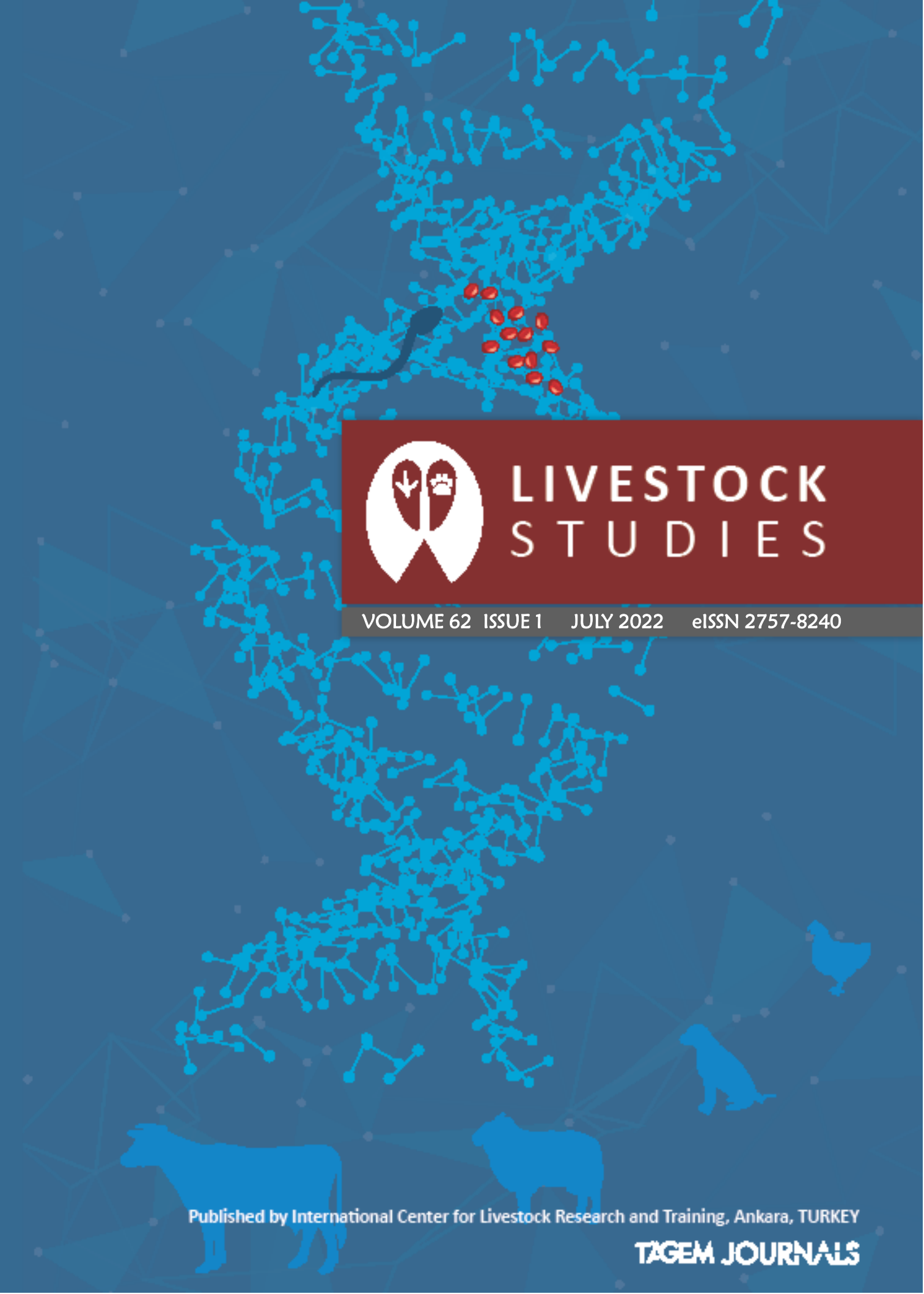

LIVESTOCK STUDIES

VOLUME 62 ISSUE 1 JULY 2022 eISSN 2757-8240

Published by International Center for Livestock Research and Training, Ankara, TURKEY

TAGEM JOURNALS

LIVESTOCK STUDIES

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E-ISSN: 2757-8240

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Livestock Studies, 2022; 62 (1): 1-6
http://doi.org/10.46897/livestockstudies.1077787

LIVESTOCK STUDIES

RESEARCH PAPER

The Effect of Early or Late Breeding on Milk Production in High Producing Lactating Dairy Cows

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Article History
Received: 03 September 2021
Accepted: 17 December 2021
First Online: 01 March 2022

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Keywords
Breeding time
Lactation
Milk yield
Dairy cow

Abstract

The objective of this study was to compare the effect of early or late breeding on milk production in high producing dairy cows. In this aim, the cows with previous average peak milk yield above 45 kg/d (n = 48) were divided into two groups; Group1 (early bred) included the cows (n = 21) were inseminated between 45 to 75 days in milk (DIM) and Group2 (n = 27; late bred) were inseminated between 76 to 124 DIM. The cows that became pregnant at their first insemination following first estrus selected for the study. Milk yield was recorded every 5 days after calving for the first 45 days then continued for every 15 days for every each cow. Average DIM in early and late bred cows at insemination were 66 (min, 45; max, 75) and 99 (min, 76; max, 124), respectively. Average milk yield up to 271 d was similar between groups, however, average milk yield from 227 to 271 d was lower (P < 0.04) in early bred cows with 26.7 kg/d compare to late bred cows with 30.3 kg/d. Even, there was no relationship between average milk yield up to 271 d, peak milk yield and day of insemination, it may be concluded that milk yield continues with more pronounced stability through the end of lactation in late bred high yielding cows.

Introduction

Optimum herd profitability can be only acquired if it is possible to maintain the balance between milk production and reproduction. The common opinion about maintaining the herd pofitability at optimum level, it is need to be aimed that 12-13 months calving interval which included one calf per cow in a yearling period. However, according to this strategy the inseminations of dairy cows, especially with high milk yield (10000-14000 kg/305 d), are coincide with the highest point of lactation when the negative energy balance is most pronounced, and resulted with lower pregnancy rates (Wathes *et al*., 2007). An also, delaying the first inseminations in lactating dairy cows with high milk production may be more beneficial with getting higher pregnancy rates, reduce the frequency per annual cow of the welfare issues associated with calving and durability of lactations (Sehested *et al.,* 2019). The previous studies reported that conflicting results pointed out that either early pregnancy favorably (Harrison *et al*., 1974; Funk *et al*., 1987; Weller and Foman, 1990; Genizi *et al*., 1992; Rehn *et al*., 2000; Arbel *et al*., 2001) or adversely (Bar-Anan *et al*., 1979; Weller *et al*., 1985; Bertilsson *et al*., 1997; Österman and Bertilsson, 2003) or no effect (Schneider *et al*., 1981; Jensen *et al*., 1997; Lehmann *et al*., 2016; Niozas *et al*., 2019) on milk production or herd profitability. Recently, the cows are producing much more milk than the cows in most of these earlier studies due to genetic and management improvements (Niozas *et al*., 2019). Thus, the effects of the time of pregnancy on milk yield still maintain its originality in high yielding dairy cows. The objective of presented study was to compare the milk yield of the cows that became pregnant following their first insemination which between 45 to 75 days (early breeding) or 76 to 124 days (late breeding) postpartum.

Materials and Methods

Selection criteria for the cows that were included in the study (n = 48) were 1) to be in the second lactation and with a peak of ≥45 kg in the previous lactation 2) to

have calving without intervention, 3) to become pregnant after insemination in their first heat 4) not to have infectious and metabolic diseases postpartum and 4) to continue their pregnancy throughout the study. Group 1 (early bred), included the cows (n = 21) were inseminated between 45 to 75 days in milk (DIM) and Group 2 included the cows (n = 27; late bred) were inseminated between 76 to 124 DIM. All cows were in the same commercial dairy herd (approximately 1000 lactating dairy cows) in the South Marmara region, Bursa, Türkiye. Breeding of cows were initiated after voluntary waiting period which is 45 DIM, with artificial insemination followed by estrus detection which was recorded combination with pedometer and visual observations as a reproductive management routine of the farm. Pregnancy examinations were routinely performed on 30, 60 days following insemination and before drying off as part of farm reproductive management procedures. The cows were fed twice daily with a high energy lactating dairy cow ration fed as a Total Mixed Ration (TMR) following National Research Council recommendations (Table 1).

Table 1. Feed ingredients for total mixed ration for high producing lactating dairy cow in the study.

Ingredient	**Amount % of DM**
Corn silage (32% DM)	31.18
Alfaalfa hay (16% Protein)	11.61
Wheat straw	1.85
Triticale silage (34% DM)	5.12
Wet orange pulp	3.93
Wet corn gluten feed (42% DM)	9.35
Sodium bicarbonate	0.64
Toxin binder	0.04
Yeast (Saccharomyces cerevisiae)	0.02
Magnesium oxide	0.20
Dry corn gluten feed	0.54
Corn gluten (65% Protein)	0.79
Hydrogenised rumen bypass fat	1.57
Dairy Min/Vit complex	0.04
Cotton seed meal (38% Protein)	8.32
Crushed corn grain	2.29
DDGS	5.45
Soy bean meal (48% Protein)	1.90
Barley	1.16
Corn	0.63
Sunflower seed meal (38% Protein)	1.00
Molasses (sugar beat)	0.84
Calcium carbonate	0.48
Salt	0.32
Bakery byproducts	4.43
Wheat middlings	6.31

Milk yield was recorded every 5 days after calving for the first 45 days then every 15 days for each cow until 271 days; since the last day for which data was not missing in all animals was day 271 in this study. During the time of data collection, the cows that had a disease, including clinical mastitis, that required their referral to the infirmary, were excluded from the study. Data were analyzed using by the computational software of SAS (release 9.2, SAS Institue Inc. Cary, NC). The PROC GLM procedure was performed to compare timing of AI, timing of peak milk, and average peak milk yields associated with different time periods of lactation between groups. Average milk yields (kg/d) were determined by taking the averages of the milk data obtained for each cow between the groups. The total milk yield (kg) was calculated by multiplying the average

of the milk yield data obtained for each cow by the time the data covers. The differences with $P < 0.05$ were considered significant.

The data evaluated in this study were obtained with the consent of the company where the study was conducted, and no ethics committee decision was required.

Results and Discussion

Average days to AI were 66.2 ± 1.9 days in the Group 1 and 99.2 ± 2.6 days in the Group 2. Average days to peak milk yield was found similar between the groups (41.7 ± 2.1 days in the Group 1 and 47.3 ± 2.7 days in the Group 2). Peak milk yield, milk yield for the first 3 months of lactation, and average milk yield up to 271 d were similar between the groups (Table 2).

There was no relationship between average milk yield up to 271 d after calving and postpartum days of insemination (Figure 1). However, average milk yield from 227 to 271 days postpartum was lower ($P < 0.04$) in the early bred cows compare to the late bred cows. (Table 2). Total milk yield from 227 to 271 d was also different ($P < 0.03$) between the groups (1135.0 ± 54.1 kg in Group 1; 1308.75 ± 65.0 kg in the Group 2, Figure 2).

Table 2. The variables of average milk yield (kg/d) between the early bred cows inseminated at 45 to 75 DIM or late bred cows inseminated at 76 to 124 DIM.

Milk Yield Variables (kg/d)	Early bred (n = 21)	Late bred (n = 27)	P value
Peak milk yield	48.1 ± 0.8	48.4 ± 1.3	0.92
Average milk yield at the beginning of lactation (up to 91 d)	42.4 ± 1.2	42.6 ± 1.1	0.77
Average milk yield at mid term lactation (from 92 to 226 d)	36.3 ± 0.9	37.4 ± 1.4	0.55
Average milk yield at the end of lactation (from 227 to 271 d)	26.7 ± 1.0	30.3 ± 1.3	0.04
Average milk yield up to 271 d	38.2 ± 1.4	39.0 ± 1.2	0.46

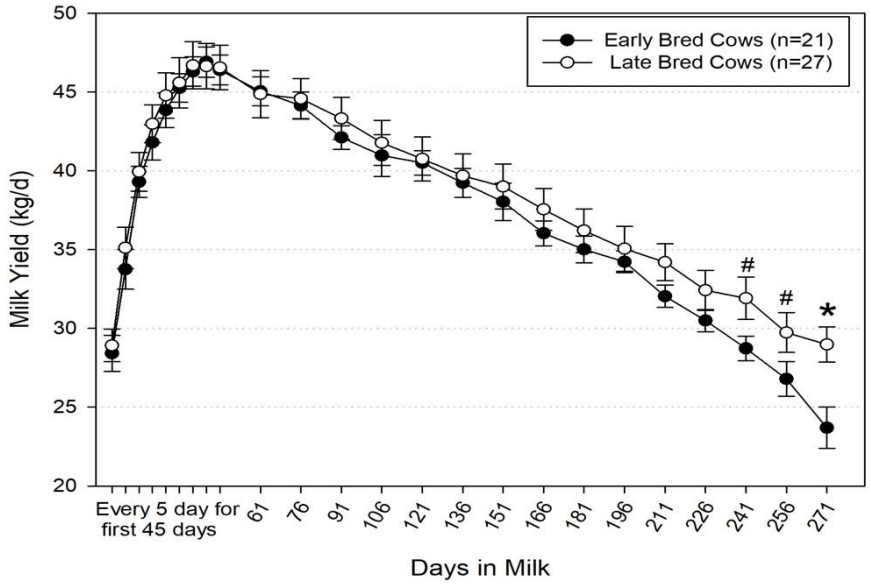

Figure 1. The effect of early or late breeding on milk yield in lactating dairy cows. In this graph, the # symbol indicates statistical tendency at the level of P=0.07 and the symbol * indicate statistical differences at the level of P=0.007.

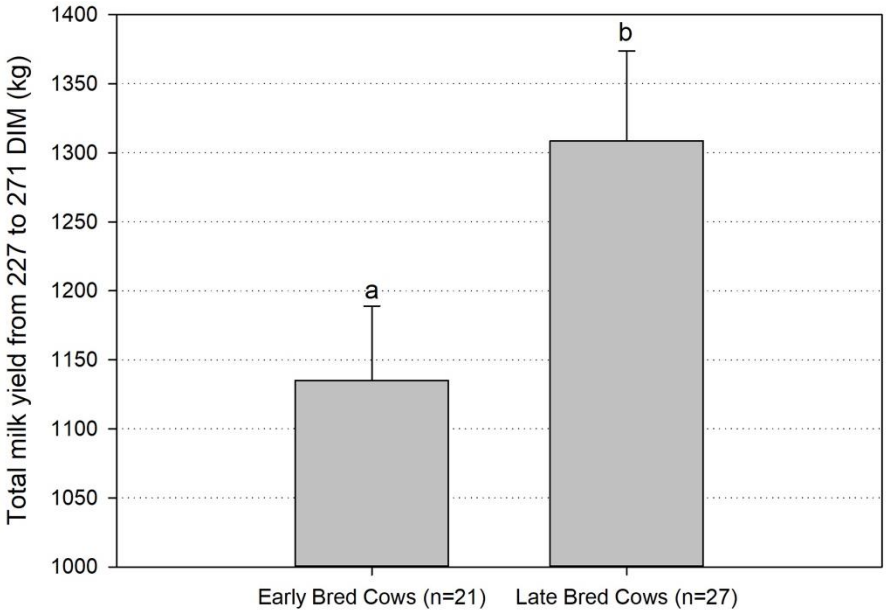

Figure 2. The total milk yield between 227 to 271 days (kg) of lactation in early or late bred cows. In this graph, the a,b symbols indicate statistical difference at the level of *P*=0.03.

Milk production and reproduction are two important factors with respect to profitability of dairy farms and much attention has been given to fertility parameters and their association with milk production. Since insemination time coincide with the period of negative energy balance is most pronounced in high producing dairy cows, delaying the first inserminations in these cows may be more beneficial with both getting higher pregnancy rates and persistency of lactation curve. Intentionally delaying of insemination or voluntary waiting period is termed as extended lactation strategy or extended calving interval in the current literature (Lehmann *et al*., 2016; Sehested *et al*., 2019; Burgers *et al*., 2021a; 2021b). Within the scope of this strategy, it is reported that it may be advantageous for cows to become pregnant when they are in a stage of more positive energy balance and also be dried off at a lower milk yield comparing with in the traditional lactation period (Sehested *et al*., 2019). In presented study, the milk yield data belongs to the cows that became pregnant following first insemination, was used deliberately; thus, the cows were included in the study went spontaneously through an extended lactation strategy on purpose not because of reproductive failure and their milk yield parameters were able to be evaluated in more physiological conditions.

