



Determination of the Optimum Fattening Period and Fattening Performance Slaughter and Carcass Characteristics of Hair Goat and Saanen × Hair Goat (G₁) Crossbred Kids Fattened in Different Systems

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ABSTRACT

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This research was carried out to investigate the fattening performance and slaughter and carcass characteristics of Hair goat and Saanen × Hair goat (G₁) crossbred kids in different fattening systems. Thirty Hair goats and 30 Saanen × Hair goat (G₁) crossbred singleton male kids 2.5-3 months old and weaned were used. The kids were fattened in three different systems: intensive, semi-intensive, and extensive. Marginal value analysis was applied to determine the optimum feeding periods of the kids. In order to determine the slaughter and carcass characteristics, all the kids fattened were taken to slaughter after determining their live weight at the end of the fattening. Live weight gains after the intensive, semi-intensive, and extensive fattening were 17.83 kg, 19.39 kg, and 18.29 kg in the Hair goat kids and 17.88 kg, 18.24 kg, and 17.32 kg in the Saanen × Hair goat (G₁) crossbred kids, respectively. In the same order, the average concentrate feed consumed by kids for 1 kg live weight gain was 7.55 kg, 7.28 kg, 7.00 kg and 7.07 kg. Hot carcass weights after the intensive, semi-intensive, and extensive fattening were 13.58, 14.06, and 13.02 kg in the Hair goat kids and 14.21, 15.03, and 14.06 kg in the Saanen × Hair goat (G₁) crossbred kids. The Saanen × Hair goat (G₁) crossbred goats increased more in live weight than the Hair goat kids and the semi-intensive fattened goats increased more in live weight than the intensive and extensive fed goats. Moreover, the optimum fattening times generally varied between the groups, but not between genotypes within the group.

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Introduction

Sheep and goat husbandry is often considered a part of farming and family businesses in Turkey. Sheep and goat husbandry has many advantages such as it can be conducted using traditional methods, greater areas are available for grazing, the gestation period is shorter than in cattle, larger litters are produced due to twin and triplet pregnancies, and management is easy (Sarıççek, 2007; Atay and Gökdal, 2016; Bolacalı et al., 2017). When steep sloping lands, maquis groves, shrubs, and brush are considered in animal husbandry, goat husbandry always comes to mind. Since goats have high adaptation, agile bodies, strong immune systems, and suitable mouths and lips for short vegetation and they like to consume brush and thorns, they can efficiently utilize local vegetation and turn those into products like meat and milk; therefore, they meet the majority of the animal origin food requirements of people living in rural provinces. Goats have been an

important source of food and materials throughout human history in many parts of the world (Webb et al., 2005; Yalçınan et al., 2012; Gül and Örnek, 2019).

There are 11,367 million goats in Turkey and the share of goat and kid meat in red meat consumption is 3.5% (TÜİK, 2020). Considering the incomes obtained in goat breeding, meat production has an important place compared to other yields. Goat meat is important for human nutrition with its high protein and low fat content. Many genetic and environmental factors have an effect on carcass and meat quality traits in goats (Banskalieva et al., 2000; Toplu, 2014). While the increase in the amount of meat in the carcass contributes to the carcass economically, an increase in the amount of fat negatively affects carcass quality. Therefore, the meat market expects a good carcass with a high rate of lean meat and a certain degree of fatness in order to prevent losses in cold storage (Pena et al., 2007).

Fattening performance is evaluated depending on the weight gain of the animal during the fattening period, the amount of feed consumed, and the fattening period. The purpose of fattening is to achieve the highest increase in body weight per animal in the shortest possible time and at a low cost. Fattening performance in animals is influenced by factors such as race, sex, age, care and feeding system, and quantity and quality of feed (Eliçin et al., 1989; Karaoğlu et al., 2001). Production systems in sheep and goat breeding are of great importance in terms of both product quantity and quality and production economy (Yakan et al., 2016). It is necessary to choose the appropriate fattening material and to adjust the optimum fattening time for economic fattening.

The aim of the present study was to determine the fattening performance and carcass characteristics of Hair goat and Saanen × Hair goat (G₁) crossbred male kids in different fattening systems.

Materials and Methods

The research protocol of the present study was approved by the Local Ethical Committee of Ondokuz Mayıs University for Animal Experiments (with decision number 2013/67). Thirty Hair goats and 30 Saanen × Hair goat (G₁) crossbred singleton male kids 2.5-3 months old and weaned were used (10 animals in each group) in the present study. The kids had been subjected to adaptation feeding for 2 weeks prior to the trial. The kids were fattened in three different systems: intensive, semi-intensive, and extensive. All of the kids subjected to intensive and semi-intensive fattening were housed in individual pens, while those subjected to extensive fattening were housed in groups. The kids in the semi-intensive group were taken to the pasture during the day and were placed in individual pens in the evening. Individual pens were arranged to provide 1.5 m² per animal. The daily nutrient requirements of all animals that underwent intensive, semi-intensive, and extensive fattening were determined as 4.3% of their live weight on the basis of daily dry matter (NRC, 2001). In order to determine the amounts of nutrients coming from the pasture during the feeding period, the quality of the pasture was established. The botanical composition by weight was determined by placing 1 m × 1 m cages on the pasture during the grazing period and slaughtering periodically and vegetation was determined by the transect method, which is based on the study of a line of 1m length and 1cm width in different parts of the pasture.

