı tam rasyonlarla besiye alınan Malya ve Akkaraman kuzularının kesim be karkas özellikleri. *(Slaughtering and carcass characteristics of Malya and Akkaraman lambs fattening with complete rations essentially based on barley and including different roughages)*. Lalahan Hay. Arş. Der. 36, 2, 68-87.

Aşkın, Y. & Cengiz, F., 1993. Animal Production and Rural Tourism in Turkey. Animal Production and Rural Tourism in Mediterranean Regions, Evora, Portugal, 11-13 October 1993.

Aygün, T. & Bingöl, M., 1999. Akkaraman varyetesi Karakaş ve Norduz kuzularının doğum ağırlıkları bakımından karşılaştırılması. (*Comparison of the birth weights of Karakaş and Norduz lambs*). Uluslar arası Hayvancılık'99 Kongresi, 21-24 Eylül 1999, İzmir, pp. 738-742.

Aygün, T., Demirel, M., Gökdal, Ö., Çelikyürek, H. & Kor, A., 1998. Farklı sürelerde sütten kesilen ve meraya ek olarak kesif yemle beslenen Karakaş kuzularının besi gücü ve karkas özellikleri *(Fattening performance and carcass characteristics of Karakaş lambs weaned at different ages and fattened concentrate in addition to the natural pasture)*. Yüzüncü Yıl Üniv. Zir. Fak., Tarım Bilimleri Derg. 8, 9-16.

Bingöl, M., 1998. Norduz koyunlarının döl ve süt verimleri ile büyüme-gelişme ve dışyapı özellikleri. *(Reproductive and milk yield with growth-development and morphological traits of Norduz sheep)*. Ph.D. thesis, YYÜ, Fen Bil. Enst., Van.

Cengiz, F., 1994. Akkaraman, Ile de France x Akkaraman (G_1) melezi ve Anadolu Merinosu kuzularında besi gücü ve karkas özellikleri *(Fattening performance and carcass characteristics of Akkaraman, Ile de France x Akkaraman (G_1) crossbred and Anatolian Merino lambs)*. Scientific Research and Studies Vol. 749, Publ. no.1355, Publication of Agric. Faculty, Ankara University.

Cengiz, F. & Arık, İ.Z., 1994. Akkaraman kuzularında kuyruk kesiminin besi gücü ve karkas özellikleri üzerine etkileri *(Effects of tail docking on fattening performance and carcass characteristics of Akkaraman lambs)*. Scientific Research and Studies Vol. 750, Publ. no.1356, Publication of Agric. Faculty, Ankara University.

Cengiz, F., Eliçin, A., Ertuğrul, M. & Arık, İ.Z., 1989. Akkaraman, Ile de France x Akkaraman (F_1) melezi, Anadolu Merinosu ve Ile de France x Anadolu Merinosu (F_1) melezi erkek kuzularında besi gücü ve karkas özellikleri. *(Fattening performance, slaughtering and carcass characteristics of Akkaraman, Ile de France x Akkaraman (F_1) crossbred, Anatolian Merino and Ile de France x Anatolian Merino (F_1) crossbred male lambs)*. Scientific Research and Studies Vol. 632, Publ. no.1145, Publication of Agric. Faculty, Ankara University.

Colomer-Rocher, F., Morand-Fehr, P. & Kirton, A.H., 1987. Standard methods and procedures for goat carcass evaluation jointing and tissue separation. Livest. Prod. Sci. 17, 149-159.

Demirulus, H. & Karaca, O., 1994. Karakaş kuzularının köylü şartlarında kimi gelişme özellikleri *(Some growth characteristics of Karakaş lambs under rural farm conditions).* Yüzüncü Yıl Üniv., Zir. Fak. Derg. 4, 75-85.

Düzgüneş, O., Kesici, T., Kavuncu, O. & Gürbüz, F., 1987. Araştırma ve Deneme Metodları (İstatistik Metodları-II) *(Research and Experimental Methods (Statistical Methods-II)*. AÜ, Zir. Fak. Yayın No: 1021, Ankara, 381 s.

Eliçin, A. & Kesici, T., 1972. İvesi Kuzularında Bazı Faktörlerin Sütten Kesim Ağırlığı Üzerine Etkileri *(The effects of some factors on weaning weight of Awassi lambs).* Ankara Üniversitesi Ziraat Fakültesi Yıllığı 22, 348-363.

Eliçin, A., Cengiz, F., Ertuğrul, M., Aşkın, Y. & Arık, İ.Z., 1989. Akkaraman ve Ile De France x Akkaraman (F_1) Melezi Erkek Kuzularda Besi Gücü ve Karkas Özellikleri. *(Fattening performance, slaughtering and carcass characteristics of Akkaraman and Ile de France x Akkaraman (F_1) crossbred male lambs).* Scientific Research and Studies Vol. 614, Publ. no.1124, Publication of Agric. Faculty, Ankara University.

Ertuğrul, M., Eliçin, A., Cengiz, F. & Dellal, G., 1989. Akkaraman, Border Leicester x Akkaraman (F_1) Dorset Down x Akkaraman (F_1) ve Ile De France x Akkaraman (F_1) Melezi Erkek Kuzularda Besi Gücü ve Karkas Özellikleri. *(Fattening performance and carcass characteristics of Akkaraman, Border Leicester x Akkaraman (F_1), Dorset Down x Akkaraman (F_1) and Ile de France x Akkaraman (F_1) crossbred male lambs).* Scientific Research and Studies Vol. 631, Publ. no.1143, Publication of Agric. Faculty, Ankara University.