Some of the previous studies (Bar-Anan *et al*., 1979; Weller *et al*., 1985; Bertilsson *et al*., 1997; Österman and Bertilsson, 2003) reported that longer calving interval which means later pregnancy affects favorably on milk production with producing 29% more ECM (Bertilsson *et al*., 1997) and higher milk production per day from one calving to another (Österman and Bertilsson, 2003), some of the studies (Harrison *et al*., 1974; Funk *et al*., 1987; Weller and Foman, 1990; Genizi *et al*., 1992; Rehn *et al*., 2000; Arbel *et al*., 2001) reported that early pregnancy affects favorably on milk production. Interestingly, the study included only swedish cows reported that late bred cows resulted with having 55-60 days longer duration of lactation, had slightly lower milk yield compare to the early bred cows with shorter duration of lactation. And also it is noted that the late bred cows maintain their lactation however produce less milk (Rehn *et al*., 2000). Milk production data of the high producing lactating dairy cows in presented study including both milk yield for first 3 months (~ 42 kg) or for whole lactation period (270 d, ~ 38.5 kg) was not affected by early or late breeding of the cows, similar with the earlier studies (Schneider *et al*., 1981; Jensen *et al*., 1997) and the mostly recent studies reported that early or late pregnancy had no effect on milk production even evaluated as Energy Corrected Milk (ECM) production (Niozas *et al*., 2019) in both primiparous and multiparous cows (Lehmann *et al*., 2016).

The lower milk yield through the end of lactation in early bred cows in presented study was found to be consistent with the current study (Burgers *et al*., 2021a) reported that the cows had calving to first service interval is more than 140 d resulted in better lactation yield, when high-producing dairy cows were selected, as presented in our study. The decrease in milk yield of early inseminated animals in presented study may also be due to the fact that these animals entered the last trimester of their pregnancy compared to the animals in the other group, since the previous reports (Olori *et*

al., 1997; Brotherstone *et al*., 2004) reported that milk yield is negatively affected by pregnancy, especially for the last trimester possibly due to pregnancy associated mammary gland regression and competition for nutrients from the developing fetus (Erb *et al*., 1952).

In scope of high producing dairy cows, it is reported that both peak milk yield and DIM at peak yield had an effect on the individual cow to maintain a high daily milk yield during extended lactation (Sehested *et al*., 2019). Average DIM at peak yield was 42 and 47 days in presented study and both were earlier comparing to the recent study (Lehmann *et al*., 2017) reported that in the multiparous cows managed with longer or shorter lactations, DIM at peak yield were 53 and 59 days and average peak milk yields were 42.7 and 32.5 kg (of ECM/d), respectively. Although there were no differences between the early (average 66d) or late bred (average 99d) cows in terms of average peak milk yield (48 kg/d) in presented study, Burgers *et al*., (2021a) reported that in the cows that early bred (<84d) in their study had lower peak milk yield (40 kg of Fat Protein Corrected Milk, FPCM/d) compare to later bred cows (~43 kg of FPCM/d). Even, it is not appropriate to interpret our study and the recent studies (Lehmann *et al*., 2017; Burgers *et al*., 2021a) together because the calculation method of peak milk yield in these studies are different, it can be said that the peak milk yield values in our study are higher than the values in these studies when general average constitutes of fat (3-4%) and protein (3.5%) in milk are placed in the corresponding places in the ECM (Sjaunja *et al*., 1991) or FPCM (CVB, 2012) formulas. Earlier DIM at peak yield and higher milk yields in presented study can be explained by the fact that presented study included high milk yielding cows but not performed in a herd basis.

Conclusion

Average milk yield up to 271 d of lactation, peak milk yield, and DIM at peak milk yield were not affected by early (average 66 DIM) or late (average 99 DIM) breeding where was more than 30 days between breedings in this study. However, it may be concluded that milk yield continues with more pronounced stability through the end of lactation in late bred cows. Thus, late insemination may contribute to the profitability obtained from milk, especially in the case of high milk yielding cows. Further trials are needed to evaluate the repeatability of this response and evaluation of early or late breeding on persistency and productivity of lactation, should be done not only with milk yield or duration of lactation, but also ECM or FPCM yield, fertility, postpartum health and feeding costs during the this period in the point of herd profitability.

References

Arbel, R., Bigun, Y., Esra, E., Sturman, H., Hojman, D. (2001). The effect of extended calving intervals in high lactating cows on milk production and profitability. *Journal of Dairy Science*, 84, 600-608. https://doi.org/10.3168/jdsS0022-0302(01)74513-4

Bar-Anan, R., Soller, M. (1979). The effect of days open on milk yield and on breeding policy post partum. *Animal Production*, 29(1), 109–119. https://doi.org/ 10.1017/ S0003356100012204

Bertilsson, J., Berglund, B., Ratnayake, G., Svennersten-Sjaunja, K., Wiktorsson, H. (1997). Optimising lactation cycles for the high yielding cow. A European perspective. *Livestock Production Science*, 50, 5–13. https://doi.org/10.1016/S0301-6226(97)00068-7

Brotherstone, S., Thompson, R., White, I.M.S. (2004). Effects of pregnancy on daily milk yield of Holstein-Friesian dairy cattle. *Livestock Production Science*, 87, 265-269. https://doi.org/10.1016/j.livprodsci.2003.07.014

Burgers, E.E.A., Kok, A., Goselink, M.A., Hogeveen, H., Kemp, B., Van Knegsel, A.T.M. (2021a). Fertility and milk production on commercial dairy farms with customized lactation lengths. *Journal of Dairy Science*, 104, 443-458. https://doi.org/10.3168/jds. 2019-17947

Burgers, E.E.A., Kok, A., Goselink, M.A., Hogeveen, H., Kemp, B., Van Knegsel, A.T.M. (2021b). Effects of extended voluntary waiting period from calving until first insemination on body condition, milk yield, and lactation persistency. *Journal of Dairy Science*, 104, 8009-8022. https://doi.org/10.3168/jds.2020-19914

CVB. (2012). Cvb tabellenboek veevoeding (feedstuff table 2012), Centraal Veevoeder Bureau Lelystad, the Netherlands.

Erb, R.E., Goodwin, M.M, Morrison, R.A., Shaw, A.O. (1952). Lactation studies: 1. Effect of gestation. *Journal of Dairy Science*, 35, 224-233. https://doi.org/10.3168/ jds.S0022-0302(52)93695-3

Funk, D.A., Freeman, A.E., Berger, P.J. (1987). Effects of previous days open, previous days dry, and present days open on lactation yield. *Journal of Dairy Science*, 70, 2366-2373. https://doi.org/10.3168/j ds.S0022-0302 (87)80297-7

Genizi, A., Schindler, H., Amir, S., Eger, S., Zarchi, M., Foote, R.H. (1992). A simulation study of the effects of the calving interval on milk yields of dairy cows in fixed time periods. *Animal Production*, 55, 309-314. https:// doi.org/10.1017/S0003356100020997

Harrison, D.S., Meadows, C.E., Boyd, L.J. (1974). Effects on interval to first service on reproduction, lactation and culling in dairy cows. *Journal of Dairy Science*, 57, 628 (Abstr.).

Jensen, E.L., Wieckert, D.A. Baumann, L.E. (1997). Optimum calving intervals for high producing cows. *Journal of Dairy Science*, 80 (Suppl. 1), 200 (Abstr.).

Lehmann, J.O., Fadel, J.G., Mogensen, L., Kristensen, T., Gaillard, C., Kebreab, E. (2016). Effect of calving interval and parity on milk yield per feeding day in Danish commercial dairy herds. *Journal of Dairy*

Science, 99, 621-633. http://dx.doi.org/10.3168/jds. 2015-9583

Lehmann, J.O., Mogensen, L., Kristensen, T. (2017). Early lactation production, health, and welfare characteristics of cows selected for extended lactation. *Journal of Dairy Science*, 100, 1487-1501. https://doi.org/ 10.3168/jds.2016-11162

Niozas, G., Tsousis, G., Malesios, C., Steinhöfel, I., Boscos, C., Bolwein, H., Kaskee, M. (2019). Extended lactation in high-yielding dairy cows. II. Effect on milk production, udder health, and body measurements. *Journal of Dairy Science*, 102, 811-823. https://doi.org/10.3168/jds.2018-15117

Olori, V.E., Brotherstone, S., Hill, W.G., McGuirk, B.J. (1997). Effect of gestation stage on milk yield and composition in Holstein Friesian dairy cattle. *Livestock Production Science*, 52, 167-176. https://doi.org/10.1016/ S0301-6226(97)00126-7

Österman, S., and Bertilsson, J. (2003). Extended calving interval in combination with milking two or three times per day: Effects on milk production and milk composition. *Livestock Production Science*, 82, 139-149. https://doi.org/10.1016/S0301-6226(03)0003 6-8

Rehn, H., Berglund, B., Emanuelson, U., Tengroth, G., Philipsson, J. (2000). Milk production in swedish dairy cows managed for calving intervals of 12 and 15 months. *Acta Agriculturae Scandinavica A Animal Science*, 50(4), 263-271. https://doi.org/ 10.1080/090647000750069458

Schneider, F., Shelford, J.A., Peterson, R.G., Fisher, J. (1981). Effects of early and late breeding of dairy cows on reproduction and production in current and subsequent lactation. *Journal of Dairy Science*, 64, 1996–2002. https://doi.org/10.3168/jds.S0022-0302 (81)82802-0

Sehested, J., Gaillard, C., Lehmann, J.O., Maciel, G.M., Vestergaard, M, Weisbjerg, M.R., Mogensen, L., Larsen, LB, Poulsen N.A., Kristensen, T. (2019). Review: extended lactation in dairy cattle. *Animals*, 13(suppl1), 65-74.https://doi.org/10.1017/ S175173 1119000806

Sjaunja, L.O., Baevre, L., Junkkarinene, L., Pedersen, J., Setala, J. (1991). A Nordic proposal for an energy corrected milk (ECM) formula. P. Gaillon, Y. Chabert (Eds.), Performance Recording of Animals: State of the Art, 1990, Centre for Agricultural Publishing and Documentation (PUDOC), Wageningen, the Netherlands, pp. 156-157.

Wathes, D.C., Fenwick, M., Cheng, Z., Bourne, N., Llewellyn, S., Morris, D.G., Kenny, D., Murphy, J., Fitzpatrick, R. (2007). Influence of negative energy balance on cyclicity and fertility in the high producing dairy cow. *Theriogenology*, 68 (Suppl. 1), 232-241. https://doi. org/10.1016/j.therio- genology.2007.04.006

Weller, J.I., Bar-Anan, R., Osterkorn, K. (1985). Effects of days open on annualized milk yields in current and following lactations. *Journal of Dairy Science*, 68, 1241–1249. https://doi.org/10.3168/jds.s0022-0302 (85)80952-8

Weller, J.I. and Folman, Y. (1990). Effects of calf value and reproductive management on optimum days to first breeding. *Journal of Dairy Science*, 73, 1318–1326. https://doi.org/ 10.3168/jdsS0022-0302(90)78798-X

Livestock Studies 62(1), 7-15
http://doi.org/10.46897/livestockstudies.1077836

RESEARCH PAPER

LIVESTOCK STUDIES

Five-year Term Evaluation of the Project Named "Kilis Goat National Breeding Project in Kilis Province"

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Article History
Received: 19 November 2021
Accepted: 20 December 2021
First Online: 01 April 2022

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Keywords
Birth weight
Weaning weight
Milk yield

Abstract

Kilis Goat National Breeding Project has been carried out for 12 years in cooperation with The General Directorate of Agricultural Research and Policies in the Ministry of Agriculture and Forestry, Hatay Mustafa Kemal University and Sheep and Goat Breeders Association of Kilis Province. The aim of the manuscript is to inform about progresses made under the relevant project. In the second five-year period of the project, 43 breeders take part in a total of approximately 6000 female and 300 male animals. Thirty-seven of these herds are base herds and six of them are elite herds. In the study, the effects of gender, maternal age, separation as breeding stock or not, birth types and years on birth and weaning weights were analysed by using the SPSS package program. The effects of herd and age differences on lactation milk yield in elite herds were also analysed by using the SPSS package program. They were determined that birth weights varied between 2.9-3.1 kg and weaning weights between 11.2-12.7 kg for different years. And, milk yield in elite herds increased from 175.6 kg to 346.1 kg from 2016 to 2020. As conclusion, it is recommended that the continuation of this project will be beneficial.

Introduction

Türkiye is among the countries that could be faced with the problem of drought in the future due to global climate change. Therefore, starting from today, it is necessary to develop appropriate livestock strategies and make future plans for better nutrition of the increasing human population. In this context, there is a great benefit in planning what the share of sheep, goats, cattle and buffalo will be in Türkiye's livestock, and which species and even breeds will be raised in which region.

Goat is an important material to meet the animal protein needs of the society. Goat is one of the animal species that has proportionally the most increment in the last 30 years in the World (www.fao.org). Undoubtedly, the fact that the goat will be among the advantageous species in the future due to global climate change and the characteristics of goat milk have effects on this increase.

Türkiye goat population, which was around 16 million at the beginning of the 1980s, is around 12 million today, and 97% of it is Hair goat (www.tuik.gov.tr). Hair goats are kept with extensive system in many regions of Türkiye. These goats, which have hard hooves and the ability to walk long, are extremely resistant to adverse environmental conditions. Milk yield for these goats has been reported as between 87 and 146 kg, and litter size as between 65% and 100% by different Researchers (Sönmez *et al.,*1973; Özcan *et al.,* 1974; Sönmez, 1974; Şimşek *et al.,* 2006).

Hair goats, which are kept with the extensive system completely dependent on nature in Türkiye, are preferred by the breeders as a profitable production tool despite their low yield characteristics. Unfortunately, a false anxiety is often expressed that forests are adversely affected in this production model. We know that hair goats, when managed correctly, provide benefits to forest

without any harm. For example, they contribute to reducing the risk of fire by eating cover plants and maquis. However, with the effect of this wrong belief, it has been said for a long time to reduce the number of Hair goats but to increase the dairy genotypes in order to protect forests and to produce in accordance with European Union standards. In this context, in the Türkiye Livestock Projection study conducted in 1969, it was foreseen that the goat population will be gradually decreased in the country. In this projection study, it was also reported that the ratio of dairy genotypes in the country's goat population should be increased in the future. In the study, it was predicted that the number of goats in the year of 2000 would be 3.6 million heads and this number would consist of 25% Hair goat, 15% Kilis goat, 5% Maltese goat and 55% dairy crossbreeds (Anonymous, 1969). For the purpose of obtaining this composition different crossbreeding studies have been started since the 1960s and have been carried out in different Universities in cooperation with the Ministry of Agriculture. For this aim some crossbred genotypes were obtained by using Saanen and Alpine bucks brought from different European countries in the breeding of Hair goat. Important results were obtained in this crossbreeding studies on milk yield, reproductive characteristics and kid developments (Özcan, 1977; Güney, 1984).

As mentioned in the projection study, Kilis goats are an important genetic material for goat breeding in Turkiye. Although not included in official figures, it is estimated that there are approximately 500 thousand heads of Kilis goats in the provinces of Kilis, Adana, Gaziantep and Hatay (Keskin *et al.,* 2017). Kilis goat is numerically less than the Hair goat and draws attention with its high yield characteristics. Although the Kilis goat is often confused with the Damascus or Aleppo goat, it is a different genotype (Keskin *et al.,* 1996; Keskin, 2000). Although this breed is reared in Kilis, Hatay, Gaziantep regions, it has been taken to many regions of Turkiye especially after this project and its keeping continues without any problems.

The National Animal Breeding Project conducted under the breeders' conditions has undertaken an important mission in terms of seeing the diversity of our genetic resources in the field of small ruminant breeding in Turkiye and improvement them on site. The existence of many sheep and goat breeds that are not included in the data of the Turkish Statistical Institute started to take place in the literature with this project. "National Genetic Improvement Project for Kilis Goats at Breeders' Condition" is one of the subprojects of this national project. This project has been carried out as two sub-projects in the province of Kilis. The results covering the period of 2016-2021 of the second package of the sub-project are included in this manuscript.

Materials and Methods

A total of 6300 goats, approximately 6000 female and 300 male goats from Kilis goat breed, and their kids constituted the animal material of the project. Individuals with black colour and long ears are preferred in the selection of breeding stocks in the project in addition to milk yield, kid development and reproduction characteristics. An index that takes into account kids' birth and weaning weights, their mothers' milk yield gave during two milk control in March - May period as well as birth type was used in the breeding separation of the kids.

I= 0,10xBW + 0,30xWW + 0,30xFMY + 0,30xSMY + BT (I, index; BW, birth weight; WW, weaning weight, FMY, milk yield at first control; SMY, milk yield at second control; BT, birth type)

Mating in the base herds was carried out by free mating method in August-September every year, and the bucks were separated from the females at least 45 days before the mating date in the base herds for oestrus synchronisation. After that, bucks and does were kept together with proportion of 5 males for 100 females until the end of the mating period. In these herds, the kids were ear-tagged at birth, the ear tag numbers of the mother and the kid, the date of birth, the number of kids at the birth (type of birth) and the sex of the kids were recorded. Weighings of the kids were made at birth and on the 60th day to reveal the growth performance of the kids. Since free breeding was done in the base herds, mating records could not be obtained, only the mother and offspring information were recorded.

In elite herds, hand mating was applied and mating records of animals were kept. Ear tag numbers of the goats giving birth, numbers of kids at birth, date of birth as well as ear numbers, genders, birth and 60th day weights of born kids were recorded. Breeding stocks were selected from the born kids for each herd at each year as 40% of the females and all the males.