The live weight of the kids during fattening was determined by weighing them every 15 days until day 98 and once a week thereafter. The cost of 1 kg of sheep and goat fattening feed given to goats is 0.94 TL and the cost of 1 kg of meadow grass is 0.6 TL. Marginal value analysis was applied to determine the optimum feeding periods of kids. In agriculture, it is not possible to increase productivity as much as desired by increasing production inputs. When to stop fattening in livestock breeding is determined by comparing the feed expenditure consumed and the value of the increase in live weight provided for that feed. Cases in which the time factor is constant, that is, the point where the total profit is maximum when the fattening process is performed once, will give the optimum

feed time. In cases in which the fattening process is repeated (the time factor is taken as a variable), the optimum fattening period will be determined by the period when the average profit is maximum (Cinemre et al., 1994; Doll and West, 1968).

The daily weights of the feeds given and leftover feeds of all kids fed by intensive and semi-intensive fattening were recorded every morning and the feed consumption and feed conversion values of the groups were determined. Weekly pasture consumption was determined by the mowing method in the kids in the semi-intensive group and their individual feed consumption was calculated by dividing by the number of animals available. No additional feeding was applied to the animals in the extensive group.

To prevent the negative effects of fasting stress, the last feeding was performed 12 hours before slaughter. In order to determine the slaughter and carcass characteristics, all the kids fattened were taken to slaughter after their live weight was determined at the end of the fattening. In the standard carcass jointing method applied to carcasses, only the kidneys, testicles, kidney pelvic fat, and part of the diaphragm remain in the carcass after slaughtering and skinning and removing the internal organs (Colomer-Rocher et al., 1987). After the slaughtering process was completed and the necessary procedures were performed on the hot carcasses, they were left for 24 hours in cold storage at +4°C. The cold carcasses were weighed after this process. The kidneys, testicles, kidneys, and pelvic fat left in the carcass during slaughter were removed from the chilled carcass and weighed; then the carcass was divided into two equal parts along the spine. The left half carcasses in which carcass studies were carried out were divided into 5 main parts: neck, shoulder, flank, long leg, and back-loin, and the weight of the pieces were recorded separately.

Experimental data on the slaughter and carcass characteristics were statistically analyzed using SPSS software (SPSS, 2005). The analyses were performed in accordance with randomized plots 2 × 3 factorial design to determine the effects of fattening systems, genotypes, and interactions on the investigated traits. The following model was used in the analyses:

$$Y_{ijk} + \mu + G_j + FS_i + (G \times FS)_{ij} + e_{ijk}$$

Where

μ	= Population mean,
G_j	= Effect of jth genotype,
FS_i	= Effect of ith fattening system,
$(G \times FS)_{ij}$	= Interaction effect of ith genotype and jth fattening system,
e_{ijk}	= Random error.

Results

The composition of the feed given to the kids during the trial is shown in Table 1. The average live weights in different periods of fattening are given in Table 2, and live weight gains by periods are given in Table 3 and Table 4. When examining the characteristics of fattening performance and carcass quality, the relevant features were used as co-factors to evaluate the effect of baseline measures, but were excluded from the model because the co-factors were determined to be statistically insignificant.

Table 1. Nutritional composition of feeds used in fattening systems and samples taken from pasture (%).

Nutritional composition	Dry meadow grass	Concentrate feed	Pasture grass
Dry matter	89.40	90.00	92.43
Crude protein	7.09	17.00	12.43
Crude fat	1.25	3.00	2.91
Crude cellulose	34.90	10.00	28.74
Crude ash	8.01	9.00	8.84
Organic matter	81.36	81.00	83.37
ADF	41.58	21.61	31.32
NDF	67.89	42.17	51.27

ADF: Acid detergent fiber; NDF: Neutral detergent fiber.

Table 2. Average live weights in different periods of fattening (kg).

