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Growth, fattening performance, and carcass characteristics of Saanen, Turkish Hair × Saanen, and Honamlı × Saanen crossbred kids

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Abstract: The study was carried out to investigate the possibilities of obtaining slaughtered kids using indigenous breeds in Saanen flocks, which does not require breeding. The birth weights were 3.22 kg, 3.05 kg, and 3.18 kg for the Saanen, Turkish Hair × Saanen (F_1), and Honamlı × Saanen (F_1) crossbred kids, respectively. The mean live weight values of the same genotypes at the end of fattening (146th day) were determined as 25.96 kg, 27.11 kg, and 29.57 kg for the male kids, respectively. The cold carcass weights and dressing percentage (%) of the same genotypes were determined to be 10.95 kg, 12.40 kg, and 13.21 kg and 43.59%, 44.43%, and 44.48%, respectively for the male kids. *M. Longissimus dorsi* (MLD) cross-sectional areas were 9.42 cm^2, 9.94 cm^2, and 11.44 cm^2 for the genotypes among the examined factors, which was statistically significant ($P < 0.05$). It might be thought that the study was important as it was among the first studies on the use of different genotypes as a sire line on the Saanen goats. The study also focused on a rarely tried pattern of commercial crossbreeding and kid production in a time when the Saanen farms do not need to breed kids. This attempt was a new concept for Saanen rearing.

Key words: Crossbreeding, goat, Saanen, Turkish Hair, Honamlı, performance

1. Introduction

The meat yield of goats, which are important means of livelihood for people living in rural areas, is quite important as well as their milk yield. As in other farm animals, when it comes to the meat yield of goats, generally the carcass amount obtained from animals comes to mind. Meat production from animals is based on revealing the carcass characteristics of animals reaching slaughter maturity through care and feeding methods applied by concentrating on the growth traits of kids [1]. Goat meat consumption has significantly increased across the world within the last 20 years [2]. This is because goat meat has taken its place in supermarkets for consumption [3].

Kid sale takes the first place among the income earned in goat breeding [4]. It is quite important that kids reared for meat production suckle their mothers and, therefore, they are fed adequately in the suckling period. Thus, kids are adapted more rapidly to forage consumption and environmental factors and they grow rapidly [5]. In order to have kids survive and thus have low mortality levels in flocks, it is required to regularly perform care-feeding and health controls for kids [6].

Goat breeding is performed rather in regions in and around forests in addition to areas with unsuitable land conditions that are inconvenient for crop and livestock farming in Turkey, which is the primary one among the leading countries of the 20th century in sheep and goat breeding [7]. Besides, there has been an increasing interest in milk goat breeding in recent years in Turkey, and for this purpose, farmers have started to breed the Saanen goats in a wide scale under intensive conditions in many regions across the world. Besides, as in America and Europe, one of the most important problems encountered in milk goat breeding in Turkey especially in recent years is the situation of male kids, corresponding to 50% of the kids born each year, and female kids without breeding characteristics.

Every country, every region, and even every sector should be in search concerning its own animal breeding field and continuously produce new alternatives and

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applications. In order to create an alternative solution to the serious problem related to the usage of male kids born in milk goat farms, obtaining meat may be preferred with certain periods by performing several applications without deteriorating the presence of breeding animals.

This alternatively designed study was conducted to determine the growth, fattening performance, and slaughter and carcass characteristics of kids obtained as a result of the crossbreeding of indigenous breeds (Honamlı and Turkish Hair) with the Saanen goats.

2. Materials and methods

2.1. The study area, animals, and data collection

This study was conducted in a private Saanen goat farm in Elmalı District of Antalya Province located in the Mediterranean region of Turkey. In the study, three groups were formed: Saanen, Turkish Hair × Saanen (F_1), and Honamlı × Saanen (F_1). The birth weights of the kids were weighed using a scale with 50-g precision in 2–3 h after birth. The kids in 3 groups were kept under the same care-feeding conditions in the same environment. A total of 63 Saanen, Turkish Hair × Saanen (F_1), and Honamlı × Saanen (F_1) crossbred kids were fattened for 56 days after weaning (on the 90th day) (15 days of adaptation to feed). The animals were fed with concentrated feed (crude protein: 15.5%, crude oil: 3.7%, crude cellulose: 8.9%, crude Ash: 5.9%) and qualified roughage (alfalfa bale and vetch bale) ad libitum during the fattening period. The Saanen, Turkish Hair × Saanen, and Honamlı × Saanen crossbred male kids (totally 35) and the Turkish Hair × Saanen and Honamlı × Saanen (F_1) crossbred female kids (totally 28) were slaughtered after the fattening period in order to examine the carcass characteristics.

The Saanen female kids were not slaughtered as they were considered as breeding materials. The live weights of the kids were determined before the slaughter and hot carcass performance were calculated based on live weight before the slaughter. After these measurements, the carcasses were chilled at 4 °C for 24 h. At the end of this process, cold carcass weights were determined.

Some cold carcass traits were determined based on their live weight values before the slaughter, and the chilling loss occurring during the waiting period was also calculated. Additionally, some carcass measurements including the carcass length and the chest girth were carried out, which is compatible with the reports by Fisher and De Boer [8] and Caneque et al. [9].