In order to calculate the lactation milk yields of the goats in the elite herds, milk controls were made at 28-day intervals and individual milk yields were calculated with the ICAR-AT method, which was also used by Keskin *et al*. (Keskin *et al.,* 2017).

The mathematical model used for the analysis of the data obtained in the project is given below.

$Y_{ijklmn}=\mu+a_i+b_j+c_k+d_l+f_m+e_{ijklmn}$; in this model;

Yijklmn= The data (birth weight, weaning weight, lactation milk yield) of n^{th} animal at i^{th} herd (elite or base) group, j^{th} breeding stock separation or non-

separation group, k^{th} maternal age, l^{th} gender and m^{th} birth type.

μ= mean of population

a_i= effect of herd group (i = elite or base)

b_j= effect of breeding stock situation

(j = separation on non-separation)

c_k= effect of maternal age (k = 2, 3, 4, 5, 6, 7+)

d_l= effect of gender (l = male or female)

f_m= effect of birth type (m = single or twin)

e_{ijklmn}= error factor

The data obtained in the study were analysed with the Oneway Anova procedure and the comparisons of the averages were made with the Duncan test by using SPSS Package Program.

Results and Discussion

The reproductive traits calculated from the project goats in the 5-year period between 2016-2020 are given in Table 1. When Table 1 is evaluated, it is seen that the birth rate determined from the project animals is lower than the 96% birth rate determined by Keskin *et al.* (1996). This may be due to the fact that the study of Keskin *et al.* (1996) was conducted in a single herd with a small number of animals and the animals were managed in better conditions.

Table 1. Some reproductive traits calculated in project material goats.

Years	KR	KY1	KY2	KY3	KY4	SRW
2016	62.4	79.0	79.0	126.7	126.7	100.0
2017	70.3	81.9	73.4	116.6	104.5	89.6
2018	87.3	101.7	83.8	116.5	96.0	82.4
2019	92.1	109.7	85.7	119.1	93.0	78.1
2020	86.9	99.8	77.5	114.9	89.1	77.6

KR, kidding rate; KY1, kid yield at birth for goats at herd; KY2, kid yield at weaning for goats at herd; KY3, kid yield at birth for goats giving birth; KY4, kid yield at weaning for goats giving birth; SRW, survival rate at weaning

It is seen that the reproductive traits obtained in the present study change from year to year. These changes are a natural consequence of the effect of environmental conditions changing from year to year in herds managed under extensive or semi-intensive conditions. The variability observed in the fertility criteria, especially the decrease in "kid yield at weaning for goats giving birth and survival rate at weaning" values may also be affected by the variability observed in climatic conditions from year to year. According to the multi-year meteorological data, the lowest temperature values in Kilis province can vary between -12 °C and -5.6 °C in the January-March period (Anonymous, 2021), which is the period between birth and weaning for kids. In addition, cottonseed grains fed to animals during this period may also be effective in the deaths of kids during this period. We know that nowadays cotton is harvested by machine and chemicals are applied to the cotton plant before harvesting. It should be useful to investigate these issues. In the study conducted with Kilis goats reared in the same region (Keskin, 2000), the birth rate, kid yield at birth and survival rate at weaning were reported as 89.7%, 130% and 89.2% respectively. As stated in the study in question, there may be differences from year to year in terms of these characteristics.

The effects of being included in elite or base herds, separation status as breeding stocks, maternal age, gender, birth type on birth and weaning weights are given in Table 2, Table 3, Table 4, Table 5 and Table 6. As can be seen from these Tables, birth type, gender and maternal age had significant effects on both birth and weaning weights ($P < 0.05$). In addition, statistically significant differences were also determined between the animals selected or not selected as breeding stocks ($P < 0.05$). Birth and weaning weights has got 40% effect in the index formula to select the animals as breeding stocks. Kids with a high index value are selected as breeding stocks with this formula. For this reason, it can be considered as a normal situation for the animals selected as breeding stocks to be heavier than the others, especially during the weaning period.

Birth and weaning weights determined in the study were sometimes similar and sometimes different from the values reported in different studies. Thus, birth and weaning weights for Kilis goats have been reported as 3.8 kg and 18.6 kg (Aktepe, 2009), 3.6 kg and 12.3 kg (Keskin *et al.,* 2017), respectively. These differences are influenced by environmental factors, especially feeding. That is, in the study conducted by Keskin (2020), the birth weight of Kilis goats, which were given additional feeding, was determined as 4.6 kg and weaning weight as 13.2 kg. In other words, better feeding of animals can affect both birth and weaning weights. Therefore, environmental conditions that change from year to year have important effects on the variability of birth and weaning weights calculated for different years from herds reared in semi-intensive conditions during the project. When the effects of birth type and sex on the average birth and weaning weights at the herds are evaluated, single born kids were generally heavier than twins and

Table 2. Effect of different factors on birth and weaning weight ($\bar{x} \pm s\bar{x}$) (year of 2016).

	Birth weight	Weaning weight
Elite-Base Herds		
Elite	3.0 ± 0.02 (1223)	12.3 ± 0.07^{a} (1157)
Base	3.0 ± 0.01 (3805)	12.8 ± 0.05^{b} (3586)
Selected or not selected as breeding stocks		
Selected	3.2 ± 0.02^{b} (1592)	14.4 ± 0.08^{b} (1494)
Not selected	3.0 ± 0.01^{a} (3434)	11.9 ± 0.04^{a} (3199)
Maternal age		
2	3.1 ± 0.02^{b} (1291)	12.5 ± 0.07^{ab} (1183)
3	3.0 ± 0.02^{a} (1007)	12.4 ± 0.07^{a} (953)
4	3.1 ± 0.02^{ab} (1303)	12.6 ± 0.10^{ab} (1218)
5	3.1 ± 0.04^{b} (452)	13.0 ± 0.12^{c} (431)
6	3.0±0.05^{a} (130)	13.6 ± 0.27^{d} (120)
7+	3.1 ± 0.03^{b} (845)	12.9 ± 0.10^{bc} (788)
Gender		
Male	3.1 ± 0.01^{b} (2559)	12.9 ± 0.05^{b} (2386)
Female	3.0 ± 0.02^{a} (2457)	12.4 ± 0.06^{a} (2307)
Birth type		
Single	3.2 ± 0.77^{c} (2902)	13.2 ± 0.05^{b} (2683)
Twin	2.9 ± 0.66^{b} (2054)	12.2 ± 0.07^{a} (1944)
Triplet	2.7 ± 0.85^{a} (72)	12.4 ± 0.33^{a} (66)
Total	3.1 ± 0.01 (5026)	12.7 ± 0.04 (4693)

Note: Different letters as superscripts in the same column indicate a difference at the 5% significance level.

triplets and male kids were generally heavier than female ones.

Similar reports were also stated by different researchers (Baltacı, 1990; Keskin *et al.,* 2017; Keskin e*t al.,* 2019) that the birth weight for Kilis goats bred in the same region as 3.7 kg in single born kids, 3.5 kg in twin kids, 3.8 kg in male kids and 2.4 kg in female kids. The researchers reported the weaning weight for the same kids as 12.2 kg in single born kids, 12.1 kg in twin kids, 12.6 kg in male kids and 11.9 kg in female kids. These values are in line with the results reported in the present study. Likewise, Keskin *et al.* (2017) stated that the average values of these characteristics could change from year to year.

Kilis goat is one of the most important domestic goat gene sources of Türkiye in terms of milk yield. The primary aim of this project is to improve the milk yield of Kilis goats. As can be seen in Table 7, the average lactation milk yields of Kilis goats in the elite herds were calculated as 175.6 ± 2.00 kg, 301.2 ± 3.61 kg, 316.5 ± 2.36, 310.8 ± 2,02 and 346.1 ± 1.46 kg in the years of 2016 - 2020, respectively. As can be seen in Figure 1, the milk yields in the elite herds tend to increase from year to year, although there may be slight fluctuations.

Undoubtedly, although the changes in the environmental conditions to which the herds managed

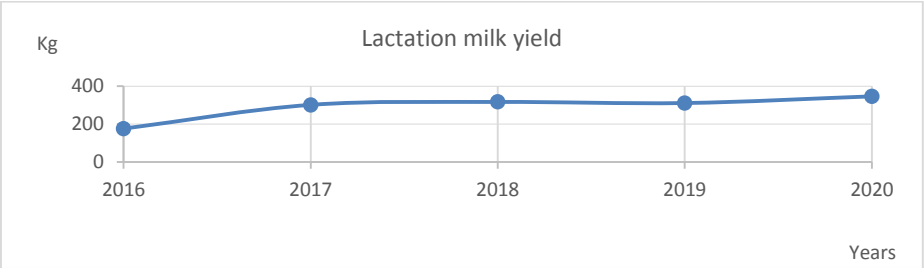

Figure 1. Variation of average lactation milk yield in the elite herds by years.

Table 3. Effect of different factors on birth and weaning weight ($\bar{x} \pm s\bar{x}$) (year of 2017).

	Birth weight	**Weaning weight**
Elite-Base Herds		
Elite	3.0 ± 0.01 (1145)	12.2 ± 0.07^{b} (860)
Base	3.0 ± 0.01 (3579)	12.1 ± 0.04^{a} (3199)
Selected or not selected as breeding stocks		
Selected	3.1 ± 0.01^{b} (1368)	13.5 ± 0.05^{b} (1311)
Not selected	3.0 ± 0.01^{a} (3353)	11.4 ± 0.03^{a} (2745)
Maternal age		
2	3.1 ± 0.01^{b} (942)	12.3 ± 0.07^{b} (1183)
3	3.1 ± 0.01^{c} (1045)	12.0 ± 0.07^{ab} (953)
4	3.0 ± 0.01^{abc} (944)	11.9 ± 0.07^{a} (1218)
5	3.0 ± 0.01a^{b} (981)	12.1 ± 0.07^{ab} (431)
6	3.0 ± 0.02^{abc} (345)	12.3 ± 0.12^{b} (120)
7+	3.0 ± 0.02^{a} (467)	11.9 ± 0.10^{a} (788)
Gender		
Male	3.1 ± 0.01^{b} (2559)	12.4 ± 0.04^{b} (2082)
Female	3.0 ± 0.02^{a} (2457)	11.7 ± 0.05^{a} (1976)
Birth type		
Single	3.1 ± 0.01^{c} (2902)	12.3 ± 0.04^{b} (2901)
Twin	2.9 ± 0.01^{b} (2054)	11.6 ± 0.06^{b} (1944)
Triple	2.8 ± 0.05^{a} (72)	9.5 ± 0.37^{a} (15)
Total	3.0 ± 0.01 (4724)	12.1 ± 0.03 (4056)

Note: Different letters as superscripts in the same column indicate a difference at the 5% significance level.

Table 4. Effect of different factors on birth and weaning weight ($\bar{x} \pm s\bar{x}$) (year of 2018).

	Birth weight	Weaning weight
Elite-Base Herds		
Elite	3.0 ± 0.02^{a} (1407)	11.9 ± 0.06^{a} (1333)
Base	3.1 ± 0.01^{b} (4230)	12.2 ± 0.03^{b} (3513)
Selected or not selected as breeding stocks		
Selected	3.1 ± 0.02^{b} (947)	14.4 ± 0.05^{b} (947)
Not selected	3.0 ± 0.01^{a} (4686)	11.5 ± 0.03^{a} (3695)
Maternal age		
2	3.1 ± 0.01^{ab} (1224)	12.1 ± 0.07^{ab} (975)
3	3.1 ± 0.01^{ab} (1913)	12.1 ± 0.05^{a} (1587)
4	3.1 ± 0.01^{b} (1158)	12.2 ± 0.06^{ab} (974)
5	3.1 ± 0.02^{ab} (684)	12.1 ± 0.08^{c} (573)
6	3.0 ± 0.02^{a} (422)	12.2 ± 0.10^{d} (361)
7+	$3.0 \pm 0,02^{a}$ (216)	12.1 ± 0.14^{bc} (176)
Gender		
Male	3.1 ± 0.01 (2884)	12.1 ± 0.04 (2448)
Female	3.0 ± 0.01 (2752)	12.1 ± 0.04 (2197)
Birth type		
Single	3.2 ± 0.01^{b} (4600)	12.6 ± 0.04^{c} (3900)
Twin	3.1 ± 0.02^{ba} (1022)	12.2 ± 0.07^{b} (736)
Triple	2.9 ± 0.17^{a} (15)	11.8 ± 0.46^{a} (10)
Total	3.1 ± 0.01 (5637)	12.1 ± 0.03 (4646)

Note: Different letters as superscripts in the same column indicate a difference at the 5% significance level.

Table 5. Effect of different factors on birth and weaning weight ($\bar{x} \pm s\bar{x}$) (year of 2019).

	Birth weight	Weaning weight
Elite-Base Herds		
Elite	2.9 ± 0.01^{b} (1419)	11.3 ± 0.05^{a} (1054)
Base	2.8 ± 0.01^{a} (4844)	11.2 ± 0.03^{b} (3840)
Selected or not selected as breeding stocks		
Selected	2.9 ± 0.01^{b} (1114)	13.2 ± 0.04^{b} (914)
Not selected	2.8 ± 0.01^{a} (5149)	10.6 ± 0.03^{a} (3880)
Maternal Age		
2	2.9 ± 0.01^{bc} (1764)	11.2 ± 0.05^{b} (1383)
3	2.9 ± 0.01^{c} (1099)	11.2 ± 0.06^{b} (850)
4	2.9 ± 0.01^{c} (1692)	11.3 ± 0.05^{b} (1288)
5	2.8 ± 0.01^{ab} (1075)	11.2 ± 0.06^{b} (882)
6	2.8 ± 0.01^{a} (485)	10.8 ± 0.10^{a} (384)
7+	2.8 ± 0.02^{ab} (148)	10.7 ± 0.19^{a} (107)
Gender		
Male	2.9 ± 0.01^{b} (3081)	11.4 ± 0.04^{b} (2461)
Female	2.8 ± 0.01^{a} (3182)	10.9 ± 0.03^{a} (2433)
Birth type		
Single	2.9 ± 0.01^{b} (4259)	11.4 ± 0.03^{b} (3296)
Twin	2.8 ± 0.01^{a} (2004)	10.8 ± 0.04^{a} (1598)
Triplet	-	-
Total	2.9±0.01 (6263)	11.2±0.03 (4894)

Note: Different letters as superscripts in the same column indicate a difference at the 5% significance level.

Table 6. Effect of different factors on birth and weaning weight ($\bar{x} \pm s\bar{x}$) (year of 2020).

	Birth weight	Weaning weight
Elite-Base Herds		
Elite	3.0 ± 0.02^{b} (1478)	11.7 ± 0.06^{b} (1159)
Base	2.9 ± 0.01^{a} (4390)	11.2 ± 0.03^{a} (3395)
Selected or not selected as breeding stocks		
Selected	3.2 ± 0.02^{b} (1000)	13.7 ± 0.05^{b} (975)
Not selected	2.9 ± 0.01^{a} (4868)	10.7 ± 0.03^{a} (3579)
Maternal Age		
2	2.9 ± 0.02^{a} (145)	11.7 ± 0.19^{b} (113)
3	3.0 ± 0.01^{b} (1445)	11.4 ± 0.06^{ab} (1104)
4	3.3 ± 0.01^{b} (1286)	11.2 ± 0.06^{a} (976)
5	3.0 ± 0.01^{b} (795)	11.3 ± 0.08^{a} (632)
6	3.0 ± 0.01^{b} (1012)	11.4 ± 0.07^{ab} (800)
7+	2.9 ± 0.01^{b} (1185)	11.3 ± 0.06^{a} (929)
Gender		
Male	3.0 ± 0.01^{b} (3006)	11.5 ± 0.04^{b} (2359)
Female	2.9 ± 0.02^{a} (2862)	11.1 ± 0.04^{a} (2195)
Birth type		
Single	3.0 ± 0.01^{b} (4371)	11.5 ± 0.03^{b} (3370)
Twin	2.9 ± 0.01^{b} (1494)	10.8 ± 0.05^{ab} (1944)
Triplet	2.7 ± 0.06^{a} (3)	8.9 ± 0.35^{a} (2)
Total	3.0 ± 0.01 (5868)	11.3 ± 0.03 (4553)

Note: Different letters as superscripts in the same column indicate a difference at the 5% significance level.