Days	Intensive fattening		Semi-intensive fattening		Extensive fattening		P	G	FS	G*FS
	Hair goat	Saanen × Hair goat (G ₁)	Hair goat	Saanen × Hair goat (G ₁)	Hair goat	Saanen × Hair goat (G ₁)				
0	9.69±0.58	11.61±0.90	9.98±0.73	11.59±0.85	9.88±0.53	11.95±0.46	-	-	-	-
14	10.89±0.58	12.96±0.94	11.31±0.74	12.95±0.88	11.10±0.54	13.24±0.46	-	-	-	-
28	12.26±0.58 ^c	14.46±1.11 ^{abc}	12.87±0.74 ^{abc}	14.97±0.89 ^a	12.49±0.57 ^{bc}	14.71±0.45 ^{ab}	*	-	*	*
42	13.89±0.54 ^c	16.24±1.20 ^{abc}	14.70±0.74 ^{abc}	16.77±0.93 ^a	14.11±0.60 ^{bc}	16.32±0.44 ^{ab}	*	-	*	*
56	15.53±0.57 ^c	18.21±1.31 ^{ab}	16.75±0.78 ^{abc}	18.85±1.00 ^a	15.86±0.65 ^{bc}	18.12±0.44 ^{ab}	*	*	*	*
70	17.30±0.62 ^c	20.34±1.43 ^{ab}	19.34±0.94 ^{abc}	21.20±1.10 ^a	17.79±0.71 ^{bc}	20.08±0.46 ^{abc}	*	*	*	*
84	19.25±0.73 ^c	22.61±1.55 ^{ab}	21.92±1.11 ^{abc}	23.80±1.22 ^a	19.85±0.79 ^{bc}	22.18±0.50 ^{abc}	*	*	*	*
98	21.38±0.88 ^c	25.02±1.67 ^{ab}	25.18±1.37 ^{ab}	26.66±1.36 ^a	22.04±0.89 ^{bc}	24.37±0.56 ^{abc}	*	*	*	*
105	22.46±0.97 ^c	25.96±1.54 ^{abc}	26.50±1.37 ^{ab}	28.00±1.36 ^a	23.17±0.94 ^{bc}	25.49±0.59 ^{abc}	*	-	*	*
112	23.59±1.06 ^b	26.08±1.31 ^{ab}	26.79±1.03 ^{ab}	28.22±1.17 ^a	24.78±0.88 ^b	26.65±0.64 ^{ab}	*	-	*	*
119	24.71±1.09	26.29±1.05	27.33±0.74	26.78±0.99	25.71±0.96	27.71±0.61	-	-	-	-
126	24.99±0.78 ^b	26.91±1.06 ^{ab}	28.22±0.55 ^a	28.18±0.95 ^a	26.28±0.81 ^{ab}	28.19±0.55 ^a	*	-	*	*
133	25.98±0.69 ^b	27.73±0.93 ^{ab}	28.55±0.19 ^a	28.35±0.40 ^a	27.33±0.76 ^{ab}	28.83±0.39 ^a	*	-	*	*
147	26.54±0.56	27.33±0.57	28.70±0.00	28.00 ± 0.00	28.33±0.85	29.12±0.23	-	-	-	-
154	26.48±0.59	26.70±0.91	-	-	26.62±1.70	28.45±0.15	-	-	-	-

a,b,c: The means indicated with different letters in the same row are significantly different; * P<0.05; -: not significant, Values are expressed as mean ± standard deviation; G: Genotype; FS: Fattening system.

Table 3. Average live weight gains in groups according to the periods (kg).

Days	Intensive fattening		Semi-intensive fattening		Extensive fattening		P	G	FS	G*FS
	Hair goat	Saanen × Hair goat (G ₁)	Hair goat	Saanen × Hair goat (G ₁)	Hair goat	Saanen × Hair goat (G ₁)				
0-14	1.20±0.04	1.35±0.06	1.33±0.06	1.36±0.05	1.22±0.04	1.29±0.04	-	-	-	-
15-28	1.37±0.06	1.59±0.09	1.57±0.09	1.60±0.06	1.39±0.05	1.47±0.05	-	-	-	-
29-42	1.63±0.16	1.78±0.11	1.83±0.11	1.81±0.07	1.62±0.07	1.62±0.06	-	-	-	-
43-56	1.65±0.10 ^b	1.98±0.14 ^{ab}	2.06±0.14 ^a	2.08±0.10 ^a	1.76±0.08 ^{ab}	1.80±0.08 ^{ab}	*	-	*	*
57-70	1.77±0.12 ^b	2.13±0.15 ^{ab}	2.35±0.21 ^a	2.35±0.11 ^a	1.93±0.09 ^b	1.96±0.09 ^{ab}	*	*	*	*
71-84	1.95±0.15 ^b	2.28±0.15 ^{ab}	2.58±0.25 ^a	2.61±0.15 ^a	2.07±0.11 ^b	2.11±0.11 ^b	*	*	*	*
85-98	2.13±0.18 ^b	2.41±0.16 ^{ab}	2.86±0.28 ^a	2.86±0.17 ^a	2.20±0.12 ^b	2.20±0.11 ^b	*	*	*	*
99-105	1.09±0.09	0.94±0.25	1.32±0.11	1.35±0.12	1.13±0.06	1.12±0.06	-	-	-	-
106-112	1.13±0.10	1.12±0.12	0.29±0.17	0.22±0.23	1.10±0.12	1.16±0.06	-	-	-	-
113-119	1.11±0.07	1.15±0.14	1.27±0.15	1.38±0.11	1.18±0.05	1.06±0.07	-	-	-	-
120-126	1.17±0.08	1.29±0.12	1.44±0.16	1.41±0.12	1.26±0.06	1.15±0.05	-	-	-	-
127-133	1.00±0.17	0.82±0.24	0.33±0.49	0.17±0.66	1.05±0.26	0.64±0.22	-	-	-	-
134-147	1.00±0.18	0.55±0.64	0.54±0.00	0.79±0.00	1.11±0.16	0.89±0.26	-	-	-	-
148-154	0.18±0.18	-0.29±0.29	-	-	0.21±0.44	-0.77±0.23	-	-	-	-

a,b,c: The means indicated with different letters in the same row are significantly different; * P<0.05; ** P<0.01; -: not significant, Values are expressed as mean ± standard deviation; G: Genotype; FS: Fattening system.

When the live weight gains were examined on days 56, 70, 84, and 98 of fattening, it was determined that the Saanen × Hair goat (G₁) crossbred kids increased more than the Hair goat kids and the semi-intensive fattening group goats increased more than the intensive and extensive fattening group goats. The difference between the groups in terms of average body weight gain in the

specified periods was significant (P<0.05). When looking at all periods in terms of daily average live weight gain, the differences between groups were significant (P<0.05). The Hair goat kids in the semi-intensive fattening group had the highest (0.159 ± 0.012) and the Saanen × Hair goat (G₁) crossbred kids in the extensive fattening group had the lowest (0.130 ± 0.005) live weight gain.