Gatenby, R.M., Bradford, G.E., Doloksaribu, M., Romjali, E., Pitono, A.D. & Sakul, H., 1997. Comparison of Sumatra sheep and three hair sheep crossbreds. I. Growth, mortality and wool cover of F_1 lambs. Small Rumin. Res. 25, 1-7.

Gökdal, Ö., 1998. Karakaş koyunlarının süt ve döl verimleri ile dışyapı ve büyüme-gelişme özellikleri *(The milk yield, reproductive performance, some body measurements and growth characteristics of Karakaş sheep)*. Yüzüncü Yıl Üniv., Fen Bil. Enst., Doktora tezi *(Ph.D. Thesis),* Van., Turkey. 107 pp.

Gökdal, Ö. Aygün, T. Bingöl, M. & Karakuş, F., 2003. The effects of docking on performance and carcass characteristics of male Karakaş lambs. S. Afr. J. Anim. Sci. 33, 185-192.

Gökdal, Ö., Ülker, H., Oto, M., Temur, C. & Budağ, C., 2000. Köylü koşullarında yetiştirilen Karakaş koyunlarının çeşitli verim özellikleri ve vücut ölçüleri *(Different production traits and body measurements of Karakaş sheep in rural farm conditions).* Yüzüncü Yıl Üniv. Zir. Fak. Tarım Bilimleri Derg. 10, 1, 103-111.

Gökdal, Ö., Ülker, H., Temur, C., Oto, M.M. & Budağ, C., 1999. Köylü koşullarında yetiştirilen Karakaş kuzularının sütten kesim dönemine kadarki büyüme-gelişme özellikleri ile vücut ölçüleri *(Growth traits and body measurements of Karakaş lambs until weaning in rural farm conditions).* Yüzüncü Yıl Üniv. Zir. Fak. Tarım Bilimleri Derg. 9, 1, 41-49.

Güney, O. & Biçer, O., 1986. Saf ve melez İvesi erkek kuzularında besi performansı ve karkas özellikleri üzerinde bir araştırma. *(A study on fattening performance and carcass compositions of pure and cross-bred Awassi ram lambs.).* Doğa Tr.Vet.ve Hay.D. 10, 3, 251-258.

Karaca, O., Altın, T. & Okut, H., 1996. Köylü işletmelerde Karakaş koyunlarının canlı ağırlık değişimlerine ilişkin kimi parametre tahminleri *(Some parameters estimation on the live weights changes of Karakaş ewes in the rural farms)*. Yüzüncü Yıl Üniv., Zir. Fak. Derg. 6, 3, 59-72.

Karaca, O., Demirel, M., Kaygısız, A. & Altın, T., 1993. Köylü işletmelerinde gebeliğin son döneminde farklı düzeylerde beslemenin Karakaş koyunlarının canlı ağırlık, kuzuların doğum ağırlığı ve yaşama gücüne etkileri *(The effects of the different levels of feeding at late pregnancy on live weight of the Karakaş ewes, birth weight and survival rates of their lambs in the rural farm).* Yüzüncü Yıl Üniversitesi, Ziraat Fakültesi Dergisi. 3/1-2, 57-72.

Karaca, O., Kaygısız, A., Altın, T. & Söğüt, B., 1990. İvesi x Akkaraman melezi kuzularının kimi gelişme özellikleri. *(Some growth traits of Awassi x Akkaraman lambs).* YYÜ, Zir. Fak. Derg. 1/1, 137-145.

Macit, M., Esenbuga, N. & Karaoğlu, M., 2002. Growth performance and carcass characteristics of Awassi, Morkaraman and Tushin lambs grazed on pasture and supported with concentrate. Small Rumin. Res. 43, 241-246.

Macit, M., Karaoğlu, M., Esenbuğa, N., Kopuzlu, S. & Dayıoğlu, H., 2001. Growth performance of purebred Awassi, Morkaraman and Tushin lambs and their crosses under semi-intensive management in Turkey. Small Rumin. Res. 41, 177-180.

Mavrogenis, A.P., 1996. Environmental and genetic factors influencing milk and growth traits of Awassi sheep in Cyprus. Heterosis and maternal effects. Small Rumin. Res. 20, 59-65.

More O'Ferral, G.J. & Timon, V.M., 1977. A comparison of eight sire breeds for lamb production. II. Lamb carcass composition. Ir. J. Agric. Res. 16, 277-284.

SAS, 1998. Statistical Analysis System user's guide. SAS Institute Inc., Cary, North Carolina, USA.

Ülker, H., Baş, S., Vanlı, Y., Karaca, O. & Aygün, T., 1999. Transferrin polimorfizminin Karakaş kuzularının bazı verim özellikleri ile ilişkileri *(Transferrin polymorphism and its associations with growth traits of Karakaş lambs)*. Y.Y.Ü. Zir. Fak. Tar. Bil. Derg. 9 (1), 23-28.

Yalçın, B.C. & Aktaş, G., 1976. Ile de France ve Akkaraman koyunları ile bunların melezlerinin verimle ilgili özellikleri üzerinde karşılaştırmalı araştırmalar *(Comparative studies on the production characteristics of Ile de France and Akkaraman sheep and their crosses)*. İstanbul Üniv., Vet. Fak. Derg. 2, 1, 21-40.