Table 7. Variation of 2016-2020 lactation milk yields ($\bar{x} \pm S\bar{x}$) in the elite herds according to age and farms

	2016	2017	2018	2019	2020
Variation by farms					
1	$146,7 \pm 5,19^{a}$ (78)	$163,5 \pm 9,51^{a}$ (100)	$290,4 \pm 6,86^{bc}$ (95)	$312,8 \pm 4,83^{cd}$ (144)	$337,5 \pm 3,54^{cd}$ (156)
2	$149,3 \pm 4,97^{a}$ (80)	$266,1 \pm 6,12^{c}$ (77)	$269,0 \pm 7,92^{a}$ (72)	$277,1 \pm 5,36^{b}$ (78)	$347,4 \pm 4,00^{cde}$ (86)
3	$153,3 \pm 3,38^{a}$ (103)	$193,1 \pm 7,61^{b}$ (81)	$300,8 \pm 6,82^{cd}$ (94)	$259,8 \pm 5,21^{a}$ (104)	$349,8 \pm 4,07^{de}$ (116)
4	$156,7 \pm 6,40^{ab}$ (53)	$213,8 \pm 4,60^{b}$ (62)	$270,7 \pm 6,05^{ab}$ (75)	$302,8 \pm 7,36^{c}$ (72)	$334,3 \pm 5,80^{bc}$ (81)
5	$188,5 \pm 8,96^{c}$ (57)	-	$301,3 \pm 6,40^{cd}$ (90)	$345,5 \pm 7,34^{f}$ (108)	$320,9 \pm 4,57^{a}$ (117)
6	$172,0 \pm 3,99^{b}$ (92)	$347,3 \pm 5,20^{d}$ (120)	$275,9 \pm 5,21^{ab}$ (120)	$258,3 \pm 4,79^{a}$ (187)	$323,6 \pm 4,24^{ab}$ (134)
7	$238,9 \pm 6,46^{d}$ (148)	$349,5 \pm 5,79^{d}$ (146)	$397,0 \pm 6,10^{f}$ (148)	$333,7 \pm 4,87^{ef}$ (210)	$354,2 \pm 3,70^{e}$ (219)
8	$189,8 \pm 3,65^{c}$ (146)	$344,3 \pm 4.94^{d}$ (167)	$296,0 \pm 6,57^{c}$ (140)	$330,0 \pm 5,30^{def}$ (168)	$374,1 \pm 3,48^{f}$ (178)
9	$148,4 \pm 4,77^{a}$ (74)	$417,0 \pm 10,71^{e}$ (53)	$341,7 \pm 6,10^{e}$ (117)	$333,4 \pm 5,81^{ef}$ (119)	$371,2 \pm 5,22^{f}$ (128)
10	$148,8 \pm 4,85^{a}$ (83)	$400,2 \pm 12,68^{e}$ (48)	$318,2 \pm 5,18^{d}$ (195)	$315,8 \pm 7,81^{cde}$ (66)	$315,7 \pm 5,02^{a}$ (74)
Variation by ages					
2	172,9 ± 4,28 (244)	$298,8 \pm 9,26^{ab}$ (167)	$301,0 \pm 5,45^{a}$ (226)	$314,3 \pm 4,32^{b}$ (266)	$319,4 \pm 5,93^{a}$ (48)
3	174,6 ± 4,42 (158)	$300,7 \pm 7,15^{ab}$ (186)	$309,9 \pm 3,46^{ab}$ (517)	$315,2 \pm 4,69^{b}$ (209)	$341,0 \pm 2,98^{b}$ (294)
4	172,6 ± 3,04 (347)	$322,6 \pm 8,63^{b}$ (139)	$342,2 \pm 5,74^{b}$ (139)	$309,3 \pm 3,49^{b}$ (395)	$348,2 \pm 3,40^{b}$ (230)
5	190,3 ± 6,05 (74)	$293,7 \pm 6,10^{ab}$ (280)	$338,4 \pm 9,85^{b}$ (280)	$326,0 \pm 5,24^{bc}$ (180)	$348,3 \pm 4,44^{b}$ (163)
6	148,2 ± 2,71 (2)	$308,4 \pm 14,05^{ab}$ (51)	$311,2 \pm 5,95^{ab}$ (51)	$340,7 \pm 15,18^{c}$ (23)	$347,3 \pm 2,95^{b}$ (314)
7+	184,6 ± 7,51 (89)	$301,2 \pm 21,79^{a}$ (31)	$314,6 \pm 12,57^{ab}$ (11)	$310,8 \pm 5,40^{a}$ (121)	$352,48 \pm 3,39^{b}$ (240)
Total					
	175,6 ± 2,00 (914)	301,2 ± 3,61 (854)	316,5 ± 2,36 (1204)	310,8 ± 2,02 (1194)	346,1 ± 1,46 (1289)

Note: Different letters as superscripts in the same column indicate a difference at the 5% significance level.

under the semi-intensive conditions are exposed from year to year have an effect on this increase, the selection program applied also has an effect.

The lactation milk yield values calculated from the project goats showed similarities with the previous studies for some years and differences for some years. Lactation milk yield in Kilis goats was reported as 294 liters by Baltacı (1990), as 376 liters by Keskin (2000), as 213 liters by Aktepe (2009), as 294 liters by Gül *et al.* (2016 and 2020), as 316-376 liters by Keskin *et al.* (2017).

The values reported in the literature are similar to the values of the herds seen in Table 7. These similarities or differences may be due to year or herd differences, management or feeding differences applied to the herds, and the change in age distribution of the animals at each herds.

Conclusion

The results of the works and processes carried out in this project so far can be listed as follows;

Breeders have learned record keeping and its importance. In the second five years of the project, it was observed that the breeders had experience in these matters.

With the effect of the seminars given to the goat breeders, important developments have been achieved especially in the field of health protection and parasite control. It is observed that many breeders are more interested in vaccination.

Breeders have started to provide breeding stock from animals whose yield characteristics have been determined.

Animal sales were made from project animals to different regions of Turkiye (such as Doğanhisar district of Konya province, Adana, Diyarbakır). The animals taken to these provinces were visited by the project team and it was observed that they adapted to the new regions. In order to demonstrate this relevance with objective criteria, a project was prepared and submitted to TAGEM for the evaluation of herds of similar ages in Konya and Kilis provinces. Unfortunately, the project was not supported. Despite this, the project team went to Doğanhisar and met with the breeders who distributed Kilis goats, and the breeders stated that they were satisfied with these goats.

The mating records kept in the elite herds included in the project were checked by paternity test. For this purpose, 118 heads of kids and 19 their possible fathers randomly selected from the elite herd were evaluated with financial support provided by Hatay Mustafa Kemal University Scientific Research Projects Commission. As a result of the analysis, 3.4% error was detected in the pairing of father and kid. According to the five different herds, the mismatch between father and kid was 0.0%, 0%, 3.0%, 4.8% and 7.4% in the herds (Keskin *et al.,* 2017). Obtained results show that elite herd breeders are successful in hand mating.

Scientific data obtained from Kilis goats were shared nationally and internationally, contributing to the promotion of the project. In addition, the best kid and lamb competition was held in Kilis and the project was introduced on a local basis.

As conclusion, it is seen that lactation milk yield increases year by year in the elite herds. There is also a wide variation for calculated lactation milk yield in the elite herds. For the more effective use of this situation in breeding, it would be beneficial to establish Kilis Goat Research Institute in Kilis. And, it would be beneficial to produce semen from pedigree males in this special herd to be created here and use them for artificial insemination in our country.

On this occasion, I would like to reiterate that, if this institute is established, very rapid developments can be achieved in goat breeding with semen to be produced from high quality and tested bucks in our country. And, Turkiye can create a brand in this field in the international arena.

Acknowledgments

This manuscript has been prepared as part of a project titled as “"National Genetic Improvement Project for Kilis Goats at Breeders' Condition" carried out in cooperation with Republic Of Turkiye Ministry Of Agriculture and Forestry, General Directorate of Agricultural Research and Policies. The authors would like to thank the General Directorate and Kilis sheep and goat breeders' association.

Author contributions

All authors contributed equally to the study.

Conflicts of interest

The author declare no conflicts of interest.

References

Aktepe, T. (2009). Kilis keçilerinde anatomik morfolojik ve fizyolojik adaptasyon parametrelerinin saptanması üzerine bir araştırma. Yüksek lisans tezi. Çukurova Üniversitesi Fen Bilimleri Enstitüsü Zootekni Anabilim Dalı, Adana.

Anonymous (1969). Türkiye'nin tarimsal üretim projeksiyonu. Ankara.

Anonymous (2021). İllere ait mevsim normalleri (1991-2020). https://www.mgm.gov.tr/ veridegerlendirme/il-ve-ilceler-istatistik.aspx?m=KILIS.

Baltacı, S. (1990). Ceylanpınar Tarım İşletmesinde yetiştirilen Kilis keçisi ve melezlerinin adaptasyonu üzerine bir araştırma. Çukurova Üniversitesi Fen Bilimleri Enstitüsü Zootekni Anabilim Dalı Yüksek Lisans Tezi, Adana.

Gül, S., Keskin, M., Göçmez, Z., Gündüz, Z. (2016). Effects of Supplemental Feeding on Performance of Kilis Goats Kept on Pasture Condition. *Italian Journal of Animal Science*. 15 (1): 110-115.

Gül, S., Yılmaz, O., Gündüz, Z., Keskin, M., Cemal, İ., Ata, N., Önel, S.E. (2020). The genetic structure of the goat breeds belonging to Northwest part of Fertile Crescent. *Small Ruminant Research*, 182: 22-28.

Güney, O. (1984). Saanen x Kilis ve Saanen x Kıl birinci geriye melez erkek oğlakların besi gücü ve karkas özellikleri üzerinde bir araştırma. *Doğa Bilim Dergisi*, Seri D1, 8 (1).

Keskin. M., Kaya, Ş., Özcan, L. ve Biçer, O. (1996). Hatay Bölgesinde yetiştirilen keçilerin bazı morfolojik ve fizyolojik özellikleri üzerinde bir araştırma. *Mustafa Kemal Üniversitesi Ziraat Fakültesi Dergisi*, 1(1): 69-84.

Keskin, M. (2000). Hatay bölgesinde yoğun yetiştirme koşullarinda Damascus keçilerinin morfolojik özellikleri ve performanslarinin saptanması. Mustafa Kemal Üniversitesi Fen Bilimleri Enstitüsü, Zootekni Anabilim Dalı, Doktora Tezi, Antakya.

Keskin, M., Gül, S., Biçer, O., Daşkıran, İ. (2017). Some reproductive, lactation, and kid growth characteristics of Kilis goats under semiintensive conditions. *Turk J Vet Anim Sci.,* 41: 248-254.

Keskin, M., Yılmaz, O., Gündüz, Z., Ata, N., Gül, S., Cemal, İ., Karaca, O., Önel, S.E. (2019). Microsatellite panels for parentage testing of Kilis goats reared in Turkey. *Turk J Vet Anim Sci.,* 43: 94-101.

Keskin, M. (2020). Effects of nutritional practices in different periods on some yield characteristics of Kilis goats. *Mustafa Kemal University Journal of Agricultural Sciences* 25 (2): 122-126.

Özcan, L. (1977). Ç.Ü. Ziraat Fakültesinde yetiştirilen Kilis ve Kılkeçilerinin ıslahında Saanen ve G1 genotiplerinden yararlanma olanakları. Çukurova Üniversitesi Ziraat Fakültesi Yayınları, 122, Bilimsel İnceleme ve Araştırma Tezleri: 19, Adana.

Özcan, L., Pekel, E., Güney, O. (1974). Ç.Ü. Ziraat Fakültesinde yetiştirilen Kilis, Kıl, Gs1 keçilerinde döl ve süt verim özellikleri üzerine karşilaştirmali araştirmalar. Çukurova Üniversitesi Ziraat Fakültesi Yıllığı, 5: 1-3 Ankara.

Sönmez, R. (1974). Melezleme yoluyla yerli Kılkeçilerin süt keçisine çevrilme olanakları. Ege Üniversitesi Ziraat Fakültesi Yayınları no: 326, İzmir.

Sönmez, R., Şengonca, M., Kaymakçı, M. (1973). Ege Bölgesinde yetiştirilen çeşitli süt tipi keçilerle bunlarin melezlerinin adaptasyon durumu ve verim özellikleri üzerine mukayeseli bir araştirma. IV. Bilim Kongresi, Ankara.

Şimşek, U.G., Bayraktar, M., Gürses, M. (2006). Çiftlik koşullarında kıl keçilerine ait bazı verim özelliklerinin araştırılması. *Fırat Üniversitesi Sağlık Bilimleri Veteriner Dergisi*, 20 (3): 221-227.

Livestock Studies 62(1),16-20
http://doi.org/10.46897/livestockstudies.1077855

LIVESTOCK STUDIES

RESEARCH PAPER

Effects of Environmental Factors on Growth Performance of Kilis goat in Gaziantep province

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Article History
Received: 17 November 2021
Accepted: 24 December 2021
First Online: 01 April 2022

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Keywords
Kilis goat
Environmental factors
Growth performance

Abstract

The study aimed to investigate the effects of maternal age, birth type, gender, birth month and birth season on birth weight, weaning weight and average daily gain of Kilis goat kids reared in Gaziantep province. This study evaluated a total of 14956 kids born in 2019 and 2020 participating in the national project named "Improvement of Kilis Goat under Farm Conditions". The result showed an average birth weight of 3.5 ± 0.01 kg, a weaning weight of 15.2 ± 0.02 kg and an average daily gain of 193.4 g. Maternal age, sex, the month of birth, and year also affected mean birth weight, weaning weight, and daily gain ($P < 0.01$).

Introduction

For sustainable production in livestock, the factors affecting the growth and development of the offspring should be determined appropriately. One of the ways to increase the effectiveness of selection on quantitative traits is to identify the effects of measurable environmental factors that influence yields. Thus, using these values, corrections can be made to the production values of individuals. This standardization of yield values eliminates the effects of the environmental factors in question and more accurately identifies the animals to be selected as breeding stock. The most important discrete environmental factors are maternal age, birth type, and sex. It is known that old mothers grow faster than young ones, single borns are faster than twins and male lambs grow faster than females (Akbaş *et al*., 2013; Gül *et al.*, 2016; Çoban and Torun, 2020; Keskin *et al*., 2017; Nuntapaitoon *et al*., 2021). Therefore, the birth and weaning weights of the above animals may be higher. The genes that control the sex and birth type of the offspring and the genes that control growth and development are different. Therefore, if the growth and development characteristics of the animals to be selected for breeding are taken into account, eliminating the impact of environmental factors with the corrections to be made will increase the accuracy of the selection. The meat, milk, leather and hair of sheep and goats are finding increasing use in different parts of life. For this reason, the breeding of small livestock is well on the way to finding the place it deserves, as its value is increasing day by day. Domestic goats, like other breeding goats, have characteristics such as better digestibility of cellulosic feeds, resistance to disease, ability to move freely in all types of terrain conditions, and economic efficiency under extensive conditions.

Kilis goat, which is one of the local genetic resources, is also an important genetic source for our country. Moreover, it is the breed with the highest milk yield among domestic goat breeds. In order to breed Kilis goats, in 2011, the Ministry of Agriculture and Forestry, General Directorate of Agricultural Research and Policy, initiated the project of breeding Kilis goats in Gaziantep province, which is a sub-project of the National Project of Sheep Breeding in Public Ownership. Under this project, goat breeders learned to keep records and awareness was created. Within the scope of this project, the milk yield, birth weight and

weaning weight of goats are determined and the selection of breeding animals is based on these data.

In animal production, the object is to increase the number of possible animals that will reach productive age and to obtain the highest yield from these animals under the breeding conditions. For this reason, birth and weaning weights are very important, and birth weight is one of the most important characteristics that determine survival. At the same time, it will be of great benefit for breeding to know the influence of the factors affecting these traits in future studies.
In this study, the effects of environmental factors on goat cub growth and development were evaluated based on the data from this project.

Materials and Methods

In this study, birth and weaning weights of Kilis goat kids born in 2019 and 2020 were used in the project named Breeding of Kilis Goats in Gaziantep. A detailed description of the data structure with the sample size was presented in Table 1.

Table 1. Descriptive statistics of growth traits in Kilis goat kids.

Traits	BW	WW	ADG
No. of observation	14956	13983	13983
Mean	3.5	15.2	193.4
Standard deviation	0.52	1.81	28.07
Standard error	0.01	0.02	0.23
Coefficient of Variation	0.14	0.12	0.15
Minimum	1.60	9.85	101.7
Maximum	6.48	24.50	333.3

BW: Birth weight, WW: Weaning weight, ADG: Average daily weight

The goats were grazed in the surrounding pastures throughout the year, depending on the season. The pastures are generally covered with short seasonal grasses and shrubs. Depending on the production season and variety, they are grazed on stubble after harvesting barley, wheat and chickpeas. During severe winter periods and when grazing is insufficient, supplementary feeding of barley, bran, wheat cracked, lentil, barley and wheat straw mixtures were given in the amount of 400 - 600 g per animal.

In the study, the birth weight and weaning weight of newborn kids were weighed using digital scales with a sensitivity of 100 g precision balance. Date of birth, type of delivery, sex and weaning weight (60^{th} day) was also recorded. Birth and weaning weights were evaluated using an additive correction coefficient for sex, birth, month of birth, year of birth and maternal age.

The mathematical model of study is;
$Y_{ijklm} = \mu + \alpha_i + \beta_j + \gamma_k + £_l + e_{ijklm}$, in this model,
Y_{ijklm}, is an individual observation
μ, the overall mean
α_i, i. effect of the sex (female or male),
β_j, j. effect of the birth type (single, twin, triplet),
γ_k, k. effect of the birth month (Jan., Feb., March)
$£_l$, l. effect of the maternal age (1, 2, 3, 4, 5≥age),
e_{ijklm}, is the experimental error.