After the carcass measurements, the slaughter started and then the chilled carcasses were split into left and right halves along the vertebral column. While weighing the carcass parts, the left half carcass was separated into a total of five parts including neck, flank, ribs, shoulder, and long leg in accordance with the manner reported by Colomer-Rocher et al. [10]. The weight of each part was recorded. Also, the region between the 12th and13th ribs was used to determine the *M. Longissimus dorsi* (MLD) cross-sectional area. The MLD cross-sectional area was drawn on a tracing paper, as stated by Akbas [11], and transferred into a computer by scanning. Then, the MLD cross-sectional area was determined using AutoCAD [12] drawing software. The backfat thickness was measured and calculated by using a digital caliper in the same cross-section.

Approval was received from Burdur Mehmet Akif Ersoy University Local Ethics Committee on Animal Experiments (Decision no: MAKÜ-HADYEK/2014/14-89) before conducting the study.

2.2. Statistical analysis

In the statistical comparison of the data, Minitab Statistical Software version 16.1 was used. A statistical model with the fixed effects (genotype, sex, birth type, and dam's age) was used to determine the least-square means of the examined traits. The effects of factors with their interactions on growth, fattening, and carcass traits were analyzed by using a generalized linear model (GLM) procedure. Additionally, the Tukey test was employed to control the significance of differences between subgroups ($P < 0.05$). When the dual interactions between the groups were examined, the interaction analyses were not performed since no statistical significance was found.

3. Results

3.1. Growth characteristics of kids

Table 1 shows the growth characteristics of the Saanen, Turkish Hair × Saanen (F_1), and Honamlı × Saanen (F_1) crossbred kids. Based on the genotype, the birth weights of the Saanen, Turkish Hair × Saanen (F_1), and Honamlı × Saanen (F_1) kids were determined to be 3.22 kg, 3.05 kg, and 3.18 kg, respectively. The differences among the genotypes were statistically significant ($P < 0.05$). Additionally, the effect of sex, birth type, and dam's age on the birth weight was significant ($P < 0.05$). The live weights of the Saanen, Turkish Hair × Saanen (F_1), and Honamlı × Saanen (F_1) kids on the 150th day were 19.49 kg, 21.89 kg, and 22.95 kg, respectively ($P < 0.05$).

3.2. Fattening performance of kids

The fattening performances of the Saanen, Turkish Hair × Saanen (F_1), and Honamlı × Saanen (F_1) male kids and the Turkish Hair × Saanen (F_1) and Honamlı × Saanen (F_1) female kids were examined (Table 2). The mean live weights of female kids at the beginning (90th day) and end (146th day) of the fattening period were 14.84 kg and 15.79 kg and 21.85 kg and 24.40 kg for Turkish Hair × Saanen (F_1) and Honamlı × Saanen (F_1), respectively. The aforementioned values were 15.95 kg, 17 kg, and 18.10 kg

Table 1. The least squares for the effects of genotype, dam age, sex, and birth type on growth characteristics of Saanen, Turkish Hair × Saanen (F_1), and Honamlı × Saanen (F_1) kids (kg) ($\bar{x}\pm s_{\bar{x}}$).

	n	Birth Weight	n	30th day	n	60th day	n	90th day	n	120th day	n	150th day
Genotype Saanen	85	3.22± 0.074 [a]	50	7.83± 0.194	50	12.33±0.377	50	14.45±0.431 [b]	50	15.08±0.664 [b]	50	19.49±0.844 [b]
H × S (F_1)	99	3.05± 0.061 [c]	71	7.82±0.166	71	12.31±0.331	71	12.98±0.384 [a,b]	71	16.95±0.582 [a]	71	21.89±0.745 [a]
Ho × S (F_1)	97	3.18±0.072 [b]	68	8.23±0.163	68	13.14±0.320	68	15.61±0.373 [a]	68	17.56±0.574 [a]	68	22.95±0.720 [a]
P		*		-		-		*		*		*
Sex												
Male	141	3.32±0.061	99	8.40±0.155	99	13.48±0.296	99	15.71±0.354	99	17.45±0.530	99	23.15±0.684
Female	140	2.98±0.063	90	7.52±0.136	90	11.71±0.292	90	14.32±0.340	90	15.61±0.516	90	19.81±0.657
P		*		*		*		-		*		*
Birth type												
Single	48	3.47±0.081 [a]	31	8.07±0.206	31	12.81±0.407	31	16.01±0.461	31	16.93±0.713	31	22.34±0.904
Twin	199	3.19±0.052 [b]	134	7.98±0.134	134	12.64±0.264	134	14.73±0.307	134	16.43±0.466	134	21.29±0.587
Multiple	34	2.79±0.112 [c]	24	7.83±0.256	24	12.33±0.534	24	14.29±0.613	24	16.23±0.944	24	20.76±1.187
P-value		*		-		-		-		-		-
Dam age												
1	21	2.61±0.132 [c]	11	8.17±0.371	11	13.02±0.752	11	13.60±0.862 [b]	11	15.02±1.323 [ab]	11	19.52±1.681 [b]
2	124	3.18±0.066 [b]	81	7.58±0.164	81	11.83±0.320	81	14.46±0.374 [b]	81	16.05±0.570 [b]	81	20.98±0.723 [b]
3	47	3.37±0.087 [ab]	33	8.06±0.206	33	12.82±0.406	33	15.84±0.464 [ab]	33	16.97±0.713 [ab]	33	22.08±0.914 [ab]
4	89	3.45±0.073 [a]	64	8.02±0.157	64	12.70±0.313	64	16.15±0.353 [a]	64	18.08±0.542 [a]	64	23.34±0.684 [a]
P		*		-		-		*		*		*