Table 4. Average live weight gains in groups according to the periods (g).

Days	Intensive fattening		Semi-intensive fattening		Extensive fattening		P	G	FS	G*FS
	Hair goat	Saanen × Hair goat (G ₁)	Hair goat	Saanen × Hair goat (G ₁)	Hair goat	Saanen × Hair goat (G ₁)				
0-14	85.9±2.70 ^b	96.3±4.10 ^{ab}	94.8±4.60 ^{ab}	99.4±3.00 ^a	86.7±2.50 ^b	92.2± 2.70 ^{ab}	*	-	*	*
15-28	97.8±4.20	113.4±6.70	111.8±6.30	114.0±4.10	99.4±3.70	104.8±3.40	-	-	-	-
29-42	116.1±11.60	127.4±8.20	130.5±7.90	128.8±4.90	115.6±4.70	115.4±4.20	-	-	-	-
43-56	117.7±7.0 ^b	140.9±10.20 ^{ab}	146.7±9.90 ^a	148.4±7.0 ^a	125.8±5.40 ^{ab}	128.3±5.40 ^{ab}	*	-	*	*
57-70	126.1±8.3 ^b	152.0±10.5 ^{ab}	167.3±14.80 ^a	168.0±8.20 ^a	137.3±6.50 ^b	140.0±6.50 ^{ab}	*	-	*	*
71-84	139.4±10.9 ^b	162.7±11.10 ^{ab}	184.3±18.0 ^a	186.0±10.50 ^a	147.7±7.60 ^b	150.3±7.60 ^b	*	-	*	*
85-98	152.3±13.1 ^b	172.1±11.50 ^{ab}	204.3±19.80 ^a	203.6±12.30 ^a	156.7±8.80 ^b	156.5±7.90 ^b	*	-	*	*
99-105	155.2±13.50	134.2±35.90	188.3±16.10	192.4±17.30	161.1±8.40	160.3±7.90	-	-	-	-
106-112	161.4±14.0	160.5±17.10	183.6±24.70	132.5±32.60	156.8±16.80	166.0±8.50	-	-	-	-
113-119	159.1±10.60	163.6±19.80	180.7±21.40	196.5±16.30	167.5±7.50	151.3±10.40	-	-	-	-
120-126	167.5±11.40	184.0±16.80	205.0±22.9	201.0±16.8	180.0±8.6	164.3±7.2	-	-	-	-
127-133	142.1±24.70	117.2±34.30	47.4±70.4	24.8±93.6	150.3±36.4	91.3±31.8	-	-	-	-
134-147	142.0±260	77.5±90.70	77.0±0.0	113.0±0.0	158.0±23.3	127.5±37.2	-	-	-	-
148-154	26.2±25.50	-41.7±41.30	-	-	24.4±48.5	-110.3±33.0	-	-	-	-

a,b,c: The means indicated with different letters in the same row are significantly different; * P < 0.05; -: not significant; G: Genotype; FS: Fattening system.

