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Short Communication / *Kısa Bilimsel Çalışma*

Determination of the reproductive characteristics of Saanen goats using estrus synchronization and the growth performances of kids

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Abstract: This study aimed to determine the reproductive characteristics of Saanen goats of Australian origin using an estrus synchronization program with hormones (MPA and PMSG) in two different mating periods (Period I and Period II) and to investigate the survival rates and growth performances of kids. According to the results of the research, it was determined that pregnancy rate and litter size were higher in the mating period I (87% and 2.16) compared to mating period II (80.5% and 2.03), and it is hypothesized that this situation is related to the length of dry period of the goats. Although the mortality rate ($P<0.001$), and body weight ($P<0.05$) at birth were affected by kidding season, the survival rate and their body weights of the Saanen-kids at days 30, 60, 90, and 120 were not affected by the kidding season ($P>0.05$). These results indicate that the kidding season should be an environmental factor to be taken into account when planning the production. In addition to this, it is important to optimize the care and management conditions, especially during the kidding season, due to the high multiple birth types for the estrus synchronization program in Saanen goats.
Keywords: Estrus synchronization, kidding season, mortality rate, Saanen goats.

Östrus senkronizasyonu uygulanan Saanen keçilerinde üreme özellikleri ve oğlaklarda büyüme özelliklerinin belirlenmesi

Özet: Bu araştırmanın amacı iki farklı çiftleştirme döneminde (Dönem I ve Dönem II) östrus senkronizasyon programı (MPA and PMSG) uygulanan Avusturalya orjinli Saanen keçilerinde üreme özellikleri, oğlaklarında yaşama gücü ve büyümenin belirlenmesidir. Araştırma sonuçlarına göre çiftleştirme dönemi I 'de elde edilen gebelik oranları ve bir doğuma oğlak sayısı (% 87 ve 2,16) çiftleştirme dönemi II 'ye (80,5% ve 2,03) göre daha yüksek olduğu tespit edilmiştir. Bu durumun keçilerin kuruda kalma süresi ile ilişkili olabileceği düşünülmektedir. Doğumdaki ölüm oranı ($P<0,001$) ve canlı ağırlık değerleri ($P<0,05$) oğlaklama döneminden etkilenmesine rağmen, oğlakların 30, 60, 90 ve 120. günlerdeki yaşama güçleri ve bu dönemlerdeki canlı ağırlıkları oğlaklama döneminden etkilenmemiştir ($P>0,05$). Bu sonuçlar, üretim planlaması yapılırken oğlaklama döneminin dikkate alınması gereken bir çevresel faktör olduğunu göstermektedir. Buna ek olarak, Saanen keçilerinde östrus senkronizasyon programı için çoklu doğum türlerinin yüksek olması nedeniyle özellikle çocukluk mevsiminde bakım ve yönetim koşullarının optimize edilmesi önemlidir.
Anahtar sözcükler: Oğlaklama dönemi, ölüm oranı, östrus senkronizasyonu, Saanen keçisi.

There are fewer goats than other farm animals in Turkey; however, the increasing demand for high-yield goat breeds has led to an increase in the number of goats in recent years (16, 18). Estrus synchronization with hormone applications in goat breedings a popular practice to ensure continuity in production, to increase the number of offspring, to reduce production costs such as care, feeding, and labor, and meeting the market demand for goat products at the appropriate time (2). In recent years, the Saanen goat has taken its place among the most preferred breeds in our country due to its high milk and fertility characteristics. For profitability and permanency in animal production, reproductive performance, survivability of the offspring and their growth characteristics should be evaluated together. No studies are evaluating the reproductive performance and offspring