[a,b,c] Values in the same column with different superscripts are statistically different (*: P < 0.05). -: nonsignificant (P > 0.05).
H × S: Turkish Hair × Saanen, Ho × S: Honamlı × Saanen, $\bar{x}$: mean values, $s_{\bar{x}}$: standard error of means.

Table 2. Fattening performance of Saanen, Turkish Hair × Saanen (F_1), Honamlı × Saanen (F_1) male kids, and Hair × Saanen (F_1), Honamlı × Saanen (F_1) female kids (kg) ($\bar{x}\pm s_{\bar{x}}$).

	n		Birth weight		90th day weight (initial)		146th day weight (final)	
	F	M	F	M	F	M	F	M
Genotype Saanen	-	10	-	3.93±0.289	-	15.95±0.701 [b]	-	25.96±0.933 [b]
H × S (F_1)	13	11	3.57±0.158	3.44±0.282	14.84±0.720	17.00±0.673 [ab]	21.85±0.972	27.11±0.890 [ab]
Ho × S (F_1)	15	14	3.40±0.123	3.52±0.235	15.79±0.549	18.10±0.548 [a]	24.40±0.824	29.57±0.726 [a]
P-value			NS	NS	NS	*	*	*
Birth type								
Single	10	16	3.68±0.169	3.91±0.264	15.67±0.760	18.51±0.612	23.18±0.926	29.36±0.813
Twin	18	19	3.29±0.113	3.34±0.217	14.95±0.503	15.52±0.554	22.07±0.881	25.35±0.727
P-value			NS	NS	NS	*	NS	*
Dam age								
2	13	9	3.09±0.121 [b]	3.53±0.239	15.50±0.567	15.93±0.573	22.91±0.673	25.78±0.761 [b]
3	4	8	4.03±0.258 [a]	4.11±0.252	15.27±0.850	17.22±0.612	22.93±1.024	27.48±0.813 [ab]
4	11	18	3.34±0.133 [b]	3.88±0.173	15.16±0.614	18.61±0.388	22.19±0.626	28.81±0.534 [a]
P-value			*	NS	NS	NS	NS	*

[a,b] Values in the same column with different superscripts are statistically different (*: P < 0.05, NS: nonsignificant). F: female, M: male
H × S: Turkish Hair × Saanen, Ho × S: Honamlı × Saanen, $\bar{x}$: mean values, $s_{\bar{x}}$: standard error of means.

and 25.96 kg, 27.11 kg, and 29.57 kg, respectively, for the male kids for the genotypes. The effect of birth type and dam's age on the mean live weight of the male kids at the end of fattening (146th day) was statistically significant ($P < 0.05$). This effect was statistically nonsignificant ($P > 0.05$) for the female kids.

3.3. Slaughter and carcass characteristics of male kids

Tables 3–5 show the slaughter and carcass characteristics of 35 male kids in the study. The live weights of the male kids before the slaughter were 25.38 kg, 26.63 kg, and 28.63 kg, respectively, for the Saanen, Turkish Hair × Saanen (F_1), and Honamlı × Saanen (F_1) crossbreds kids. The hot dressing percentage values of the kids were 45.41%, 45.36%, and 45.65%, respectively. The differences between the genotypes were statistically nonsignificant ($P > 0.05$). A similar condition was also valid for the dam's age and birth type ($P > 0.05$). The hot carcass performances of the single kids were relatively higher compared to the twin kids (45.81%), but it was statistically nonsignificant ($P > 0.05$).

In the study, the cold carcasses and the cold dressing percentages were determined to be 10.95 kg, 12.40 kg, and 13.21 kg and 43.59%, 44.43%, and 44.48% for the Saanen, Turkish Hair × Saanen (F_1), and Honamlı × Saanen (F_1) crossbred male kids, respectively. The *M. Longissimus dorsi* (MLD) cross-sectional areas were 9.42 cm^2, 9.94 cm^2, and 11.44 cm^2 for the genotypes. The effect of genotype, dam's age, and birth type was statistically significant ($P < 0.05$). The carcass length and chest girth of the single male kids were higher compared to the twin male kids ($P < 0.05$). In the study, the effect of genotype, dam's age, and birth type on carcass part ratios and out-of-carcass part ratios (except for intestines) was statistically nonsignificant ($P > 0.05$).