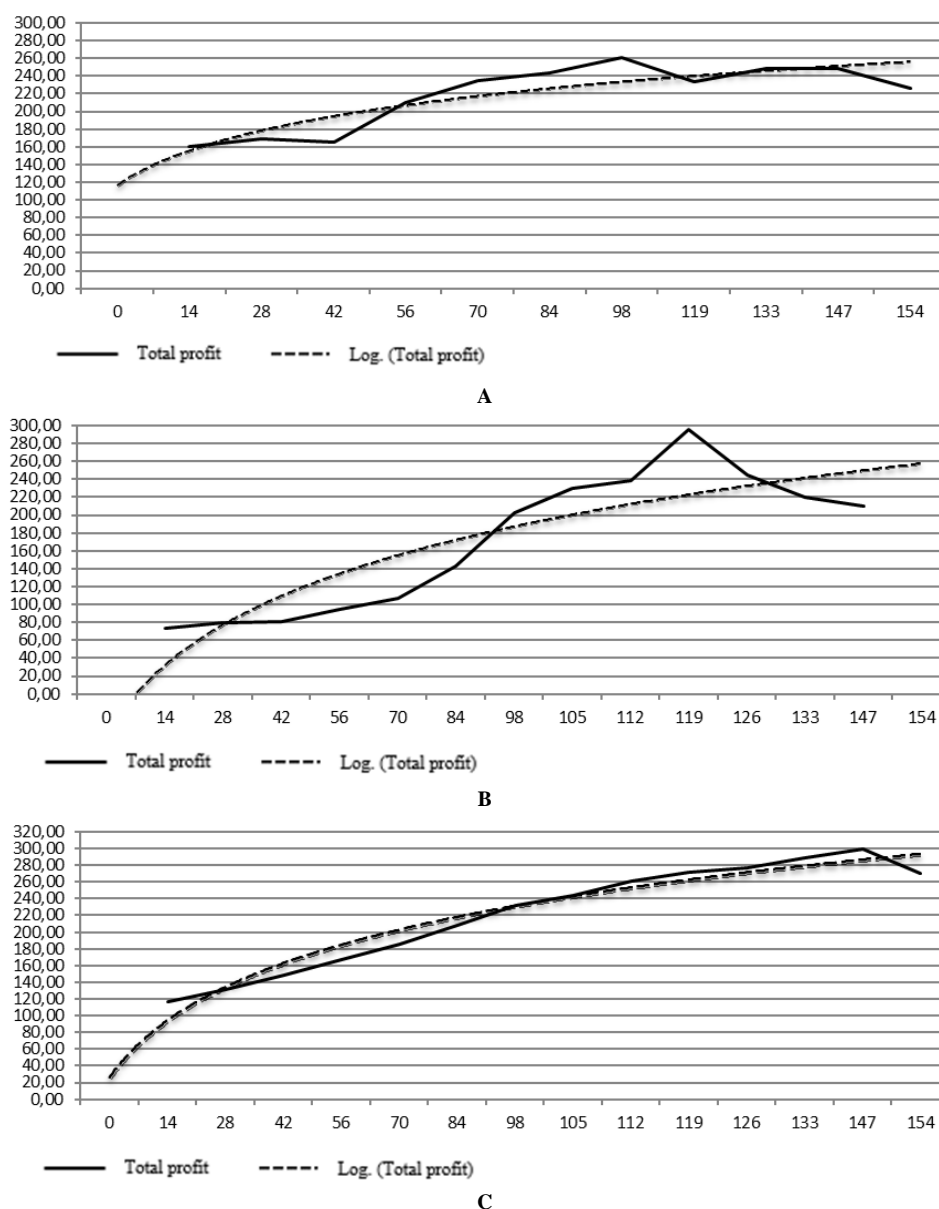


Figure 1. Total profit curves for Hair Goat. Intensive fattening Hair Goat (A), semi-intensive fattening Hair Goat (B), extensive fattening Hair Goat (C).

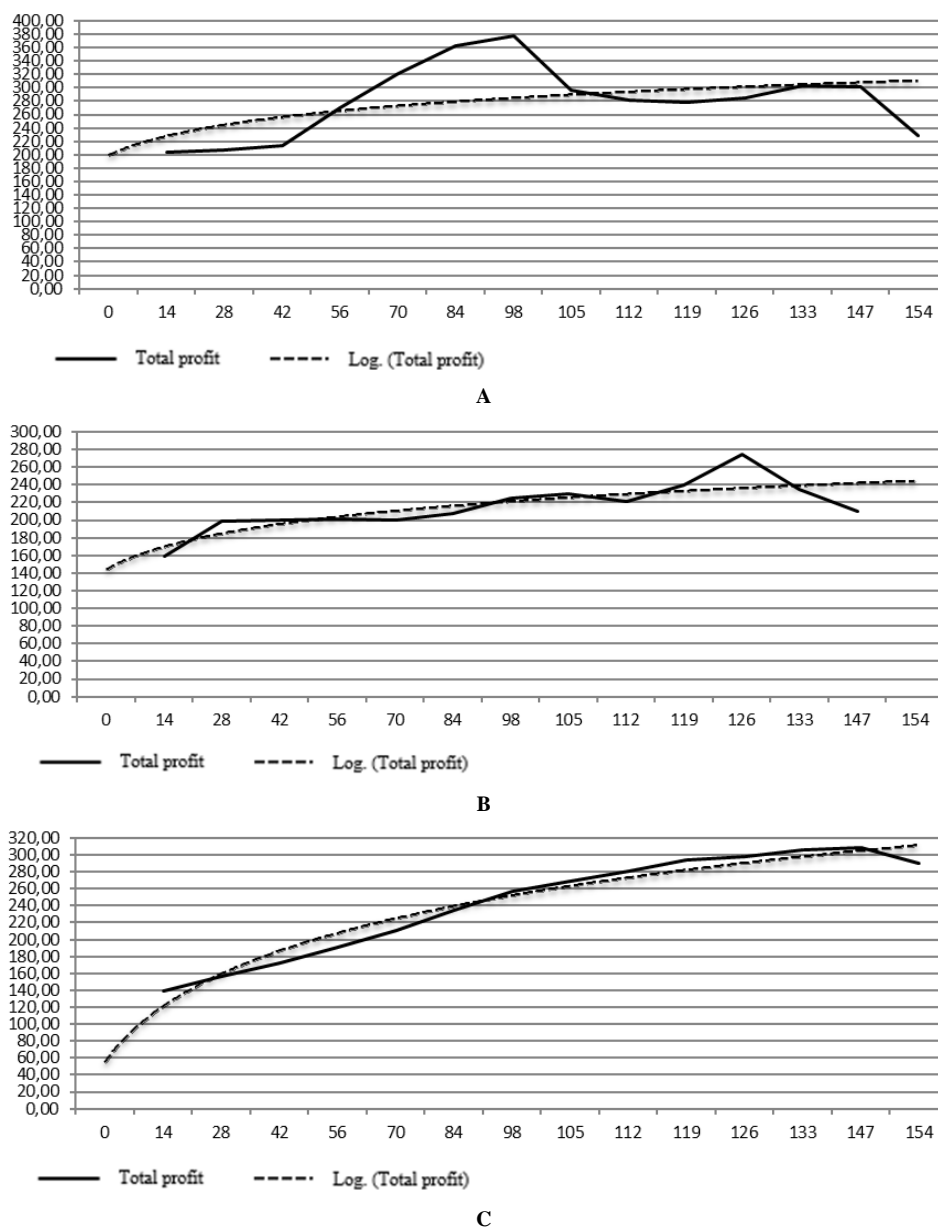


Figure 2. Total profit curves for Saanen × Hair Goat (G_1) crossbred. Intensive fattening Saanen x Hair Goat (G_1) crossbred (A), semi-intensive fattening Saanen x Hair Goat (G_1) crossbred (B), extensive fattening Saanen × Hair Goat (G_1) crossbred (C).