Statistical analyzes of the study were performed using the General Linear Model (GLM) and it's significance control of differences between group means by Duncan multiple comparison test in Statistical Package for Social Sciences version 21.0 software for Windows. The normality assumption was tested with Kolmogorov-Smirnov and Shapiro-Wilk tests. The homogeneity assumption was tested with Levene's test. Explanatory statistics of variables are given as mean ± standard error (SPSS, 2012).

Results and Discussion

In this study, the effects of maternal age, the month of birth, year of birth, type of delivery and sex on birth and weaning weights of Kilis goat kids were investigated (Table 2).

Table 2 shows that sex has an effect on birth weight. Birth weights of both sexes were close (3.6 + 0.01 kg vs. 3.5 + 0.01 kg), but these differences were statistically significant ($P < 0.01$). The influence of sex in kids was also evident in weaning weight. Again, similar results were obtained and the numerical difference between them was statistically significant ($P < 0.01$). A similar effect was also observed in daily body weight gain ($P < 0.01$). there were similar effects in favour of males in terms of developmental traits.

Several researchers have found that sex has an effect on birth, weaning, and daily weight gain. (Savaş, 2009; Andries, 2013; Deribe and Taye, 2013; Gül *et al*., 2016; Keskin *et al*., 2017, Çelik and Oflaz, 2018). The birth weight of Kilis goats is 3.8 kg in male kids and 3.4 kg in female kids; weaning weight is 11.9 kg in females and 12.6 kg in males. Özdemir and Keskin (2018), reported that the birth weights of Kilis goat kids 3.4 kg in females and 3.8 kg in males and weaning weights of 12.6 kg and 13.5 kg according to the same sex order in Kilis goat kids reared in Gaziantep. Our results were close to the researchers' reports in terms of birth weight and higher than their reports in terms of weaning weight. This difference could be due to differences in care, feeding and herds.

It was determined that the type of delivery has an effect on birth weight. While birth weights of single and twin kids were similar, numerical differences were important between triplets and the other two types of birth ($P < 0.01$). On the other hand, the single and twin kids had similar body weights at weaning ($P > 0.05$). There were significant differences between triplet and the others ($P < 0.01$). The highest weaning weight was recorded by the single kids (15.2 ± 0.02 kg) and the

Table 2. The least-square means ± SE of the growth performance in Kilis goat kids by the gender, birth type and mother age.

	n	BW (kg)	n	WW (kg)	n	ADG (g)
Gender						
Male	7475	3.6 ± 0.01	7009	15.2 ± 0.02	7009	194.3 ± 0.34
Female	7481	3.5 ± 0.01	6974	15.1 ± 0.02	6974	192.4 ± 0.32
P		0.000		0.000		0.000
Birth type						
Single	8972	3.6 ± 0.01^{b}	8262	15.2 ± 0.02^{b}	8262	193.6 ± 0.32^{b}
Twin	5963	3.5 ± 0.01^{b}	5700	15.1 ± 0.02^{b}	5700	193.0 ± 0.33^{b}
Triplet	21	3.1 ± 0.01^{a}	21	14.3 ± 0.22^{a}	21	186.5 ± 0.75^{a}
P		0.000		0.000		0.028
Maternal age						
2	2569	3.5 ± 0.01^{a}	2420	14.7 ± 0.04^{a}	2420	187.2 ± 0.56^{a}
3	3124	3.6 ± 0.01^{b}	2898	15.2 ± 0.03^{b}	2898	193.3 ± 0.52^{b}
4	3628	3.5 ± 0.01^{a}	3316	15.1 ± 0.03^{b}	3316	193.3 ± 0.47^{b}
5 ≥	5635	3.6 ± 0.01^{b}	5349	15.4 ± 0.03^{c}	5349	196.2 ± 0.39^{c}
P		0.000		0.000		0.000
Overall	14956	3.5 ± 0.01	13983	15.2 ± 0.02	13983	193.4 ± 0.24

BW: Birth weight, WW: Weaning weight, ADG: Average daily gain

Table 3. The least-square means ± se of the growth performance in Kilis goat kids by the months and years.

Months	n	BW (kg)	n	WW (kg)	n	ADG (g)
January	4653	3.5 ± 0.01^{a}	4385	15.2 ± 0.03^{b}	4385	194.5 ± 0.42^{b}
February	7867	3.5 ± 0.01^{a}	7384	15.1 ± 0.02^{a}	7384	193.2 ± 0.34^{ab}
March	2436	3.6 ± 0.01^{b}	2214	15.1 ± 0.03^{a}	2214	191.5 ± 0.55^{a}
P		0.000		0.037		0.000
Years						
2019	7330	3.5 ± 0.01	6752	14.5 ± 0.02	6752	188.7 ± 0.33
2020	7626	3.6 ± 0.01	7231	15.5 ± 0.02	7231	197.7 ± 0.33
P		0.000		0.000		0.000

BW: birth weight, WW: weaning weight, ADG: Average daily gain

lowest by the triplets (14.3 ± 0.22 kg). This similarity was also the case with daily weight gain. While the live weights calculated for single and twin kids were similar (193.6 ± 0.32 g vs. 193.0 ± 0.33 g), a statistical difference was found between these two groups and the triplet kids (186.5 ± 0.75 g).

Studies on different goat breeds have determined the effect of birth type on birth weight, weaning weight and daily body weight gain (Momani *et al*., 2012; Deribe and Taye, 2013; Keskin *et al*., 2016; Özdemir and Keskin, 2018; Kurtay, 2019; Çoban and Torun, 2020). Gül *et al*. (2016) reported that the birth weight of Kilis goat kids was 3.0 ± 0.05 kg for single kids in the control group, 2.5 ± 0.06 kg for twins, 3.5 ± 0.05 kg for single-born kids in the supplementary feed group, 2.9±0.08 kg in twin born kids, 2.9 ± 0.08 kg in twin born kids. Weaning weights in Kilis goats were 16.0 ± 0.14 kg and 14.1 ± 0.23 kg in the control group according to the same birth type order while in the supplementary feeding group they were 17.7 ± 0.29 kg and 16.1 ± 0.22 kg. The results were high concerning birth weight and low concerning weaning weight. The numerical differences between the goats maybe since the goats are kept in different provinces, as well as the differences in care and feeding.

This study shows that maternal ages have effects on birth weights in different age groups. The birth weight of kids born to does age two years and kids born to does age 4 years were the same (3.5 ± 0.01 kg; $P > 0.01$), and the same situation was found in kids born to mothers aged 3 and 5 years and above (3.6 ± 0.01 kg; $P > 0.01$). The difference of 100 g between both age groups was statistically significant ($P < 0.01$). Dams have influences on weaning weight and daily weight gains. While the lowest weaning weight was obtained by the 2 years old mothers (14.7 ± 0.04 kg), the highest value was obtained by the dams that had given birth at the age of 5 years and older ($P < 0.01$). As for daily live weight gain, the lowest kid weight was obtained by 2-year-old mothers and the highest value was obtained by mothers who had given birth at the age of 5 years and above ($P < 0.01$).

In terms of birth weight and developmental characteristics of goats, Bolcalı and Küçük (2012) determined that maternal age was not significant in Saanen goats, on the other hand, some researchers reported that this factor has a significant effect on birth and weaning weights (Çelik and Oflaz, 2018, Mellado *et al*., 2006; Sghaier *et al*., 2007; Erten and Yılmaz, 2013). The birth weights of kids were influenced by their birth months (Table 3). While weights of kids born in January and February were the same (3.5 ± 0.01 kg vs. 3.5 ± 0.01 kg), this value was 3.6 ± 0.01 kg in March ($P < 0.01$).

Weaning weight and daily weight gain were also affected by birth months ($P < 0.05$; $P < 0.001$). Daily live weight gain was 194.5 ± 0.42 g in kids born in January, 193.2 ± 0.34 g in kids born in February and 191.5 ± 0.55 g for kids born in March ($P < 0.01$).

This situation, which may vary according to the region and pasture vegetation may have a positive or negative effect on the developmental characteristics of the kids with high birth weight in the current study. We know that the fact that goats give birth at different months affects the birth weight, weaning weight and daily gain of kids. Thus, Browning *et al*. (2011) found that the average birth weight of goats were 2.95 kg in March and 3.17 kg in May. In the same study, the average weaning weights and daily weight gains were informed as 15.58 kg and 139.8 g for March and 13.19 kg and 111.1 g for May, respectively. It has also been reported that birth months affect birth weight, weaning weight and daily gain in kids (Andries, 2013; Das *et al*., 2018; Alemu *et al*., 2020; Nuntapaitoon *et al*., 2021). The reports of these researchers are in line with our results. Years of birth have important effects on the birth weight, weaning weight and daily weight gain (Table 3). There are different studies that years have important or unimportant effects on these characteristics. Thus, they were found that year of birth did not affect the developmental characteristics of kids in Kilis goats (Bolcalı and Küçük, 2012; Gül *et al.,* 2016). However, Savaş (2009), Petrovic *et al*. (2012), Andries (2013), Das *et al*. (2018), Alemu *et al*. (2020), Nuntapaitoon *et al.* (2021) found that the year has got effect on these characteristics. In the present study, it can be speculated that the effect of the year on these characteristics were caused by semi-extensive production systems in goat breeding. The fact that production is largely dependent on natural pasture and the climatic conditions can change from year to year undoubtedly affect these results.

Conclusion

The current results show that maternal age, birth month, birth year, sex and birth type have significant effects on birth weight, weaning weight and daily live weight gain in Kilis goats. The results indicate that eliminating the effects of these environmental factors will increase the efficiency of selection to select the breeding stocks for Kilis goat herds.

Author Contributions

All authors contributed equally to the study.

Conflicts of Interest

The author declares no conflicts of interest.

Acknowledgments

The authors would like to thank the Republic of Türkiye Ministry of Agriculture and Forestry, General Directorate of Agricultural Research and Policies for its project support (Project No: 27KLS2012-01).

References

Akbas, A.A., Colak, M., Elmaz, O., Saatci, M. (2013). Determination of growth performance of the Saanen kids reared in north-west Mediterranean condition. *Eurasian J Vet Sci.* 29, 2: 70-75.

Alemu, T.T, Ashebir, W., Aman, G., Mieso, G., Genet, D. (2020). Growth performance evaluation of goat breed under farmers management at Fantale district, Oromia regional state, Ethiopia. *SF Journal of Agricultural and Crop Management* 1, 2: 1-5.

Andries, K.M. (2013). Growth and performance of meat goat kids from two seasons of birth in Kentucky. *Sheep & Goat Research Journal* 28: 16-20.

Bolacalı, M., Küçük, M. (2012). Fertility and milk production characteristics of Saanen goats raised in Muş region. *Kafkas Univ Vet Fak Derg*. 18, 3: 351-358.

Browning, R.Jr., Leite-Browning, M.L. (2011). Birth to weaning kid traits from a complete diallel of Boer, Kiko, and Spanish meat goat breeds semi-intensively managed on humid subtropical pasture. *Journal Anim Sci* 89, 9: 2696-2707.

Çelik, H.T., Oflaz, M. (2018). Investigation on survival rate and growth characteristics of pure Hair goat and Saanen x Hair goat (F_1, B_1, B_2) crossbreds in breeder conditions. *Mediterranean Agricultural Sciences* 31, 1: 77-85.

Çoban, Y., Torun, O. (2020). Çukurova Üniversitesi Ziraat Fakültesi Araştirma ve Uygulama Çiftliğinde

yetiştirilen keçilerin döl ve süt verim performanslari. *Ç.Ü Fen ve Mühendislik Bilimleri Dergisi* 39, 10: 91-99.

Das, B.C., Bera, S., Pandit, S., Panda, R., Roy, M. (2018). Studies on growth parameters of black Bengal goats in coastal Sundarban of West Bengal. *International Journal of Fauna and Biological Studies* 5, 1–4.

Deribe, B., Taye, M. (2013). Evaluation of growth performance of Abergele goats under traditional management systems in Sekota district, Ethiopia. *Pakistan Journal of Biological Sciences* 16, 14: 692-696.

Erten, Ö., Yılmaz, O. (2013). Ekstansif koşullarda yetiştirilen Kıl keçilerinin döl ve süt verimi özelliklerinin araştırılması. *YYU Veteriner Fakultesi Dergisi* 24, 3: 109-112.

Gül, S., Keskin, M., Göçmez, Z., Gündüz, Z. (2016). Effects of supplemental feeding on performance of Kilis goats kept on pasture condition. *Italian Journal of Animal Science* 15, 1: 110-115.

Keskin, M., Gül, S., Can, E., Gündüz, Z. (2016). Yarı entansif koşullarda yetiştirilen Şam Keçileri ile Kilis x Kıl keçisi melez genotipinin süt ve döl verim özellikleri. *Lalahan Hay Araşt Enst Derg.* 56, 1: 20-24.

Keskin, M., Gül, S., Biçer, O., Daşkıran, İ. (2017). Some reproductive, lactation, and kid growth characteristics of Kilis goats under semiintensive conditions. *Turkish Journal of Veterinary and Animal Sciences* 41: 248-254.

Kurtay, T. (2019). Yetiştirici koşullarinda Halep Keçisi x Kilis Keçisi F_1 oğlaklarinin büyüme ve yaşama özelliklerinin belirlenmesi. Yüksek Lisans Bitirme Tezi. Dicle Üniversitesi Fen Bilimleri Enstitüsü, Diyarbakır, 54s.

Mellado, M., Valdez, R., García, J.E., López, R., Rodríguez, A. (2006). Factors affecting the reproductive performance of goats under intensive conditions in a hot arid environment. *Small Rumin Res.* 63: 110-118.

Momani, MS., Sanogo, S., Coulibaly, D., Al-Olofi, S., Alkhewani, T. (2012). Growth performance and milk yield in Sahelian x Anglo-Nubian goats following crossbreeding in the semi-arid zone of Mali. *Agricultura Tropica Et Subtropica* 45, 3: 117-125.

Nuntapaitoon, M., Buranakarl, C., Thammacharoen, S., Katoh, K. (2021). Growth performance of Black Bengal, Saanen, and their crossbred F_1 as affected by sex, litter size, and season of kidding *Anim. Sci. J.* 92: e13571.

Özdemir, F.H., Keskin, M. (2018). Comparison of Kilis goats raised in Gaziantep and Kilis provinces due to some morphological and physiological characteristics. *Journal of Agricultural Faculty of Mustafa Kemal University* 23, 1: 115-123.

Petrovic, C.V., Ilic, Z., Muslic, D.R., Petrovic, M.P., Petrovic, M.M., Tomic, Z., Marinkov, G. (2012). Analysis of environmental and genetic factors in growth characterıstics of Balkan goat. *Biotechnology in Animal Husbandry* 28, 2: 275-282.

Savaş, T. (2009). Keçilerde doğum ağırlığı üzerine doğum tipi x cinsiyet etkileşimi ve akrabalı yetişmenin etkisi. *Tarım Bilimleri Dergisi* 15, 1: 96-104.

Sghaier, N., Amor, G., Mabrouk, O, Mouldi, A., Mohamed, B.H. (2007). Indigenous kids weight variation with respect to non genetic factors under pastoral mode in Tunisian arid region. *Journal of Animal Veterinary Advances* 6, 3: 441-450.

SPSS (2012). IBM Corp. Released 2012. IBM SPSS Statistics for Windows, Version 21.0. Armonk, NY, USA: IBM Corp.

Livestock Studies 62(1), 21-30
https://doi.org/10.46897/livestockstudies.1120052

RESEARCH PAPER

LIVESTOCK STUDIES

The First Identification and Some Carcass Characteristics of the 7 Lumbar Vertebrae in Sheep in Turkey

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Article History
Received: 30 September 2021
Accepted: 23 February 2022
First Online: 23 May 2022

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Keywords
Lamb
Lumbar vertebrae number
Slaughter traits
Carcass traits

Abstract

The purpose of this study was to draw attention to the number of the lumbar vertebrae in BA B1 crosses (Bafra×F1 (Bafra×Akkaraman)) lambs (75% Bafra and 25% Akkaraman), and the effect of 7 lumbar vertebrae on some carcass traits. Even though some studies reported that the number of the lumbar vertebrae might be considerably different dependent on the sheep genotype, this has not been reported for Turkish breeds. While a study on the BA B1 lambs has been performed, seven lumbar vertebrae have been identified in four of the eighteen lambs. The means of the carcass length (80.800±0.583 and 84.375±1.375 cm) (P = 0.036), leg weight (5.942±0.079 and 6.209±0.052kg) (P = 0.032), loin weight (1.560±0.096 and 1.849±0.060 kg) (P = 0.048), and loin's lean weight (0.875±0.059 and 1.058±0.032 kg) (P=0.040) were statistically different between the groups of lambs (6 and 7 lumbar vertebrae, respectively). In conclusion, the number of lumbar vertebrae has economically affected important parts of the carcass.