3.4. Slaughter and carcass characteristics of female kids

Tables 6–8 show the slaughter and carcass characteristics of the Turkish Hair × Saanen (F_1) and Honamlı × Saanen (F_1) crossbred female kids. The mean live weights before the slaughter and hot carcass weights of the female kids were determined to be 21.22 kg and 23.86 kg, and 9.48 kg and 10.80 kg, respectively ($P < 0.05$). The hot dressing percentages were 45.10% and 44.57%, respectively, for the Honamlı × Saanen (F_1) and Turkish Hair × Saanen (F_1) crossbred female kids ($P > 0.05$).

In the study, the *M. Longissimus dorsi* (MLD) cross-sectional areas were determined to be 10.17 cm^2 and 8.84 cm^2, respectively, for the Honamlı × Saanen (F_1) and Turkish Hair × Saanen (F_1) crossbred female kids ($P > 0.05$). The backfat thickness and the carcass length were determined to be 0.50 mm and 0.44 mm, and 71.89 cm and 68.02 cm, respectively, for the same genotypes ($P > 0.05$).

4. Discussion

The birth weights determined for the Saanen, Turkish Hair × Saanen (F_1), and Honamlı × Saanen (F_1) crossbred kids in the present study were higher compared to the studies [14,15], which report different birth weights for similar genotypes, and these values of this study were lower in terms of the mean live weight at the age of the 60th and 90th days. In a study conducted on the Saanen and Saanen × Turkish Hair goat (F_1) crossbred kids reared under breeder conditions [16], it was determined that the birth weights of kids were 4.04 kg and 4.08 kg, respectively, and in a study conducted on the Honamlı goats reared under breeder conditions, the mean birth weight was found to be 4.2 kg in the male kids and 3.7 kg in the female kids [17]. In the present study, it was determined that when the mean live weights on the 150th

Table 3. Some slaughter and carcass characteristics of Saanen, Turkish Hair × Saanen (F_1), and Honamlı × Saanen (F_1) male kids ($\bar{x}\pm s_{\bar{x}}$).

Traits	Genotype				Dam age				Birth type		
	Saanen	H × S (F_1)	Ho × S (F_1)	P	2 years old	3 years old	4 years old	P	Single	Twin	P
Slaughter weight (kg)	25.38±0.751^b	26.63±0.610^b	28.63±0.552^a	*	25.58±0.692^b	27.38±0.881^{ab}	28.41±0.561^a	*	28.40±0.651	25.36±0.532	*
Hot carcass weight (kg)	11.55±0.287^b	12.89±0.362^b	13.47±0.538^a	*	11.47±0.263^b	12.52±0.305^{ab}	13.22±0.283^a	*	13.43±0.336	11.44±0.285	*
Dressing percentage (%)	45.41±0.434	45.36±0.347	45.65±0.273	-	44.66±0.422	45.62±0.353	46.22±0.366	-	45.86±0.463	45.14±0.367	-
Head weight (g)	1713±62.204^b	1869±33.401^a	1919±42.102^a	*	1711±22.428^b	1881±33.308^a	1908±40.202^a	*	1940±30.342	1727±42.670	*
4 Feet weight (g)	743±22.618	761±16.823	817±15.104	-	731±14.904	795±21.16	796±13.557	-	831±18.210	717±25.313	*
Skin weight (g)	1861±61.901^b	2316±63.451^a	2410±58.242^a	*	2050±57.807	2205±45.902	2333±53.488	-	2420±53.207	1962±50.324	*
Visceral organs weight (g)	1322±29.305^{ab}	1233±31.036^b	1419±43.229^a	*	1285±33.452	1306±37.101	1383±30.423	-	1369±35.203	1281±28.518	-
Omental-mesenteric fats weight (g)	186.10±15.202	229.02±18.504	223.90±20.215	-	187.23±22.204	208.76±28.203	243.02±18.140	-	252.27±19.152	173.74±14.621	*

^{a,b}: Values in the same line with different superscripts are statistically different (*: $P < 0.05$). -: nonsignificant ($P > 0.05$).
H × S: Turkish Hair × Saanen, Ho × S: Honamlı × Saanen, $\bar{x}$: mean values, $s_{\bar{x}}$: standard error of means.

Table 4. Some cold carcass characteristics of Saanen, Turkish Hair × Saanen (F_1), and Honamlı × Saanen (F_1) male kids ($\bar{x}\pm s_{\bar{x}}$).