yields of exotic goat breeds. This study aimed to determine the reproductive characteristics of Saanen goats of Australian origin using an estrus synchronization program with hormones in two different mating seasons and to investigate the survival rates and growth performances of kids. The Saanen goats had Australian origins and were certified as high-class dairy goats in this study. The study was carried out in a private enterprise located in the Bolvadin district of Afyonkarahisar province with a semi-humid steppe climate during the period from 2011 to 2013. In the research, the same animals were used in both mating seasons (mating period I and mating period II). The first mating period consisted of 100 randomly selected female goats, the youngest one was 18 months old. They are defined as the mating period I (mating in August 2011). While 34 of these animals were lactating, the remaining 66 animals were recorded to be dry for at least one month (39±9 days). After the synchronization, these 87 goats gave birth and were dried off on about 150 days of lactation. These goats were defined as the mating period group II (mating in June 2012). The kidding season of mating period I and mating period II occurred in January 2012 (kidding season I) and November 2012 (kidding season II), respectively. The ages of dams were classified into three groups: 18 to 23 months of age (dam age group I), 24 to 35 months of age (dam age group II), and 36 months of age and older (dam age group III). A hormonal synchronization program was applied during the anestrus period of the animals in both periods for sexual stimulation. For this purpose, sponges containing 60 mg of medroxyprogesterone acetate (Esponjavet, Hipra, Turkey) were applied intravaginally and kept in the vagina for 10 days. On day 10 of the protocol, injection with 500 IU pregnant mare serum gonadotropin (PMSG; Gonas, Hipra, Turkey) was performed, then vaginal sponges were removed at 12 days. Hand mating was carried out as a buck for 30 goats. The goats used in the study were fed with two different rations. Each goat was fed 700 grams of roughage (7% crude protein, 1800 kcal ME/kg) and 350 grams of concentrated feed (20% crude protein, 2800 kcal ME/kg) per day until the third month of pregnancy. Then, advanced pregnancy rations 1.3 kg/goat/day roughage (9% crude protein, 1900 kcal ME/kg) and 700 g/goat/day concentrated feed (24% crude protein, 2900 kcal ME/kg) were applied. In addition to these feeds, the goats were taken to natural pasture for grazing between 06:00 and 10:00 a.m., 3:00 and 8:00 p.m. each day. Newborn kids were kept with their mothers for 10 days after birth. After this period, the kids were separated from the doe. The feeds of the kids consisted of meadow grass *ad libitum* and a concentrated mixture (100 g/goat/day) containing 16% crude protein and 2500 kcal ME/kg. After their mothers had been milked, the kids were allowed to suck only twice a day (morning and evening) for one hour each, until the weaning period (90 days). The kids' growth was determined using a digital scale sensitive to 50 grams. Fertility characteristics were calculated according to formulas specified by Akçapınar (2). Statistical analyses were performed using the software package SPSS 17 for Windows Significances of differences in reproductive characteristics of the goats were determined using the Chi-square test. The growth of the kids at different periods were calculated using general linear model (GLM). Yijkl = μ + Ci + Dj + Ek + Fl + eijkl Where; Y = the dependent variable, μ = the overall mean, Ci = the fixed effect of sex (i= female or male), Dj = the fixed effect of birth type (j= single, twin, triplet, quadruplet), Ek = the fixed effect of maternal age (k=I, II, III), Fl= The effect of kidding season (l=I, II), Eijklm = the random error. The Tukey's multiple-range test was used for multiple comparisons of groups statistical significance was taken at $P \leq 0.05$ (11, 13).

The data of reproductive characteristics of Saanen goats were presented in Table 1. In the present study, litter size was similar to the results of other studies using Saanen goat breeds of Australian origin in Turkey (9, 20). This value is higher than the data of other studies (4, 6, 8, 12, 14, 16, 17, 19) conducted with goats that were stated to be Saanen goats but which origin is unknown. The average pregnancy rate of Saanen goats in this study was found to be higher than in some studies (4, 6, 16, 19) and lower than in others (9, 14, 17). It is thought that the origin or genotype differences of goats may have affected litter size and pregnancy rate. Also, the difference in the climatic conditions of goats (6, 14, 17), hormone application to goats for the estrus synchronization or use of different synchronization methods (8, 12, 16), and different

Table 1. Reproductive characteristics (n; %) of Saanen goats using estrus synchronization by mating period.