Introduction

The mammalian vertebral column, also known as the spinal column or spin, consists of a sequence and repeating bones called vertebrae and is divided into five morphologically different and functionally distinct spinal regions (cervical, thoracic, lumbar, sacral and caudal vertebrae) (Donaldson *et al*., 2013; Zhang *et al*., 2019). The vertebrae number of the each region gives the vertebral pattern, and this pattern is generally C7T13L6(7)S4Ca(Cy)16-18 in the sheep breeds (Akers and Denbow, 2013). This pattern varies across the mammalian species, but the cervical vertebrae number is conserved at a total of seven in the mammalian species except for a few species (Lambe *et al*., 2014; Lee *et al*., 2011). Moreover, the vertebral number of the post-cervical region shows differences between and within the breeds. For instance, Arabian horses have one less lumbar vertebra than the all other common horse breeds, and European commercial pig breeds (n=21–23) have more thoracolumbar vertebrae than the Asian breeds (n=19-20) (Borchers *et al*., 2004; Reese, 2019; Zhang *et al*., 2017). In the sheep, European breeds (n=17-21) and Chinese indigenous breeds (n=19-21) may reveal the range of variation in terms of the thoracolumbar vertebrae number (Zhang *et al*., 2017, 2019). It is reported that lumbar vertebrae numbers of the Texel, Scottish Blackface, and Mongolia sheep have shown a variation between 4 and 7; 6 and 8; 6 and 7, respectively (Donaldson *et al*., 2013; Zhang *et al*., 1998;).

The length of the thoracolumbar region affects the production traits, so the variation of the thoracolumbar vertebra number within the breeds can be used to increase the production yields per animal. For example, Arabian horses have five lumbar vertebrae, and this trait provides them a better endurance ability than other horse breeds. On the other hand, long thoracolumbar region in the livestock affects the body length, carcass

traits and the amount of quality meat in the carcass because this region is the most valuable section of the carcass. In addition, long body length can affect the fertility and milking traits since the long lumbar region provides larger area for genital organs (Akçapınar and Özbeyaz, 1999; Akçapınar, 2000).

It is known that vertebral number was highly heritable in the pigs (Borchers *et al*., 2004; King and Roberts, 1960), and the selection of pig broods with longer back trait caused more thoracolumbar vertebras in the commercial pig breeds having 21 to 23 thoracolumbar vertebras than their ancestors having 19 thoracolumbar vertebras (Donaldson *et al*., 2013; Fredeen and Newman, 1962; Yang *et al*., 2009). King and Roberts (1960) reported that each extra vertebra caused an increase of about 1.5 cm in the carcass length, and on the other hand Tohara (1967) stated this variation in the pig breeds could cause totally 85 mm extension in the carcass length.

As already mentioned, the trochal and lumbar vertebrae numbers in the sheep show a variation between and within the breed. Higher thoracolumbar vertebrae number is a desirable trait; therefore, this is expected to increase in the sheep populations. Zhang and Siqin (1998) indicated this rate increase in the Mongolian sheep between 1982 and 1996 years. The heritability of the vertebra number in the sheep is different for separate vertebral regions. While this trait in the Texel sheep is high for the trochal region (h^2=0.99; SE=0.42), it is relatively low for the lumbar region (h2=0.08; SE=0.12) (Donaldson, 2015).

Genetic control of the vertebral morphology was determined to be done by the Hox gene family (Wellik, 2007). Previous studies showed that Vertin (VRTN) gene affects the thoracic vertebrae number in sheep and pigs, and NR6A1 gene affects the lumbar vertebrae number in pigs (Li *et al*., 2019; Yang *et al*., 2016).

The objective of this current study was to evaluate the effect of 6 and 7 lumbar vertebrae numbers (Figure 1) on the slaughter and carcass traits in the BA B1 genotype.

Materials and Methods

Materials

This study was performed using 9 BA B1 lambs (5 lambs having 6 lumbar vertebrae and 4 lambs having 7 lumbar vertebrae). BA B1 lamb is a crossbreed genotype, obtained via the crossbreeding of Bafra (75%) and Akkaraman (25%) breeds at the Gozlu state farm (38° 29' N and 32° 27' E, 1020 m of altitude) in the central Anatolia region of Turkey. Bafra rams mated with Akkaraman ewes, and F1 ewes were then backcrossed with Bafra rams to produce the second cross (B1) lambs.

Lambs were separated from dams at an average 90 days of age (weaning) and fattened during 84 days with ad-libitum concentrate fed (15% crude protein and 2,800 kcal/kg ME) and 300 g alfalfa hay per animal/day after 10 days dietary adaptation period. Finally, lambs having 6 and 7 lumbar vertebrae were slaughtered at a mean weight of 42.950±0.877 and 42.175±0.893 kg, respectively.

Methods

Lambs' weights were determined 12 hours before slaughter, and then when fasting just before slaughter. Head, skin, feet, heart, lungs, liver, spleen, testicles, full digestive tract, empty rumen, empty intestine, trachea-

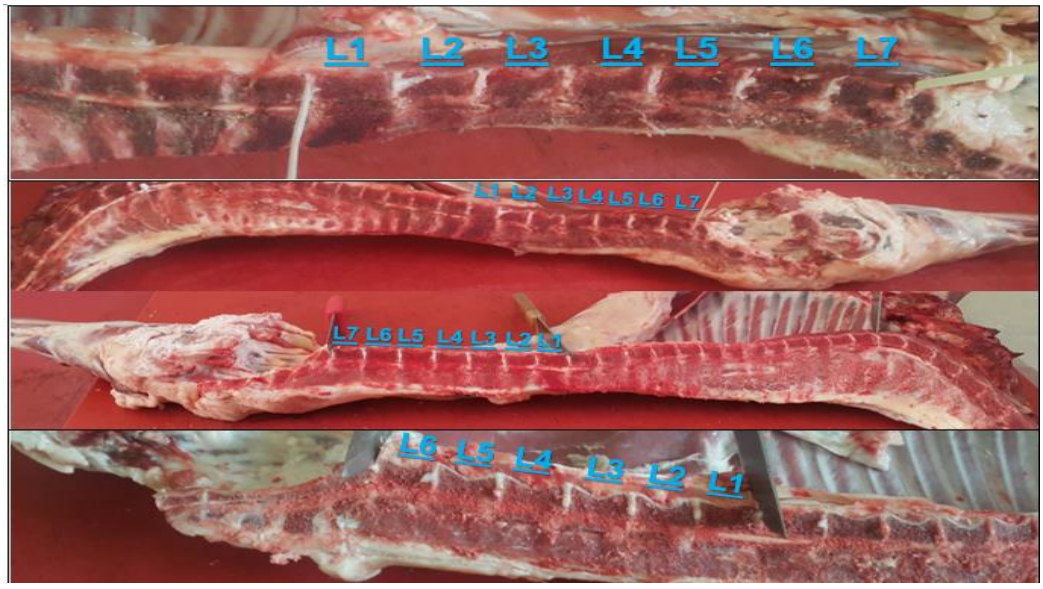


Figure 1. Some carcass photos for the carcasses having 6 and 7 lumbar vertebrae.

esophagus, omental fat, and mesenteric fat were removed and weighted after bleeding. Then, the carcass measurements were taken.

The length of the carcass (between the caput humeri and tuber ischia), the back (between the distal cranial points of the shoulder and the tail), the leg internal (between the cranial edge of symphysis pubis and the tarsal–metatarsal joint), the leg external (between the articulatio coxae and the tarsal–metatarsal joint), the rump (between the tuber coxae and tuber ischia) and the neck (between the distal cranial point of the shoulder and cranial point of the neck) were measured on the carcasses. Similarly, the width of the leg (distance between the two gigots at the junction point alignment of the legs), the chest (distance between the left and right of the extremitas proximalis scapulas) and the rump (distance between the articulationes coxae) were obtained on the carcasses. Then, leg circumference (over the articulationes coxae on the carcass), chest girth (over the caudal points of the scapulas), rump girth (over the articulationes coxae), chest depth (distance between the sternum and the withers) were taken. Carcass compactness and leg compactness indexes were calculated by the formulae: cold carcass weight/length (kg/m) and leg weight/length (kg/m), respectively (Santos *et al*., 2007).

Gastrointestinal tracts were weighed both full and empty to identify gastro-intestinal contents weights, and empty body weight was calculated using these values. Consequently, dressing percentages were calculated based on slaughter weight and empty body weight. The carcass body (including perinephric–pelvic fat and kidneys) was chilled at 4 °C for 24 h and weighed. To measure the eye muscle (MLD: musculus longissimus dorsi) area (cm2), it was drawn onto the transparency sheet at the level of the 12th and 13th rib 24 h after the slaughter, and this figure area was calculated using th e AutoCAD software (version 2019). At the same time, the fat depth was measured from subcutaneous fat using a caliper in this region.

After this period, tail, perinephric–pelvic fat and kidneys were separated from the carcasses, and the carcasses were symmetrically divided through the columna vertebralis. Left and right side of the carcass were weighed, and left side was cut into six sections (leg, foreleg, back, loin, neck and breast+flank) according to the Akçapınar (1981). These individual cuts were grouped by first quality (leg, back, and loin), second quality (foreleg), and third quality (neck and breast+flank) according to the Díaz *et al*. (2006). Each individual cut piece was dissected and weighed as the lean, bone, fat, and remainder.

Statistical Analysis

In this study, SPSS software package (SPSS Software, 2005) was used for the t-test analysis to determine the influence of having 6 and 7 lumbar vertebrae lambs within the genotype on the slaughter and carcass characteristics.

Results and Discussion

Generally, lamb meat production is the primary function of the world and Turkey sheep industry. The profit increase in this industry can be achieved in a number of ways; and especially development of the carcass quality traits is one of those ways. The detection of the easy identification methods, determination of the gene effects on the carcass characteristics and using those in the animal breeding programs can provide an increase in the amount of muscle and saleable meat for specific body regions or cuts. For instance, the increase in the trochal and/or lumbar vertebrae numbers (i.e., larger carcass length and lumbar vertebrae number) is significant in terms of sheep meat production.

Table 1. Means (±SE) of slaughter characteristics.

Trait	Means			Minimum	Maximum
	L6 (n:5)	L7 (n:4)	Sig.	L6 - L7	L6 - L7
Final weight (kg)	44.020±0.905	44.088±0.915	0.960	42.450-42.750	46.700-46.750
Slaughter weight (kg)	42.950±0.877	42.175±0.893	0.560	41.350-41.200	45.450-44.850
Empty body weight (kg)	40.663±0.755	40.636±0.861	0.981	39.179-39.197	43.042-43.071
Hot carcass weight (kg)	20.452±0.590	20.211±0.529	0.776	18.982-19.395	22.589-21.766
Carcass weight (kg)	19.720±0.524	19.650±0.403	0.922	18.400-19.000	21.600-21.800
Hot dressing[a] (%)	47.627±1.062	47.909±0.304	0.810	44.853-47.075	50.535-48.531
Hot dressing[b] (%)	50.270±0.738	49.730±0.531	0.591	48.449-48.763	52.481-50.756
Chilled dressing[a] (%)	45.940±1.081	46.960±0.312	0.587	42.684-46.116	48.322-47.515
Chilled dressing[b] (%)	48.485±0.724	48.360±0.231	0.880	46.455-47.868	50.183-48.983

L6 and L7: No. of lumbar vertebrae

[a] Based-on slaughter weight

[b] Based-on empty body weight

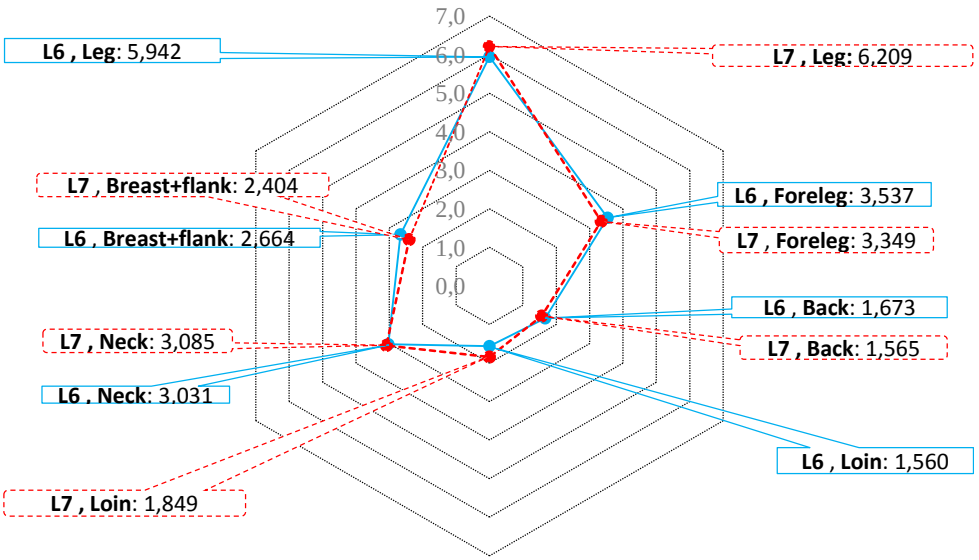


Figure 2. Means for individual cuts in the carcass (kg).

As a result of this information, it is known that larger lumbar vertebrae number will affect the quality meat ratio in the carcass. Therefore, the evaluation of the vertebral number in the sheep breed can improve the profit of the producer per animal.

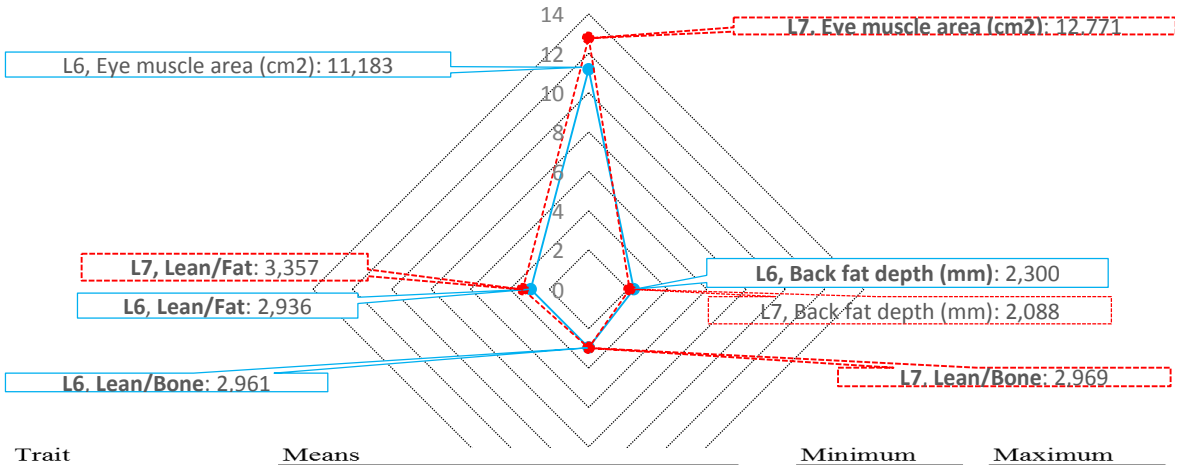
The values of the slaughter characteristics were presented in Table 1. The differences in the slaughter characteristics between L6 and L7 lamb groups were not significant. This result can be considered to be normal since the final and slaughter weights of two groups are very close.

There were not any significant differences between the non-carcass components of two groups (Table 2). It, however, draws attention to the weight of skin, head, and omental fat which are higher for the lambs having 6 lumbar vertebrae.

The traits of carcass measurements were shown in Table 3. As expected, carcass length of the lambs having 7 lumbar vertebrae was significantly (P = 0.036) longer than the lambs having 6 lumbar vertebrae. There were significant differences between two groups for rump width (P = 0.048). Besides, leg external length and neck length were numerically better for the lambs having 7 vertebrae.

The means, minimum-maximum values and ratios for individual cuts and compositions of carcasses were given in Table 4. Weight of leg (P = 0.032) and loin (P = 0.048) values between two groups were found to be statistically important. The highest leg and loin weights were obtained for the lambs having 7 lumbar vertebrae (Figure2).

Eye muscle area, back fat depth, lean/bone and lean/fat values were reported in Figure3. There were no statistical differences between two groups in terms of these values. Eye muscle area and lean/ fat values of the lambs having 7 lumbar vertebrae, however, are



Trait	Means			Minimum	Maximum
	L6 (n:5)	L7 (n:4)	Sig.	L6 - L7	L6 - L7
Lean/Fat	2.936±0.246	3.357±0.417	0.392	2.026-2.479	3.379-4.330
Lean/Bone	2.961±0.120	2.969±0.096	0.958	2.659-2.793	3.254-3.200
Eye muscle area (cm^2)	11.183±0.622	12.771±0.455	0.091	9.465-13.255	11.480-13.599
Back fat depth (mm)	2.300±0.413	2.088±0.262	0.245	1.570-1.660	3.850-2.850

Figure 3. Means (±SE) and minimum-maximum values for some carcass traits.

Table 2. Means (±SE), minimum-maximum values and ratios (±SE) for non-carcass components.