Traits	Genotype				Dam age				Birth type		
	Saanen	H × S (F_1)	Ho × S (F_1)	P	2 years old	3 years old	4 years old	P	Single	Twin	P
Cold carcass weight (kg)	10.95±0.412^{b}	12.40±0.283^{b}	13.21±0.313^{a}	*	11.14±0.350^{b}	12.14±0.431^{a}	11.68±0.482^{ab}	*	13.04±0.260	11.09±0.332	*
Chilling loss (%)	3.25±0.053^{a}	2.08±0.067^{b}	2.38±0.057^{b}	*	2.45±0.046	2.74±0.021	2.52±0.047	-	2.67±0.042	2.47±0.053	-
Dressing percentage (%)	43.59±0.387	44.43±0.332	44.48±0.441	-	43.45±0.381	44.33±0.515	44.74±0.403	-	44.48±0.308	43.86±0.401	-
Right half of carcass weight (kg)	5.48±0.154^{b}	6.01±0.204^{ab}	6.52±0.273^{a}	*	5.66±0.187^{b}	6.08±0.203^{ab}	6.38±0.227^{a}	*	6.54±0.116	5.54±0.178	*
Left half of carcass weight (kg)	5.58±0.137^{b}	5.96±0.257^{ab}	6.53±0.146^{a}	*	5.48±0.179^{b}	6.05±0.224^{ab}	6.53±0.159^{a}	*	6.51±0.162	5.39±0.132	*
Shoulder weight (g)	1183±29.211^{b}	1232±32.610^{ab}	1339±54.110^{a}	*	1148±36.821^{b}	1280±46.331^{ab}	1326±29.634^{a}	*	1353±28.014	1150±34.114	*
Flank weight (g)	776±26.124	765±29.015	868±40.276	-	743±33.407^{b}	779±42.110^{ab}	886±28.349^{a}	*	880±29.238	725±31.500	*
Neck weight (g)	605±18.414	685±30.127	707±28.237	-	601±20.129	714±30.224	704±19.337	-	727±20.617	608±18.903	-
Ribs weight (g)	1341.1±32.103^{b}	1467±28.310^{ab}	1495.2±24.901^{a}	*	1382.2±26.501^{b}	1425.9±30.901^{ab}	1597.1±40.31^{a}	*	1414.2±30.11	1524.3±34.50	*
Sirloin weight (g)	930±23.401^{b}	1058±29.101^{ab}	1059±38.024^{a}	*	968±18.704^{b}	1038±20.301^{ab}	1141±24.221^{a}	*	1131±32.404	968±18.144	*
Loin weight (g)	413±21.024	409±15.320	436±18.217	-	414±14.014	388±13.178	456±16.107	-	446±10.282	393±16.563	-
Long leg weight (g)	1689±40.447^{b}	1810±52.178^{b}	2040±44.728^{a}	*	1645±38.304^{b}	1858±55.110^{ab}	2036±40.510^{a}	*	1990±28.321	1703±40.247	*
Back fat thickness (mm)	0.55±0.023	0.53±0.034	0.56±0.019	-	0.47±0.032	0.59±0.014	0.58±0.045	-	0.56±0.019	0.53±0.042	-
M. Longissimus dorsi area (cm^2)	9.42±0.268^{b}	9.94±0.228^{b}	11.44±0.147^{a}	*	9.80±0.191^{b}	10.37±0.251^{ab}	10.63±0.152^{a}	*	10.85±0.157	9.68±0.239	*
Carcass length (cm)	74.99±0.724^{ab}	73.18±0.676^{b}	76.67±0.537^{a}	*	73.36±0.563^{b}	74.87±0.683^{ab}	76.60±0.861^{a}	*	76.30±0.287	73.59±0.452	*
Carcass chest girth (cm)	64.27±0.519	65.07±0.568	64.16±0.622	-	63.11±0.642^{b}	64.19±0.574^{a}	66.19±0.710^{a}	*	65.69±0.489	63.30±0.510	*

^{a,b}: Values in the same line with different superscripts are statistically different (*: $P < 0.05$). -: nonsignificant ($P > 0.05$).
H × S: Turkish Hair × Saanen, Ho × S: Honamlı × Saanen, $\bar{x}$: mean values, $s_{\bar{x}}$: standard error of means.

Table 5. Percentages of the valuable parts and noncarcass components in Saanen, Turkish Hair × Saanen (F_1), and Honamlı × Saanen (F_1) male kids ($\bar{x}\pm s_{\bar{x}}$).

Traits	Genotype				Dam age				Birth type		
	Saanen	H × S (F_1)	Ho × S (F_1)	P	2 years old	3 years old	4 years old	P	Single	Twin	P
Percentages of carcass components											
Shoulder (%)	21.21±0.339	20.63±0.204	20.60±0.182	-	21.01±0.232	21.14±0.292	20.28±0.183	-	20.82±0.384	20.80±0.273	-
Flank (%)	13.83±0.242	12.86±0.178	13.20±0.266	-	13.49±0.171	12.82±0.260	13.58±0.301	-	13.50±0.187	13.10±0.219	-
Neck (%)	10.60±0.257	11.48±0.176	11.02±0.370	-	10.60±0.279	10.84±0.213	10.67±0.354	-	11.15±0.322	10.92±0.287	-
Ribs (%)	24.00±0.323	24.64±0.213	24.42±0.177	-	25.12±0.224	23.47±0.254	24.48±0.213	-	24.53±0.224	24.18±0.362	-
Sirloin (%)	16.57±0.234	17.74±0.345	17.76±0.186	-	17.57±0.313	17.00±0.266	17.51±0.247	-	17.41±0.243	17.31±0.270	-
Loin (%)	7.42±0.113	6.68±0.204	6.68±0.164	-	7.57±0.170	6.47±0.224	6.49±0.266	-	7.12±0.130	6.86±0.176	-
Long Leg (%)	30.36±0.377	30.38±0.250	31.20±0.280	-	30.15±0.288	30.79±0.315	31.11±0.257	-	30.78±0.225	30.52±0.282	-
Percentages of noncarcass components											
Head (%)	6.72±0.062	6.92±0.104	6.52±0.091	-	6.64±0.071	6.87±0.062	6.65±0.104	-	6.80±0.054	6.64±0.094	-
4 Feet (%)	2.92±0.023	2.82±0.042	2.77±0.045	-	2.83±0.034	2.91±0.072	2.76±0.039	-	2.84±0.046	2.83±0.076	-
Skin (%)	7.31±0.164	8.54±0.201	8.16±0.132	-	7.92±0.208	7.99±0.173	8.11±0.104	-	8.27±0.158	7.74±0.114	-
Visceral organs (%)	5.19±0.101^{a}	4.56±0.113^{b}	4.81±0.074^{b}	*	4.98±0.071	4.77±0.104	4.81±0.092	-	5.04±0.103	4.67±0.120	*
Omental mesenteric fats (%)	0.73±0.056	0.83±0.092	0.74±0.053	-	0.73±0.045	0.74±0.081	0.83±0.115	-	0.85±0.074	0.68±0.093	-