Group	TNG	PN	PR	Single Birth		Twinning Birth		Triplet Birth		Quadriplet Birth		Litter Size
Mating period	n	n	%	n	%	n	%	n	%	n	%	
I	100	87	87	24	27.6	33	37.9	22	25.3	8	9.2	2.16
II	87	70	80.5	21	30.00	30	42.9	15	21.4	4	5.7	2.03
Total	187	157	83.95	45	28.66	63	40.1	37	23.6	12	7.64	2.10
P			**ns**		**ns**		**ns**		**ns**		**ns**	**ns**

ns: P>0.05. TNG: Total Number of Goats, PN: Number of goats pregnant, *Pregnancy rate: PN.*

Table 2. Survival rate (%) according to kidding period, dam age, sex and birth type in Saanen-kids.

Factors	n				Survival Rate (%)			
	Total number of born kids	Number of dead kids at birth	Kids born alive	Mortality rate at birth%	30. day	60. day	90. day	120. day
Kidding season				***	ns	ns	ns	ns
I	188	67	121	35.6	91.7	89.3	86.8	83.5
II	142	25	117	17.6	95.7	92.3	91.5	89.7
Sex				ns	ns	*	**	**
Male	148	37	111	25.0	92.8	86.5	82.9	80.2
Female	182	55	127	30.2	94.5	94.5	94.5	92.1
Dam age				ns	*	*	*	*
I	35	8	27	22.9	81.5^{a}	74.1^{a}	74.1^{a}	70.4^{a}
II	186	59	127	31.7	92.9^{a}	91.3^{b}	89.0^{ab}	85.0^{a}
III	109	25	84	22.9	98.8^{b}	95.2^{b}	94.0^{b}	94.0^{b}
Birth type				*	*	*	*	*
Single	58	12	46	20.7	97.8^{a}	93.5^{a}	93.5^{a}	89.1^{a}
Twinning	111	17	94	15.3	98.9^{a}	98.0^{a}	93.6^{a}	91.5^{a}
Triplet	97	28	69	28.9	95.7^{a}	89.9^{a}	89.9^{a}	88.4^{a}
Quadruplet	64	35	29	54.7	65.5^{b}	65.5^{b}	65.5^{b}	62.1^{b}
Total	330	92	238	24.80	96.75	91.70	91.70	88.75

*P>0.05,ns, *: P<0.05,* **: P < 0.01,***: P<0.001. $^{a, b:}$Means within a column with different letters are significantly different.

Table 3. Effects of kidding season, sex, dam age and birth type on body weight in Saanen-kids (kg) (X±Sx̄).

Factors	n	Birth		d 30		d 60		d 90		d 120
Kidding season		*		ns		ns		ns		ns
I	121	2.85±0.06	111	6.10±0.17	108	10.25±0.27	105	14.04±0.35	101	18.93±0.49
II	117	3.05±0.06	112	6.54±0.18	108	10.87±0.33	107	14.36±0.38	105	18.94±0.32
Sex		***		***		***		***		ns
Male	111	3.19±0.07	103	6.82±0.29	96	11.96±0.35	92	15.52±0.41	89	20.28±0.51
Female	127	2.74±0.06	120	5.86±0.14	120	9.45±0.21	120	13.19±0.31	117	17.91±0.38
Dam age		***		ns		ns		ns		ns
I	27	2,06±0.14^{a}	22	5.44±0.36	20	9.56±0.54	20	13.04±0.65	19	17.19±0.80
II	127	3.03±0.05^{b}	118	6.38±0.18	116	10.61±0.28	113	14.16±0.35	108	19.03±0.65
III	84	3.12±0.07^{b}	83	6.47±0.20	80	10.75±0.48	79	14.57±0.46	79	19.23±0.74
Birth type		***		**		***		*		ns
Single	46	3.21±0.11^{a}	45	6.73±0.35^{a}	43	11.34±0.59^{a}	43	15.00±0.65^{a}	41	19.75±0.66
Twinning	94	3.15±0.07^{a}	93	6.57±0.18^{a}	92	11.18±0.35^{a}	88	14.80±0.39^{a}	86	19.35±0.57
Triplet	69	2.75±0.08^{b}	66	5.96±0.18^{ab}	62	9.76±0.29^{ab}	62	13.47±0.43^{ab}	61	18.32±0.66
Quadruplet	29	2.38±0.11^{c}	19	5.33±0.31^{b}	19	8.44±0.54^{b}	19	12.03±0.79^{b}	18	17.17±1.22
Total	238	2.95±0.04	223	6.32±0.12	216	10.56±0.22	212	14.20±0.26	206	18.94±0.32