Descriptive values for the feed consumption of the research material kids are given in Table 5. When the data obtained are examined, for the intensive and semi-intensive fattening groups of Hair goat kids the average daily amount of concentrate feed consumed was 1.08 kg and 1.22 kg respectively. For the intensive and semi-intensive fattening groups of Saanen × Hair goat (G_1) crossbred kids, the average daily amount of concentrate feed consumed was 1.13 kg and 1.22 kg respectively. For the intensive and semi-intensive fattening groups of Hair goat and Saanen × Hair goat (G_1) crossbred kids the average feed consumed for 1 kg live weight gain was 7.55 kg, 7.28 kg, 7.0 kg and 7.07 kg respectively. Knowing the optimum feeding periods according to the fattening methods of each genotype is of absolute importance in the planning of business and for increasing profitability.

In the present study, it is possible to see the optimum fattening times of fattened kids with the help of the curves in Figure 1 and Figure 2. As seen in the figures, the total profit, which determines the optimum fattening period in cases in which fattening is carried out once a year, increases from the beginning and reaches its highest value on days 98 and 98 after intensive fattening, on days 119 and 126 after semi-intensive fattening, and on day 147 after extensive fattening. Therefore, these periods were determined as the optimum feeding periods for each genotype and fattening method. In the earlier stages of nutrition, there are also periods when total profit is high. However, during these periods, the live weight of the animals is not sufficient for slaughter, because the sale of carcasses obtained from animals slaughtered at these live weights is not possible. For this reason, while deciding on

the optimum feeding time, it has been emphasized that the live weights of the animals are suitable for consumable carcasses. In studies on fattening in kids, the fattening period is shortened in cases in which live weight per fattening or fattening age is advanced. However, the fattening period is longer when the fattening started with weaning. These factors should also be taken into account when evaluating the optimum feeding time. In our study,

the optimum fattening times were found to be longer in all three feeding methods in both genotypes, since fattening starts right after the weaning of goats.

The Hair goat and Saanen × Hair goat (G₁) crossbred kids were sent to slaughter after fattening. The averages of the determined slaughter and carcass characteristics are given in Table 6 and Table 7.

Table 5. Daily feed intake per animal according to periods (g).

Days	Intensive fattening		Semi-intensive fattening		P	G	FS	G*FS
	Hair goat	Saanen × Hair goat (G ₁)	Hair goat	Saanen × Hair goat (G ₁)				
0-14	394.44±21.67	466.00±33.31	410.00±28.79	470.00±32.46	-	-	-	-
15-28	626.67±37.27	730.00±63.33	762.00±43.91	773.33±55.53	-	-	-	-
29-42	736.67±37.27	840.00±63.33	912.00±47.37	890.00±47.22	-	-	-	-
43-56	796.67±37.27 ^b	910.00±63.33 ^{ab}	1042.50±48.08 ^a	1025.00±41.48 ^a	*	-	*	*
57-70	886.67±37.27 ^b	995.00±60.46 ^b	1199.00±54.37 ^a	1197.78±45.94 ^a	**	-	*	*
71-84	1005.56±41.2 ^b	1100.00±52.17 ^b	1288.89±57.6 ^a	1343.89±44.75 ^a	**	-	*	*
85-98	1137.78±46.45 ^b	1190.00±52.17 ^b	1440.63±35.08 ^a	1461.11±43.92 ^a	**	-	*	*
99-105	1293.33±56.86 ^c	1413.00±51.51 ^{bc}	1466.25±34.69 ^b	1632.22±41.69 ^a	**	*	*	*
106-112	1341.11±62.55 ^c	1425.56±40.21 ^{bc}	1520.00±38.36 ^{ab}	1621.25±28.69 ^a	**	*	*	*
113-119	1375.56±57.81 ^b	1475.56±44.07 ^{ab}	1471.67±32.08 ^{ab}	1612.50±51.54 ^a	*	*	*	*
120-126	1405.00±46.41 ^c	1467.50±42.92 ^{bc}	1596.00±38.42 ^{ab}	1615.00±39.48 ^a	*	*	*	*
127-133	1445.00±51.96 ^b	1494.29±39.87 ^b	1712.00±45.43 ^a	1732.50±26.89 ^a	**	-	*	*
134-147	1460.00±61.41	1445.00±38.84	-	-	-	-	-	-
148-154	1501.67±71.01	1513.33±48.42	-	-	-	-	-	-
0-154	1082.90±28.05 ^b	1130.84±36.87 ^b	1222.99±28.11 ^a	1223.50±26.29 ^a	*	*	*	-
AFI	7.55±0.45	7.00±0.35	7.28±0.70	7.07±0.30	-	-	-	-

^{a,b,c}: The means indicated with different letters in the same row are significantly different; * P<0.05; ** P<0.01; -: not significant, Values are expressed as mean ± standard deviation; G: Genotype; FS: Fattening system, AFI: Average feed intake per 1 kg live weight (0-154)

Table 6. Average values for some slaughterhouse traits of Hair Goat and Saanen × Hair Goat (G₁) crossbred kids.