Trait	Means (kg)			Minimum	Maximum	Ratio (as % of slaughter weight)		
	L6 (n:5)	L7 (n:4)	Sig.	L6 - L7	L6 - L7	L6	L7	Sig.
Skin	5.785±0.401	5.043±0.289	0.197	4.650-4.476	7.017-5.820	13.428±0.722	11.935±0.466	0.147
Head	2.201±0.031	2.098±0.072	0.199	2.143-1.881	2.316-2.185	5.132±0.068	4.980±0.173	0.460
Feet	0.978±0.035	0.990±0.035	0.822	0.875-0.886	1.079-1.041	2.286±0.111	2.348±0.074	0.678
Heart	0.175±0.007	0.184±0.005	0.322	0.159-0.169	0.191-0.192	0.410±0.023	0.438±0.011	0.322
Lungs	0.723±0.040	0.640±0.034	0.170	0.617-0.588	0.819-0.734	1.680±0.071	1.523±0.097	0.222
Liver	0.937±0.033	0.951±0.041	0.787	0.831-0.899	1.029-1.074	2.180±0.064	2.250±0.049	0.433
Kidneys	0.148±0.007	0.146±0.004	0.844	0.135-0.140	0.175-0.155	0.346±0.021	0.3475±0.005	0.953
Spleen	0.117±0.018	0.103±0.013	0.571	0.073-0.078	0.180-0.139	0.274±0.044	0.245±0.033	0.631
Testicles	0.308±0.015	0.317±0.004	0.609	0.270-0.309	0.360-0.325	0.716±0.023	0.755±0.014	0.223
Trachea- Esophagus	0.094±0.009	0.092±0.006	0.816	0.074-0.077	0.124-0.106	0.220±0.017	0.220±0.020	1.000
Full digestive tract	7.329±0.451	7.367±0.293	0.949	6.334-6.692	8.918-7.992	17.048±0.884	17.458±0.499	0.719
Empty rumen	1.250±0.044	1.226±0.073	0.779	1.160-1.118	1.405-1.439	2.912±0.090	2.915±0.190	0.988
Empty intestine	1.713±0.032	1.835±0.081	0.174	1.645-1.653	1.833-2.018	4.000±0.142	4.348±0.145	0.134
Omental fat	0.548±0.056	0.431±0.067	0.217	0.429-0.309	0.686-0.585	1.276±0.131	1.018±0.141	0.224
Mesenteric fat	0.461±0.033	0.423±0.052	0.536	0.330-0.273	0.510-0.510	1.074±0.073	0.998±0.114	0.575

L6 and L7: No. of lumbar vertebrae

Table 3. Means (±SE) and minimum-maximum values for carcass measurements.

Trait	Means (cm)			Minimum	Maximum
	L6 (n:5)	L7 (n:4)	Sig.	L6 - L7	L6 - L7
Carcass length	80.800±0.583	84.375±1.375	0.036	79.000-80.500	82.000-87.000
Back length	61.600±1.208	63.875±0.747	0.178	57.000-62.000	64.000-65.500
Leg internal length	28.000±0.652	27.375±0.747	0.547	26.500-26.000	30.000-29.500
Leg external length	41.000±0.474	42.000±0.677	0.252	39.500-41.000	42.000-44.000
Rump length	7.400±0.510	7.625±0.554	0.775	6.000-6.500	9.000-9.000
Neck length	14.700±0.700	15.750±0.433	0.272	13.000-14.500	17.000-16.500
Leg circumference	48.900±0.510	48.875±0.657	0.976	47.500-47.000	50.000-50.000
Chest girth	75.800±0.735	75.750±1.250	0.972	74.000-73.000	78.000-79.000
Rump girth	58.900±1.308	58.625±0.800	0.872	54.500-57.000	62.000-60.000
Leg width	16.900±0.245	16.750±0.323	0.717	16.000-16.000	17.500-17.500
Chest width	17.900±0.332	17.250±0.433	0.264	17.000-16.000	19.000-18.000
Rump width	17.700±0.122	17.250±0.144	0.048	17.500-17.000	18.000-17.500
Chest depth	27.700±0.300	28.625±0.625	0.195	27.000-27.000	28.500-30.000

L6 and L7: No. of lumbar vertebrae

larger than those of the lambs having 6 lumbar vertebrae. In addition, the back fat depth of the lambs having 7 lumbar vertebrae was lower than that of the lambs having 6 lumbar vertebrae.

Table 5 illustrated the results measured and calculated for the composition of the individual cuts in the carcass. As expected, the lean weight in the loin cuts of the group having 7 lumbar vertebrae was significantly (P = 0.040) higher than that of the other group having 6 lumbar vertebrae (Figure 4).

Comparison of lumbar vertebrae numbers of BA B_1 genotype showed that the lambs having 7 lumbar vertebrae had better quality meat ratio because of the leg and loin weights, lean value in the loin section, and long carcass length (Tables 1, 3, 4, and Figures 2 and 4).

The leg and loin weights and lean meat content in the loin for the carcass having 7 lumbar vertebrae will affect the quality meat ratio in the lamb carcass, and these desirable traits are commercially valuable because of their sale at higher prices. The similar studies in the pig breeds were performed with the variation of vertebral numbers, and their outcome on the carcass traits. The results of those also revealed that the increasing in the lumbar vertebrae numbers affect the quality meat ratio in carcass (Borchers *et al.,* 2004; Tohara, 1967).

The back length means of the lambs having 7 lumbar vertebrae was 2.275 cm longer than that of the lambs having 6 lumbar vertebrae. It can be inferred from this result that one extra lumbar vertebra causes 2.275 cm in length. This finding is similar with Li *et al.*'s (2017)

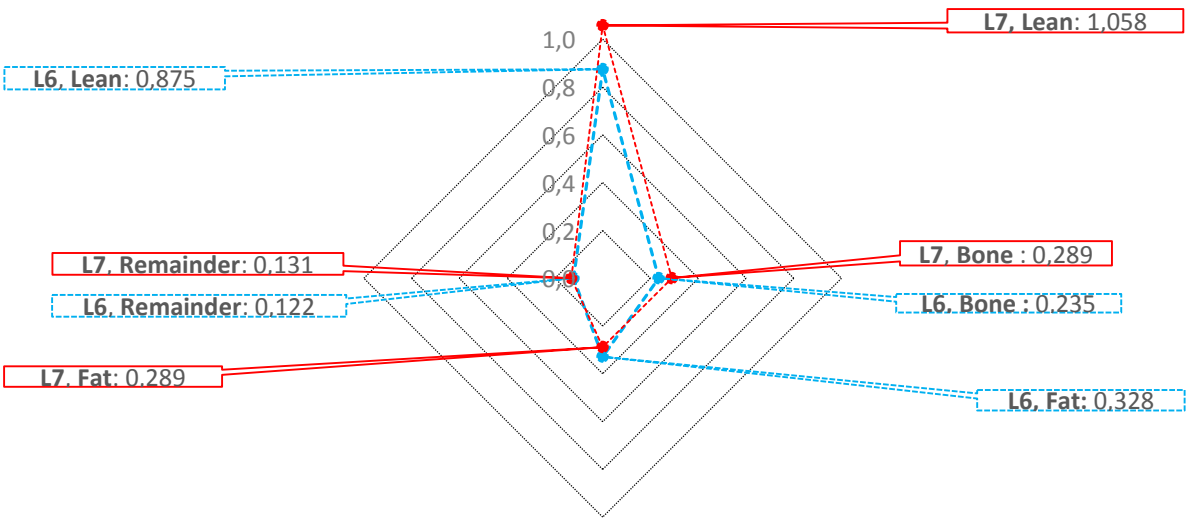


Figure 4. Means for composition of the loin (kg).

Table 4. Means (±SE), minimum-maximum values and ratios (±SE) for individual cuts and composition of carcasses.

Trait	Means (kg)			Minimum	Maximum	Ratio (as % of carcass weight)		
	L6 (n:5)	L7 (n:4)	Sig.	L6 - L7	L6 - L7	L6 (n: 5)	L7 (n: 4)	Sig.
Individual cuts in the carcass								
Leg	5.942±0.079	6.209±0.052	0.032	5.713-6.073	6.095-6.321	30.187±0.621	31.636±0.658	0.156
Foreleg	3.537±0.191	3.349±0.141	0.475	3.048-3.057	4.229-3.646	17.950±0.923	17.034±0.552	0.453
Back	1.673±0.111	1.565±0.061	0.453	1.272-1.422	1.882-1.713	8.502±0.597	7.991±0.459	0.537
Loin	1.560±0.096	1.849±0.060	0.048	1.345-1.712	1.851-2.000	7.967±0.653	9.435±0.470	0.127
Neck	3.031±0.266	3.085±0.212	0.883	2.512-2.711	4.044-3.695	15.392±1.378	15.668±0.806	0.877
Breast+flank	2.664±0.310	2.404±0.165	0.516	2.095-2.123	3.860-2.834	13.404±1.186	12.210±0.641	0.440
Tail	0.848±0.154	0.813±0.128	0.869	0.570-0.480	1.340-1.075	4.248±0.677	4.120±0.622	0.896
Perinefral and pelvic fat	0.465±0.037	0.376±0.036	0.133	0.380-0.315	0.560-0.480	2.350±0.145	1.906±0.140	0.068
Category								
First quality	9.175±0.226	9.623±0.102	0.144	8.331-9.332	9.560-9.786	46.656±1.714	49.062±1.481	0.338
Second quality	3.537±0.191	3.349±0.141	0.475	3.048-3.057	4.229-3.646	17.950±0.923	17.034±0.552	0.453
Third quality	5.695±0.359	5.490±0.367	0.704	4.872-4.881	6.873-6.528	28.796±1.204	27.878±1.378	0.630
Composition of the carcass								
Lean	9.984±0.186	10.132±0.227	0.627	9.466-9.666	10.553-10.640	50.707±1.024	51.669±1.983	0.660
Bone	3.388±0.112	3.423±0.140	0.849	3.128-3.076	3.756-3.759	17.264±0.895	17.477±0.994	0.878
Fat	3.529±0.391	3.140±0.333	0.488	2.845-2.458	5.025-3.970	17.752±1.454	15.906±1.382	0.397
Remainder	1.505±0.064	1.766±0.252	0.299	1.333-1.372	1.634-2.496	7.679±0.488	8.921±1.064	0.290

L6 and L7: No. of lumbar vertebrae

Table 5. Means (±SE), minimum-maximum values and ratios (±SE) for composition of individual cuts of carcasses.

Trait	Means (kg)			Minimum	Maximum	Ratio (as % of individual cuts)		
	L6 (n:5)	L7 (n:4)	Sig.	L6 - L7	L6 - L7	L6 (n: 5)	L7 (n: 4)	Sig.
Leg								
Lean	3.500±0.051	3.691±0.119	0.153	3.334-3.464	3.601-3.994	58.955±1.319	59.451±1.835	0.828
Bone	1.087±0.033	1.160±0.035	0.174	1.022-1.067	1.216-1.232	18.294±0.526	18.673±0.443	0.611
Fat	0.941±0.105	0.935±0.093	0.968	0.584-0.701	1.136-1.141	15.754±1.591	15.070±1.532	0.770
Remainder	0.415±0.035	0.423±0.026	0.858	0.281-0.349	0.478-0.466	6.997±0.647	6.806±0.371	0.819
Foreleg								
Lean	2.065±0.132	2.014±0.035	0.746	1.736-1.951	2.537-2.093	58.289±0.808	60.338±1.647	0.270
Bone	0.719±0.055	0.655±0.031	0.379	0.599-0.569	0.886-0.718	20.385±1.389	19.558±0.478	0.627
Fat	0.431±0.067	0.404±0.054	0.772	0.268-0.283	0.613-0.527	12.125±1.632	11.938±1.178	0.932
Remainder	0.322±0.027	0.276±0.036	0.334	0.251-0.180	0.396-0.348	9.200±0.882	8.167±0.791	0.424
Back								
Lean	0.787±0.024	0.780±0.029	0.847	0.703-0.724	0.847-0.851	47.651±2.350	49.875±0.980	0.453
Bone	0.377±0.054	0.339±0.050	0.626	0.264-0.240	0.519-0.431	22.415±2.469	21.404±2.451	0.726
Fat	0.407±0.072	0.333±0.026	0.413	0.220-0.274	0.659-0.390	23.774±3.112	21.500±2.268	0.592
Remainder	0.102±0.014	0.113±0.015	0.614	0.071-0.080	0.153-0.148	6.160±0.726	7.221±0.884	0.380
Loin								
Lean	0.875±0.059	1.058±0.032	0.040	0.684-0.995	1.037-1.118	56.219±2.631	57.328±1.806	0.752
Bone	0.235±0.041	0.289±0.029	0.344	0.128-0.210	0.325-0.343	14.722±1.906	15.557±1.258	0.726
Fat	0.328±0.047	0.371±0.037	0.516	0.226-0.264	0.505-0.431	21.367±3.632	20.067±2.004	0.780
Remainder	0.122±0.019	0.131±0.017	0.734	0.073-0.080	0.167-0.152	7.693±0.867	7.048±0.828	0.614
Neck								
Lean	1.511±0.044	1.534±0.059	0.760	1.383-1.398	1.625-1.670	51.225±4.134	50.341±3.558	0.880
Bone	0.602±0.023	0.615±0.065	0.840	0.543-0.441	0.645-0.722	20.526±1.992	20.472±2.896	0.988
Fat	0.633±0.290	0.311±0.028	0.362	0.211-0.242	1.771-0.370	18.632±6.505	10.103±0.691	0.287
Remainder	0.286±0.018	0.625±0.260	0.282	0.224-0.335	0.331-1.402	9.617±0.818	19.085±6.364	0.234
Breast+flank								
Lean	1.246±0.078	1.055±0.049	0.094	1.098-0.953	1.536-1.189	47.829±.638	44.267±2.581	0.374
Bone	0.368±0.029	0.366±0.045	0.961	0.320-0.307	0.455-0.498	14.139±1.032	15.252±1.650	0.569
Fat	0.791±0.249	0.787±0.155	0.991	0.339-0.554	1.732-1.232	27.434±5.140	32.188±4.460	0.520
Remainder	0.259±0.038	0.197±0.018	0.219	0.138-0.148	0.366-0.236	10.597±2.115	8.293±0.983	0.396

L6 and L7: No. of lumbar vertebrae

(lumbar vertebrae length=2.22 cm) and Zhang *et al.*'s (2017) (lumbar vertebrae length=1.30 cm) in China, and Donaldson's (2015) results (lumbar vertebrae length=2.91 cm) in the United Kingdom. In addition to those, same condition was reported in the pig breeds (King and Roberts, 1960; Tohara, 1967).

The back fat depth of the lambs having 7 lumbar vertebrae group was lower than that of the lambs having 6 lumbar vertebrae groups, which was in accordance with total fat value in the carcass. Therewithal, these findings were also consistent with Borchers *et al.*'s (2004) results in the pig. The back fat depth and rump width values of the lambs having 6 lumbar vertebrae were higher than those of another group. In addition, the lambs having 6 lumbar vertebrae have higher skin and omental fat weight than the lambs having 7 lumbar vertebrae. When these data were assessed, it can be said that the lambs having 7 lumbar vertebrae were still developing stage than the lambs having 6 lumbar vertebrae in this slaughter weight. Some researchers reported that the piglets having 7 lumbar vertebrae had a tendency toward a higher age at slaughter (Meyer and Lindfeld, 1969).

The eye muscle area in the 7 lumbar vertebrae group had larger than another group. Although this difference was not very vital, the value was close to the significance level (P=0.091). This result was in accordance with Borchers *et al.*'s (2004) findings at which they reported that more lumbar vertebrae in pigs were significantly affected by the eye muscle area value. In addition, eye muscle area is a significant indicator of lean meat quantity and body muscling (especially hind-leg muscles) in the sheep (Cloete *et al.,* 2004; Hopkins *et al.,* 1992). In this study, it was identified that the lambs with 7 lumbar vertebrae have a larger eye muscle area with a heavier leg and loin, and also higher lean weight in the leg and loin than the lambs with 6 lumbar vertebrae. These results were correlated with other studies with these aspects (Cloete *et al.,* 2004; Hopkins *et al.,* 1992).

Conclusion

It was concluded that the lambs having 7 lumbar vertebrae had significantly higher carcass length, leg weight, loin weights and loin's lean weight. The evaluation of the vertebral number and using this information in the animal breeding programs will affect the profit per sheep in the world. As a result of this work, we can say that identification of the variation of the vertebrae number for Turkey sheep breeds by the ultrasound or genetic testing can be used as the selection criteria for the sheep breeding.

Author Contributions

O.F., Gungor, C. Ozbeyaz and N. Unal conceived and designed research. OF Gungor and N Unal conducted experiments. O.F., Gungor analyzed the data and wrote the manuscript. C. Ozbeyaz and N. Unal reviewed and supervised, and C. Ozbeyaz edited the manuscript. All authors read and approved the manuscript.

Acknowledgments

This project was supported by Ankara University Scientific Research Projects Coordination Unit (64299502-604.01.02-E.84290). The authors gratefully acknowledge the contribution of esteemed senior Prof. Dr. Halil Akcapinar, who was retired from Ankara University.

Ethical Statement

All animal procedures were conducted under the protocol approved by the Ankara University Animal Experiments Local Ethics Committee (File no. 2018-34, Decision no. 2018-4-36).

Conflict of interest

The authors declare no conflict of interest.