^{a,b}: Values in the same line with different superscripts are statistically different (*: $P < 0.05$). -: nonsignificant ($P > 0.05$).
H × S: Turkish Hair × Saanen, Ho × S: Honamlı × Saanen, $\bar{x}$: mean values, $s_{\bar{x}}$: standard error of means.

day were compared between the genotypes, the Honamlı × Saanen (F_1) crossbred kids were approximately 3.5 kg heavier than the Saanen kids and 1 kg heavier than the Turkish Hair × Saanen (F_1) crossbred kids. In addition, it was generally detected that the male kids were heavier than the female kids. The single kids were also heavier than the twin kids and both the birth weights and the live weights on the 150th day were higher as the dam's age increased.

Table 6. Some slaughter and carcass characteristics of Turkish Hair × Saanen (F_1), and Honamlı × Saanen (F_1) female kids ($\bar{x}\pm s_{\bar{x}}$).

Traits	Genotype			Dam age				Birth type		
	H × S (F_1)	Ho × S (F_1)	P	2 years old	3 years old	4 years old	P	Single	Twin	P
Slaughter weight (kg)	21.22±0.322	23.86±0.252	*	22.24±0.513	22.87±0.452	22.51±0.612	-	22.56±0.502	22.52±0.404	-
Hot carcass weight (kg)	9.48±0.233	10.80±0.403	*	9.90±0.187	10.05±0.313	10.48±0.234	-	10.26±0.286	10.03±0.032	-
Dressing percentage (%)	44.57±0.317	45.10±0.279	-	45.05±0.420	44.87±0.279	45.58±0.287	-	45.33±0.377	44.35±0.276	-
Head weight (g)	1388±34.304	1473±32.802	-	1398±26.131	1473±30.114	1420±30.176	-	1461±28.142	1400±32.280	-
4 Feet weight (g)	593±10.272	634±11.094	-	590±11.703	680±20.236	642±15.275	-	616±12.231	611±20.272	-
Skin weight (g)	1749±43.287	1819±48.131	-	1748±43.512	1840±43.601	1758±46.371	-	1822±43.110	1745±40.223	-
Visceral organs weight (g)	1088±21.023	1194±23.166		1070±27.617	1233±27.402	1120±26.322	-	1170±25.503	1112±24.366	-
Omental-mesenteric fats weight (g)	1 77.98±14.450	275.82±18.310	*	225.63±18.501	194.37±23.304	240.70±16.263	-	228.01±14.051	205.22±13.487	-

*: P < 0.05. -: nonsignificant (P > 0.05). H × S: Turkish Hair × Saanen, Ho × S: Honamlı × Saanen, $\bar{x}$: mean values, $s_{\bar{x}}$: standard error of means.

Table 7. Some cold carcass characteristics of Turkish Hair × Saanen (F_1) and Honamlı × Saanen (F_1) female kids ($\bar{x}\pm s_{\bar{x}}$).