Traits	Intensive fattening		Semi-intensive fattening		Extensive fattening		P	G	FS	G*FS
	Hair goat	Saanen × Hair goat (G ₁)	Hair goat	Saanen × Hair goat (G ₁)	Hair goat	Saanen × Hair goat (G ₁)				
Slaughterhouse weight (kg)	26.06±0.85	26.46±0.89	28.74±0.63	28.99±0.60	26.87±0.56	28.22±0.35	-	-	-	-
Hot carcass weight (kg)	13.58±0.48 ^b	14.21±0.59 ^{ab}	14.06±0.27 ^{ab}	15.03±0.53 ^a	13.02±0.17 ^b	14.06±0.20 ^{ab}	*	*	*	*
Hot carcass percentage (%)	48.36±0.58 ^{ab}	48.11±0.67 ^{ab}	47.35±0.96 ^b	50.07±1.12 ^a	45.19±0.63 ^c	48.13±0.38 ^{ab}	*	*	*	*
Head weight (kg)	1.78±0.06 ^b	2.09±0.05 ^a	1.90±0.04 ^b	2.12±0.03 ^a	1.83±0.05 ^b	2.14±0.04 ^a	**	*	-	*
Four-legs weight (kg)	0.83±0.02	0.81±0.03	0.81±0.03	0.79±0.03	0.78±0.03	0.78±0.02	-	-	-	-
Flank weight (kg)	2.64±0.12 ^{ab}	2.27±0.13 ^c	2.91±0.11 ^a	2.39±0.11 ^{bc}	2.61±0.11 ^{ab}	2.12±0.05 ^c	**	*	-	*
Omental and mesentric fat weight (kg)	0.44±0.06 ^a	0.39±0.05 ^{ab}	0.37±0.04 ^{abc}	0.24±0.03 ^c	0.34±0.04 ^{abc}	0.30±0.03 ^{bc}	*	-	*	*
Lung, heart and liver weight (kg)	1.12±0.04 ^c	1.31±0.05 ^b	1.29±0.05 ^b	1.50±0.05 ^a	1.19±0.05 ^{bc}	1.28±0.04 ^b	**	*	*	*

^{a,b,c}: The means indicated with different letters in the same row are significantly different; * P<0.05; ** P<0.01; -: not significant, Values are expressed as mean ± standard deviation; G: Genotype; FS: Fattening system.

Table 7. Carcass traits of Hair Goat and Saanen x Hair Goat (G₁) crossbred kids and weights of carcass sections in left half of the carcass.

Traits	Intensive fattening		Semi-intensive fattening		Extensive fattening		P	G	FS	G*FS
	Hair goat	Saanen × Hair goat (G ₁)	Hair goat	Saanen × Hair goat (G ₁)	Hair goat	Saanen × Hair goat (G ₁)				
Cold carcass weight (kg)	13.37±0.47 ^{ab}	13.85±0.50 ^{ab}	13.75±0.27 ^{ab}	14.22±0.40 ^a	12.81±0.17 ^b	13.88±0.20 ^{ab}	*	-	*	*
Cold carcass percentage (%)	47.62±0.59 ^a	46.97±0.57 ^a	46.31±0.93 ^a	47.41±0.83 ^a	44.45±0.58 ^b	47.51±0.32 ^a	*	-	*	*
Testis weight (kg)	0.11±0.01	0.09±0.00	0.11±0.01	0.11±0.01	0.11±0.00	0.11±0.00	-	-	-	-
Kidney weight (kg)	0.05±0.00	0.06±0.01	0.05±0.00	0.06±0.01	0.06±0.00	0.05±0.01	-	-	-	-
Kidney and knob fat weight (kg)	0.28±0.03 ^a	0.22±0.03 ^{ab}	0.16±0.03 ^{bc}	0.14±0.02 ^c	0.17±0.02 ^{bc}	0.13±0.01 ^c	**	-	*	*
Left half carcass weight (kg)	6.67±0.24 ^b	6.98±0.29 ^{ab}	6.91±0.14 ^{ab}	7.40±0.26 ^a	6.39±0.08 ^b	6.91±0.10 ^{ab}	*	-	*	*
Long leg weight (kg)	1.96±0.05 ^{bc}	2.11±0.12 ^{abc}	2.19±0.06 ^a	2.16±0.06 ^{ab}	1.93±0.04 ^c	2.09±0.04 ^{abc}	*	*	*	*
Shoulder weight (kg)	1.31±0.05 ^{ab}	1.38±0.04 ^{ab}	1.40±0.03 ^a	1.40±0.04 ^a	1.27±0.02 ^b	1.38±0.04 ^{ab}	*	-	*	*
Back-loin weight (kg)	1.72±0.11	1.77±0.10	1.75±0.09	1.84±0.10	1.57±0.09	1.69±0.07	-	-	-	-
Neck weight (kg)	0.64±0.06	0.69±0.05	0.71±0.07	0.75±0.10	0.63±0.05	0.77±0.06	-	-	-	-
Flank weight (kg)	0.57±0.05	0.54±0.04	0.56±0.02	0.54±0.03	0.54±0.03	0.55±0.04	-	-	-	-

^{a,b,c}: The means indicated with different letters in the same row are significantly different; * P<0.05; ** P<0.01; -: not significant, Values are expressed as mean ± standard deviation.