P>0.05,ns; *: P<0.05; **: P<0.01; ***: P<0.001. $^{a-c}$: means within a column with different letters are significantly different *(P<0.05).*

management strategies (4, 14) in the investigated studies may explain the differences. In the current study, the litter size and pregnancy rate obtained in the mating period I was higher than that of mating period II. However, the pregnancy rate of the 27 animals in the mating period I that was still lactating and dried off for only a month was similar (pregnancy rate 79.41, litter size 2.00) to the results obtained in mating period II. According to these results, we hypothesize that the differences observed in the litter size and pregnancy rate may be due to the short length of the dry period, as uterine involution may not have been fully realized in this short amount of time (5, 10). The data of survival rates and growth characteristics of Saanen-kids up to 120 days were presented in Tables 2 and 3. The birth weights of the offspring in this study were lower than those in similar studies conducted on Saanen goats in Turkey (1, 3, 6, 8, 14, 17, 19). Birth weight differences may be due to higher rates of triplet and quadruplet births in this study, together with genetic traits of the dams and environmental effects compared to other studies (2, 15). The mortality rate of the offspring in this study was higher than in various studies (6, 9, 14, 16, 17). These differences

may be due to the low birth weights of offspring observed in the present study (7, 15). The survival rate and body weight values obtained in the study were found to be lower than the values reported in some studies on unsynchronized Saanen goats (3, 9). This may be related to the lower birth weight of the offspring obtained in the current study compared to other studies. In addition, in this study, triplet and quadruplet birth rates were higher than in other studies. In this case, because the offspring were not able to get sufficient colostrum, they may have been at higher risk of developing various diseases (11, 15). Although the bodyweight of male kids were significantly higher than those of female kids during the growth periods at 30, 60, and 90 days of the growth period ($P<0.001$), it was found that female kids had a higher survival rate than those of males kids, especially at 60, 90 and 120 days of the growth period ($P\leq0.05$). This situation may be related to the sex of kids or it may be associated with the fact that the enterprise carries more attention to female kids for future breeding. In this preliminary study, it was noted that in Australian-origin Saanen goats raised in semi-humid steppe climatic conditions (Afyonkarahisar) with which synchronization protocols were applied during the anestrus period, the pregnancy rates and litter size obtained in the mating period I were higher compared to mating period II. Moreover, the survival and body weight values were similar in kidding season I and kidding season II, except for birth. Although the mortality rate ($P<0.001$), and body weight ($P<0.05$) at birth were affected by the kidding period, the survival rate and their body weights of the Saanen-kids at days 30, 60, 90, and 120 were not affected by the kidding season ($P>0.05$). According to the results, we hypothesize that the length of the dry period may be an important factor in reproductive efficiency. However, further studies are needed to confirm this theory. These results indicate that the kidding season should be an environmental factor to be taken into account when planning the production. Also, if the estrus synchronization program will be implemented in Saanen goats, it is important to optimize the care and management conditions, especially during the kidding season, due to the high multiple birth types.

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Ethical Statement

This study does not present any ethical concerns.

Conflict of Interest

The authors declared that there is no conflict of interest.

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