Traits	Genotype			Dam age				Birth type		
	H × S (F_1)	Ho × S (F_1)	P	2 years old	3 years old	4 years old	P	Single	Twin	P
Cold carcass weight (kg)	9.18±0.187	10.53±0.204	*	9.64±0.234	9.72±0.342	10.21±0.341	-	9.98±0.201	9.73±0.131	-
Chilling loss (%)	2.50±0.056	2.67±0.053	-	2.30±0.033	2.20±0.043	2.26±0.064	-	2.33±0.039	2.17±0.053	-
Dressing percentage (%)	43.36±0.232	43.96±0.234	-	43.99±0.219	42.85±0.338	44.40±0.278	-	44.13±0.187	43.19±0.264	-
Right half of carcass weight (kg)	4.61±0.177	5.30±0.214	*	4.94±0.167	4.90±0.206	5.02±0.186	-	5.04±0.123	4.87±0.162	-
Left half of carcass weight (kg)	4.69±0.140	5.27±0.152	*	4.79±0.123	4.96±0.242	5.19±0.167	-	4.99±0.145	4.97±0.170	-
Shoulder weight (g)	930±29.551	1068±48.114	*	972±29.804	1003±50.114	1033±25.910	-	995±26.024	1010±35.114	-
Flank weight (g)	605±28.034	663±38.238	-	603±28.337	644±36.117	655±29.128	-	656±27.534	613±30.335	-
Neck weight (g)	437±29.115	501±26.214		418±19.324	490±29.225	499±15.630	-	476±18.508	462±17.608	-
Ribs weight (g)	1178.2±26.104	1357.8±24.914	*	1205.1±24.601^b	1251.2±28.704^b	1348.2±35.312^a	*	1250.9±28.111	1284.1±26.52	-
Sirloin weight (g)	871±25.127	966±31.027	-	883±16.445	913±19.327	959±20.528	-	917±26.727	919±17.192	-
Loin weight (g)	307±14.129	392±17.624	*	322±12.103	338±11.162	389±13.204	-	324±10.531	365±14.543	-
Long leg weight (g)	1510±45.147	1689±46.414	*	1543±33.447	1577±52.112	1650±40.322	-	1616±25.343	1583±37.22	-
Back fat thickness (mm)	0.44±0.032	0.50±0.023	*	0.51±0.034	0.47±0.023	0.53±0.053	-	0.50±0.022	0.49±0.034	-
M. Longissimus dorsi area (cm^2)	8.87±0.205	10.17±0.126	*	9.44±0.139	9.46±0.188	9.61±0.156	-	9.70±0.167	9.31±0.208	-
Carcass length (cm)	68.02±0.530	71.89±0.470	*	68.86±0.435	70.39±0.572	70.50±0.842	-	70.41±0.220	69.49±0.421	-
Carcass chest girth (cm)	59.73±0.465	60.71±0.619	-	60.59±0.540	59.54±0.563	60.52±0.486	-	60.51±0.387	59.92±0.535	-

^{a,b}: Values in the same line with different superscripts are statistically different (*: P < 0.05). -: nonsignificant (P > 0.05).
H × S: Turkish Hair × Saanen, Ho × S: Honamlı × Saanen, $\bar{x}$: mean values, $s_{\bar{x}}$: standard error of means.

The hot carcass dressing percentages of the Saanen, Turkish Hair × Saanen, and Honamlı × Turkish Hair crossbred male kids were calculated based on the live weight before the slaughter (44.57% and 45.65%). These values found in the present study were lower compared to the values reported by Atay et al. [18] for the Turkish Hair goat kids, by Gökdal [19] for the Turkish Hair goat and the Saanen × Turkish Hair goat crossbred kids, and by Kor et al. [20] for the Saanen × Kilis crossbred kids. Also, the hot carcass values determined for the Honamlı × Saanen crossbred kids were relatively compatible with the values reported by Akbas [11] for the Honamlı × Turkish Hair goat crossbred kids. In the present study, the difference between the hot dressing percentages of the single and twin kids in both the slaughter groups (the male and female kids) was statistically nonsignificant (P > 0.05). Similarly, Todaro et al. [21] reported that there was no statistically significant difference between the single and twin kids in terms of performances.

The cold dressing percentage values determined in the present study (between 43.59% and 44.48% based on slaughter weight) were compatible with the values reported by Özcan et al. [22] and lower than the values reported by Bonvillani et al. [23].

It was observed in the present study that the differences between the genotypes for the hot and cold carcass weights

Table 8. Percentages of the valuable parts and noncarcass components in Turkish Hair × Saanen (F_1) and Honamlı × Saanen (F_1) female kids ($\bar{x}\pm s_{\bar{x}}$).

Traits				Dam age				Birth type		
	H × S (F_1)	Ho × S (F_1)	P	2 years old	3 years old	4 years old	P	Single	Twin	P
Percentages of carcass components										
Shoulder (%)	20.15±0.178	20.35±0.212	-	19.67±0.208	20.28±0.186	20.96±0.234	-	20.38±0.332	20.12±0.240	-
Flank (%)	12.54±0.157	12.76±0.169	-	12.47±0.135	12.70±0.243	12.78±0.193	-	12.90±0.163	12.41±0.202	-
Neck (%)	9.45±0.152	9.19±0.287	-	8.75±0.254	9.28±0.262	9.92±0.242	-	9.46±0.274	9.18±0.227	-
Ribs (%)	25.21±0.170	25.70±0.162	-	25.16±0.214	25.47±0.187	25.74±0.241	-	25.17±0.211	25.74±0.343	-
Sirloin (%)	18.18±0.323	18.60±0.240	-	18.28±0.276	18.25±0.292	18.63±0.238	-	18.44±0.216	18.33±0.181	-
Loin (%)	6.61±0.178	7.45±0.163	-	6.80±0.140	6.92±0.215	7.31±0.234	-	7.24±0.138	6.82±0.190	-
Long leg (%)	32.05±0.450	32.40±0.384	-	32.04±0.243	32.19±0.270	32.45±0.287	-	32.47±0.222	31.98±0.277	-
Percentages of noncarcass components										
Head (%)	6.14±0.101	6.55±0.071	*	6.29±0.056	6.42±0.082	6.32±0.112	-	6.48±0.053	6.21±0.073	-
4 Feet (%)	2.67±0.043	2.76±0.032	-	2.65±0.032	2.74±0.061	2.75±0.056		2.76±0.051	2.68±0.062	-
Skin (%)	8.20±0.215	7.64±0.173	*	7.89±0.206	7.93±0.135	7.94±0.173	-	8.17±0.144	7.76±0.131	-
Visceral organs (%)	4.99±0.146	5.01±0.094	-	4.69±0.074	4.99±0.109	5.21±0.085	-	5.08±0.113	4.92±0.160	-
Omental mesenteric fats (%)	0.65±0.038	0.98±0.085	*	0.97±0.023	0.81±0.092	0.99±0.104	-	0.99±0.071	0.89±0.095	