Discussion and Conclusion

In goat breeding enterprises, it is possible to produce economical meat by subjecting the surplus male and female goats born every year to short-medium-term intensive fattening (Karadağ and Köycü, 2011). Fattening is a part of herd management and is an economic activity that makes up the majority of the income especially in sheep and goat breeding and aims to provide the highest meat production in the shortest time with the least expense (Karabacak et al., 2019). In order to increase the profitability of fattening, it is necessary to conduct research on feeding methods in addition to selection applied for appropriate carcass development. Fattening performance is determined according to daily body weight gain and feed efficiency. When the data obtained from the present study were evaluated, it was observed that the values of Saanen × Hair goat (G₁) crossbred kids in terms of average live weight levels in various periods of the feeding were higher than the values of Hair goat kids, and these differences were significant (P<0.05). However, when compared in terms of live weight at the end of fattening and total live weight gain during fattening, no statistically significant difference was found between the groups. In terms of fattening starting weight, the Saanen × Hair goat (G₁) crossbred kids started fattening at an average live weight of about 2 kg higher than the Hair goat kids, but the difference narrowed in the later stages of the fattening. The results obtained are in agreement with those of similar studies (Sarçiçek, 2007; Atay et al., 2010; Karadağ and Köycü 2011). Serious

decreases in daily body weight gains were observed after day 126 of feeding. These decreases are likely to be due to the increase in temperature. Animals are adversely affected by high temperatures.

Feed consumption is one of the most important input factors in animal husbandry (Çiçek et al., 2010; Tüzemen, 2018). When the concentrate feed consumed by the groups for 1 kg live weight gain was examined, it was determined that the Saanen × Hair goat (G₁) crossbred kids in the intensive breeding group had the lowest value. The fact that the intensive group consumed less concentrated feed in both genotypes compared to the semi-intensive group indicates that the animals found their environment strange and were stressed. This situation increased the feed waste of the animals in the intensive group and caused them to fall behind the semi-intensive group in terms of body weight. It also caused the feed intake to be higher in the intensive group than in the semi-intensive group. The daily concentrate consumption results obtained in the present study are in agreement with the results of similar studies conducted on kids (Atay et al., 2010; Karadağ and Köycü, 2011).

The basic principle in animal husbandry is to increase the productivity per individual. However, production costs should also be minimized in order to increase operating profitability in addition to increasing efficiency. In addition, as well as the fattening system, the fattening period should be economically rational in order to achieve

the profitability of the enterprise (Güneş et al., 2001; Elmalı et al., 2010). When the results obtained regarding the optimum feeding time are evaluated, the optimum time determined in semi-intensive fattening was found to be more usable in terms of total concentrate feed consumption for both genotypes. In our study, the results obtained for optimum feeding times obtained according to different feeding systems are in accordance with the literature (Aydın et al., 2014).

When a quality carcass is mentioned, it is understood that the ratio of quality meat in the total carcass weight is high, the ratio of fat and bone is low, and the nutritional value and taste of the meat are good (Akman et al., 2001). When the results of the slaughter and carcass characteristics were evaluated, the extensive fattening group Saanen × Hair goat (G_1) crossbred kids had higher values than the other groups for head weight, the semi-intensive fattening group Hair goats had higher values for skin weight, the intensive fattening group Saanen × Hair goat (G_1) crossbred kids had higher averages than the other groups for internal fat, and the semi-intensive Saanen × Hair goat (G_1) crossbred kids had higher values for lung, heart, and liver weight. There are reports that fat is higher in goats fattened with mixed feed and that the shares of skin and lung, heart, and liver weight are low in goats fattened in pastures (Aydın and Arık, 1999; Daşkıran et al., 2006).

When the data obtained were examined, it was determined that the semi-intensive breeding group Saanen × Hair goat (G_1) crossbred kids had higher live weight and slaughter averages than the other groups. The intensive fattening group Hair goat kids had higher weight of kidneys and renal fat than the other groups. The semi-intensive fattening group Hair goats, on the other hand, had a higher average of long leg and shoulder weight compared to the other groups. The highest hot carcass yield was obtained in the Saanen × Hair goat (G_1) kids in the semi-intensive group. The higher body weight of goats in the semi-intensive group compared to the other groups supports this result. Slaughter and carcass characteristics may vary depending on the feed. Production systems in sheep and goat husbandry are of great importance in terms of both product quantity and quality and production economy (Yakan et al., 2016). Similar studies on Hair goat and Saanen × Hair goat (G_1) kids support the result of our study, and it has been reported that there is no statistically significant difference between genotypes in terms of carcass characteristics (Şimşek and Bayraktar, 2007, Yalçın et al., 2012; Gökdağ et al., 2013).

When the results of this study are evaluated as a whole, it can be suggested that breeders use semi-intensive fattening rather than intensive fattening in their fattening applications and Hair goat kids fattening ability is better than that of Saanen × Hair goat (G_1) kids. However, more research is needed in this area, and it should be ensured that the yields of crossbred genotypes are better demonstrated with similar studies.

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