*: $P < 0.05$. -: nonsignificant ($P > 0.05$). H × S: Turkish Hair × Saanen, Ho × S: Honamlı × Saanen, $\bar{x}$: mean values, $s_{\bar{x}}$: standard error of means.

in the slaughter groups including the male and female kids were statistically significant ($P < 0.05$) and there was an opposite situation for the dressing percentages in terms of the aforementioned significance ($P > 0.05$). In parallel with the situation presented in the present study, Yılmaz et al. [24] did not determine a statistical difference between different genotypes in terms of hot dressing percentages and Koşum et al. [25] reported opposite situations.

No statistical significance was determined between the single and twin kids in both the slaughter groups (the male and female kids) in terms of the backfat thickness, which was important in determining the fat level of the carcass ($P > 0.05$) and it was observed that the Honamlı × Saanen crossbred kids had relatively higher backfat thickness compared to the other genotypes. However, the differences given above were statistically significant only in the female slaughter group ($P < 0.05$). The values determined in the present study (0.53 mm and 0.56 mm for the male kids) were higher compared to the values reported by Özcan et al. [22] and Yılmaz et al. [24] and lower than the values reported by Koyuncu et al. [26].

The highest values in terms of the *M. longissimus dorsi* (MLD) cross-sectional area, which provides information about the meat amount in the carcass, were found in the Honamlı × Saanen crossbred kids. In the present study, the effect of the genotype on the MLD cross-sectional area was found to be significant ($P < 0.05$) and this situation has also been reported by different studies [25,27]. In the present study, the MLD cross-sectional area (11.44 cm^2) determined for the Honamlı × Saanen crossbred male kids was rather compatible with the values reported by Akbas [11] for the Honamlı × Turkish Hair kids with similar preslaughter weights to the present study. The MLD cross-sectional area values determined for the Turkish Hair × Saanen crossbred male kids in the present study were lower than the values reported by Gökdal [19] for the Saanen × Turkish Hair goat crossbred kids and higher than the values reported by Yılmaz et al. [24] for the same genotypes. It is considered that the abovementioned situation may be due to the differences in the preslaughter live weights of the kids included in these studies.

In the present study, no statistical significance was determined between the genotypes in terms of the rates of carcass parts for both the male and female slaughter groups ($P > 0.05$). In parallel with the mentioned situation, Özcan et al. [22] found that breed or genotype had a nonsignificant effect on carcass part rates in kids. In addition, the shoulder (20.60% and 21.23%), rib (24% and 24.64%), and leg (30.36% and 31.20%) rates determined in the present study for the genotypes in the male kids were relatively lower than the reports by Akbas [11] for the same breed slaughtered with similar weights. Additionally, the values found in the present study were lower than the values reported by Bonvillani et al. [23] and Koşum et al. [25] and compatible with the reports by Atay et al. [18] and Kor et al. [20].

No statistical difference was found between the genotypes for the male kids for head and skin, which are among the noncarcass parts ($P > 0.05$) calculated in the present study; however, the situation was the opposite in

the female kids ($P < 0.05$). The values of head and skin rates calculated in the study were generally compatible with the values reported by many researchers [18,22,28] for different breeds.

In the present study, the carcass length values determined for the Saanen goat kids were higher compared to the values reported by Koşum et al. [25] for the Saanen kids and similar to the reports of Şimşek and Bayraktar [28] and Atay [29] for the Saanen × Turkish Hair crossbred kids with live weights before the slaughter.

Saanen rearing in Turkey is a part of the livestock sector based on intensive feeding. When the field is viewed from this aspect, especially Saanen male kids and nonbreeding female kids are not considered for alternative meat production because of their low growth performance and inadequate feed conversion efficiency for meat production. Each year, these kids, which emerge inevitably in the enterprise, constitute a serious problem. Therefore, the present study searched for some applicable solutions to this problem by endorsing a divergent crossbreeding method.

This study can be considered among the first studies on the usage of different genotypes as a sire line in Saanen flocks. It might also be considered as one of the initial alternative attempts for commercial crossbreeding and butchery kid production from Saanen farms. Surplus crossed male and female kids are the base of this production mechanism. This system can be applied in a farm at certain defined times when the enterprise does not need young breeding animals. Generally, it is also foreseen that the study results would provide a different approach for goat raising by intensive breeding and may present alternatives to the sector especially in terms of the product range.

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