References

Akçapınar, H. (1981). Dağlıç, Akkaraman ve Kıvırcık kuzuların entansif beside büyüme ve yemden yararlanma kabiliyeti üzerinde karşılaştırmalı araştırmalar. *Veterinary Journal of Ankara University,* 28 (1–4), 112–129. https://doi.org/10.1501/Vetfak_0000000912.

Akçapınar, H., Özbeyaz, C. (1999). Fundamentals of animal breeding (HayvanYetiştiriciliği Temel Bilgileri). Kariyer press, Ankara

Akers, R., Denbow, D. (2013). *Bones and skeletal system In: Anatomy and Physiology of Domestic Animals* (155). Second edition. Wiley Blackwell, Ames, Iowa, USA.

Borchers, N., Reinsch, N. e Kalm, E. (2004). The number of ribs and vertebrae in a Piétrain cross: Variation, heritability and effects on performance traits. *Journal of Animal Breeding and Genetics*, 121, 392–403. https://doi.org/10.1111/j.1439-0388.2004.00482.x.

Cloete, J. J. E., Cloete, S. W. P., Hoffman, L. C., Fourie, J.E. (2004). Slaughter traits of Merino sheep divergently selected for multiple rearing ability. *South African Journal of Animal Sciences*, 34, 189-196. https://scholar.sun.ac.za/handle/10019.1/16431?show=full.

Díaz, M. T., Fuente, J., Pérez, C., Lauzurica, S., Álvarez, I., Huidobro, F.R., Velasco, S., Cañeque, V. (2006). Body composition in relation to slaughter weight and gender in suckling lambs. *Small Ruminant Research*,64(1-2):126-132. https://doi.org/10.1016/j.smallrumres.2005.04.007

Donaldson, C.L. (2015). *Spine characteristics in sheep: Metrology, relationship to meat yield, and their genetic parameters*. Ph.D. Thesis, University of Edinburgh, Scotland.

Donaldson, C. L., Lambe, N. R., Maltin, C. A., Knott, S. e Bunger, L. (2013). Between- and Within-Breed Variations of Spine Characteristics in Sheep. *Journal of Animal Science*, 91, 995–1004.

https://doi.org/10.2527/jas.2012-5456.

Fredeen, H. T., Newman, J. A. (1962). Rib and vertebral numbers in swine: I. Variation observed in a large population. *Canadian Journal of Animal Science*, 42, 232–239. https://doi.org/10.4141/cjas62-036.

Hopkins, D. L., Gilbert, K. D., Pirlot, K. L., Roberts, A. H. K. (1992). Elliotdale and crossbred lambs: Growth rate, wool production, fat depth, saleable meat yield, carcass composition and muscle content of selected cuts. *Australian Journal of Experimental Agriculture*, 32(4), 429–434.https://doi.org/10.1071/EA9920429

King, J.W.B. e Roberts, R.C. (1960). Carcass length in the bacon pig; Its association with vertebrae numbers and prediction from radio-graphs of the young pig. *Animal Breeding Research Organization*, 9, 59–65. https://doi.org/10.1017/S0003356100033493.

Lambe, N. R., Donaldson, C. L., Mclean, K. A., Gordon, J., Menezes, A. M., Clelland, N., Bünger, L. (2014). *Genetic control of CT-based spine traits in elite Texel rams*. Proceedings of the 4th Farm Animal Imaging Conference, 52–55. Edinburgh, UK.

Lee, Y. J., Mcpherron, A., Choe, S., Sakai, Y., Roshantha, A., Lee, S., Oh, S.P. (2011). Growth differentiation factor 11 signaling controls retinoic acid activity for axial vertebral development. *Developmental Biology*,347, 195– 203.https://doi: 10.1016/j.ydbio.2010.08.022

Li, C., Li, M., Li, X., Ni, W., Xu, Y., Yao, R., Wei, B., Zhang, M., Li, H., Zhao, Y., Liu, L., Ullah, Y., Jiang, Y., Hu, S. (2019). Whole-Genome resequencing reveals loci associated with thoracic vertebrae number in sheep. *Frontiers in Genetics,* 10, 1–8. https://doi.org/10.3389/fgene.2019.00674.

Li, C., Zhang, X., Cao, Y., Wei, J., You, S., Jiang, Y., Cai, K., Wumaier, W., Guo, D., Qi, J., Chen, C., Ni, W., Hu, S. (2017). Multi-vertebrae variation potentially contribute to carcass length and weight of Kazakh sheep. *Small Ruminant Research*, 150, 8–10. https://doi.org/10.1016/j.smallrumres.2017.02.021.

Meyer, H., Lindfeld, A. (1969). Studies of number and length of the vertebrae in the refined German Landrace pig (Untersuchungen über Wirbelzahl und Wirbellänge beim Deutschen veredelten Landschwein). *Deutsche tierarztliche Wochenschrift*, 76, 448–453

Reese, H. H. (2019). *Arabian horse breeding*. Papamoa Press.

Santos, V. A. C., Silva, S. R., Mena, E. G., Azevedo, J.M.T. (2007). Live weight and sex effects on carcass and meat quality of suckling lambs. *Meat Science*, 77(4), 654-61. https://doi: 10.1016/j.meatsci.2007.05.019

SPSS, (2005). Statistical package for social sciences for window, Statistical Innovations Inc. (Versiyon 14.01; No: 9869264). USA

Tohara, S. (1967). Pig improvement with special reference to the number of vertebrae-variation of the number of vertebrae in Pigs. *Japan Agricultural Research Quarterly*, 2,29–34.https://www.jircas.go.jp/sites/default /files/publication/jarq/02-1-029-034_0.pdf.

Wellik, D.M. (2007). Hox patterning of the vertebrate axial skeleton. *Developmental Dynamics*, 236, 2454–2463.https://doi.org/10.1002/dvdy.21286.

Yang, G., Ren, J., Zhang, Z., Huang, L. (2009). Genetic evidence for the introgression of Western NR6A1 haplotype into Chinese Licha breed associated with increased vertebral number. *Animal Genetics*, 40, 247–250.https://doi.org/10.1111/j.1365-2052.2008.01820.x.

Yang, J., Huang, L., Yang, M., Fan, Y., Li, L., Fang, S., Deng, W., Cui, L., Zhang, Z., Ai, H., Wu, Z., Gao, J., Ren, J. (2016). Possible introgression of the VRTN mutation increasing vertebral number, carcass length and teat number from Chinese pigs into European pigs. *Scientific Reports*, 6, 1–8. https://doi.org/10.1038/srep19240.

Zhang, L., Luo, X., Siqinbilig, Zhang, S. (1998). The lengths of thoracic and lumbar vertebrae and the performance of Mongolia sheep. *Journal of Inner Mongolia Institute of Agriculture and Animal Husbandry*, 19(3), 1–5. https://europepmc.org/article/cba/320063.

Zhang, L., Siqin, B. (1998). *The genetic patterns and the performance testing of Multi vertebrae Mongolia sheep.* World Congress on Genetics Applied to Livestock Production, 24, 246–249. http://www.wcgalp.org/system/files/proceedings/1998/genetic-pattern-and-performance-testing-multivertebrae-mongolian-sheep.pdf.

Zhang, X., Li, C., Li, X., Liu, Z., Ni, W., Cao, Y., Yao, Y., Islamov, E., Wei, J., Hou, X., Hu, S. (2019). Association analysis of polymorphism in the NR6A1 gene with the lumbar vertebrae number traits in sheep. *Genes and Genomics*, 41, 1165–1171.https://doi.org/10.1007/s13258-019-00843-5.

Zhang, Z., Sun, Y., Du, W., He, S., Liu, M., Tian, C. (2017). Effects of vertebral number variations on carcass traits and genotyping of Vertnin candidate gene in Kazakh sheep. *Asian-Australasian Journal of Animal Sciences,* 30, 1234–1238.https://doi.org/10.5713/ajas.16.0959.

Livestock Studies, 2022; 62 (1): 31-36
http://doi.org/10.46897/livestockstudies.1120128

LIVESTOCK STUDIES

RESEARCH PAPER

The Effect of Zinc Supplementation on Plasma Melatonin and Kisspeptin Levels in Rams

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Article History
Received: 30 September 2021
Accepted: 03 March 2022
First Online: 23 May 2022

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Keywords
Kisspeptin
Melatonin
Zinc
Ram

Abstract

The study that researched the effect of zinc added to the rations of rams on kisspeptin and melatonin levels was conducted on 2 years old 12 Kivircik crossbreed rams (6 control, 6 experimental) for 1 year. In addition to the *ad libitum* dry alfalfa straw, it was given mixed feed (barley, salt and vitamin-mineral mixture as standard) supplemented with 25 mg/kg/ DM ZnO, for the control group and 125 mg/kg/ DM ZnO for experimental group per day. During the study, blood samples were taken once a month and kisspeptin and melatonin levels were measured with ELISA in plasmas obtained from blood samples. Melatonin levels were found to be between 62.8-164.5 ng/L in experimental group and 22.1-105.9 ng/L in control group. Kisspeptin levels were determined to be between 209.8-514.2 ng/L in experimental group and 92.6-356.6 ng/L in control group. Zinc supplementations showed numerical increases in kisspeptin and melatonin levels but because of the individual variations, no statistical significance was found ($P > 0.05$).

Introduction

Zinc; is an important trace element that mediates vital functions such as vitamin synthesis, hormone production, enzyme activation, energy production, reproduction and growth. It has been reported that zinc deficiency causes regression in growth and development, reproductive disorders, weakening of the immune system and histological structural disorders in organs (Haenlein and Anke 2011). Melatonin regulates reproduction in animals depending on photoperiod by inhibiting GnRH and LH in the long-day period and triggering GnRH secretion in short-day period but the relationship between melatonin and GnRH hasn't been explained clearly yet (Buchanan and Yellon, 1991, Viguie *et al*., 1995, Goodman *et al*., 2010). Kisspeptins are proteins controlled by the Kiss-1 gene and acts by binding to GPR54 receptor. It has been reported that there are 4 type of kisspeptin which have same binding sites but different amino acid sequences (Kisspeptin- 54, 14, 13 and 10) and the type that binds strongest to the receptor is kisspeptin-10 (Lee *et al*., 1996, Othaki *et al* 2001).

In recent years, kisspeptin was reported to assume an important role by transferring the melatonin signals to the GnRH neurons (Irwig *et al*., 2004, Ancel *et al*., 2012). Revel *et al.* (2006) reported that melatonin activates the reproductive axis by modulating Kiss1-R signals depending on photoperiod. Carnevalli *et al.* (2011) determined that melatonin induces kisspeptin and GnRH receptors in zebrafish. Alvarado *et al.* (2015) found that exogenously melatonin administration increased significantly Kiss-1-R expression in male sea bass in the hypothalamus after 30 days.

Researches carried out in ewes also showed that determination of Kiss-1 expression, in the long-day period was significantly lower than short-day period (Clarke *et al*., 2009b) and in short-day period Kiss-1-mRNA expression in arcuat nucleus is significantly higher than long-day period (Wagner *et al*., 2008). It has been suggested that kisspeptin, can play a role on starting melatonin-induced GnRH secretion, by transferring melatonin signals into the basal

premamillar nucleus of the hypothalamus (Clarke *et al*., 2009a).

It has been found that melatonin administrations increased levels of zinc and leptin and there is an interaction between melatonin-zinc-leptin triplet (Song and Chen, 2009). Another study's results in pinealectomied mice, showed that zinc supplementation increased melatonin levels and there was an interaction between zinc and melatonin (Baltacı *et al.,* 2003). On the based of literature data, we found few references about zinc and kisspeptin. Quershi and Abbas (2013) suggested that kisspeptin-10 administration increased serum zinc, copper, cobalt and manganese levels but administration of kisspeptin-10 antagonist (peptide 234) decreased these trace elements dramatically.

In this study, based on the information given above, it was thought that zinc might effect on plasma melatonin and kisspeptin levels and aimed to investigate the effect of long-term Zn supplementation to the ration of rams on plasma melatonin and kisspeptin levels.

Materials and Methods

Animals, Housing and Breeding

The study was conducted one year (from April 2017 to March 2018) with 2 years old 12 Kıvırcık crossbreed rams which were divided into two groups (6 control, 6 experimental) and housed in outdoor paddocks in Aydın Adnan Menderes University Faculty of Veterinary Medicine's farm. This study was approved by the Ethics Committee of the Experimental Medicine Research and Application Centre of Selçuk University, 2017 / 62 report.

Throughout the study, all rams were fed individually with *ad libitum* dry alfalfa straw and 150 g/day pellet formed mixed feed (barley, salt and vitamin-mineral mixture) which include 25 mg/kg/DN ZnO (Zinc oxide). According to ARC (1980), the zinc requirement has been reported to be 30 mg/kg/DM in growing lamb, and 27 mg/kg/DM in lactating sheep. Additionally to the standard ration, experimental rams were provided to take 100 mg/kg/DM ZnO. Thus, a total of 125 mg/kg /DM ZnO was given to the experimental group daily. Water was provided ad libitum.

Sample Collection and Hormone Assays

Blood samples were collected with holder in monthly intervals from vena jugularis and centrifugated for 5 min 3000 rpm and obtained plasma samples were stored at -20 C^0 for one year until the end of the study. Hormone assays performed with ELISA kits. Kisspeptin (Bioaassay Tecnologl Laboratory catalog no: E0051Sh) and melatonin levels (Bioaassay Tecnologl Laboratory catalog no: E0108Sh) were measured with ELISA reader (Biotek ELx800) at 460 nm.

Statistical Analysis

Statistical analyses were conducted with SPSS (version 21). Data's normality and homogeneity were analyzed with Kolmogorov- Smirnov and Shapiro Wilk tests and test results showed that data distribution were not normal and homogenous. Therefore, Mann-Whitney U test was used for analyzing the statistical difference of means.

Results and Discussion

Melatonin levels showed seasonal changes in both control and experimental groups. The levels of the control group were found to be 22.1 ± 14.1 ng/L in April, which started to increase (93.8 ± 45.5 ng/L) in June and decreased after September. Similar progress was observed in the experimental group; the levels of melatonin were found to be 62.8 ± 26.2 ng/L in April, 164.5 ± 61.7 ng/L in June, and the highest levels until October decreased to 46.6 ± 26.5 ng/L in November (Table 1, Figure 1). Although zinc supplementation was increased the melatonin levels of the experimental group, the differences were not statistically significant, due to individual values were highly variable. In kisspeptin levels, similar to the levels of melatonin, seasonal changes were observed in the control group. The kisspeptin levels in the control group started to rise in May and reached the highest levels in June (356.6 ± 184.6 ng/L). In the experimental group, the kisspeptin levels reached the highest level in June (514.2 ± 180.4 ng/L). The kisspeptin levels maintained with slight releases until October and decreased rapidly to 215.5 ± 124.8 ng/L in November (Table 2, Figure 2).

To our best knowledge there was no study about the effects of zinc on kisspeptin and/or melatonin in both rams and ewes in the literature.

Baltacı and Moğulkoç (2017) reported that zinc supplements increased melatonin and leptin levels in male mice with hypothyroidism ($P < 0.05$). Bediz *et al.* (2003), reported that melatonin production decreased in zinc deficiency, while zinc supplements increased melatonin production in rats. In another study, it was reported that melatonin supplements to rats increased plasma and small intestinal melatonin levels (Özturk *et al.,* 2008). Studies on kisspeptin and zinc were limited in the literature. However, the fact that Kiss-1 mRNA expression was higher in the short-day period compared to the long-day period (Wagner *et al.,* 2008, Clarke *et al.,* 2009b) has given rise to thought that kisspeptin was affected by melatonin. In the present study, numerical increases in melatonin and kisspeptin levels were observed in rams. However, no statistical difference was found due to the highly variable individual hormone levels ($P > 0.05$).

Plasma melatonin levels in the experimental group showed monthly remarkable variations like in control but the highest level of melatonin (164.5 ± 61.7 ng/L)

was determined in June and showed high concentrations until October. The lowest level of melatonin was 23.1 ± 12.1 ng/L in January and remained 46.6 ± 26.5-77.7 ± 62.9 ng/L intervals in the other months (Table 1, Figure 1). Although considerable differences were seen in melatonin levels between experimental and control group, especially in April, June and October, but it wasn't found to be significant ($P > 0.05$).

Table 1. Monthly plasma melatonin levels of experimental and control groups, ng/L.

Months	Experimental	Control	*P* Value
April	62.8 ± 26.2	22.1 ± 14.1	0.180
May	69.3 ± 27.6	76.0 ± 55.2	0.240
June	164.5 ± 61.7	93.8 ± 45.5	0.394
July	92.0 ± 43.2	104.7 ± 53.4	0.818
August	133.1 ± 58.9	105.9 ± 56.4	0.394
September	99.5 ± 51.1	83.0 ± 54.2	0.589
October	112.8 ± 42.0	63.4 ± 52.0	0.132
November	46.6 ± 26.5	57.6 ± 50.3	0.394
December	48.3 ± 24.4	56.1 ± 50.0	0.699
January	23.1 ± 12.1	57.2 ± 51.2	0.818
February	69.8 ± 41.7	69.4 ± 60.0	0.818
March	77.7 ± 62.9	68.7 ± 58.8	1.000

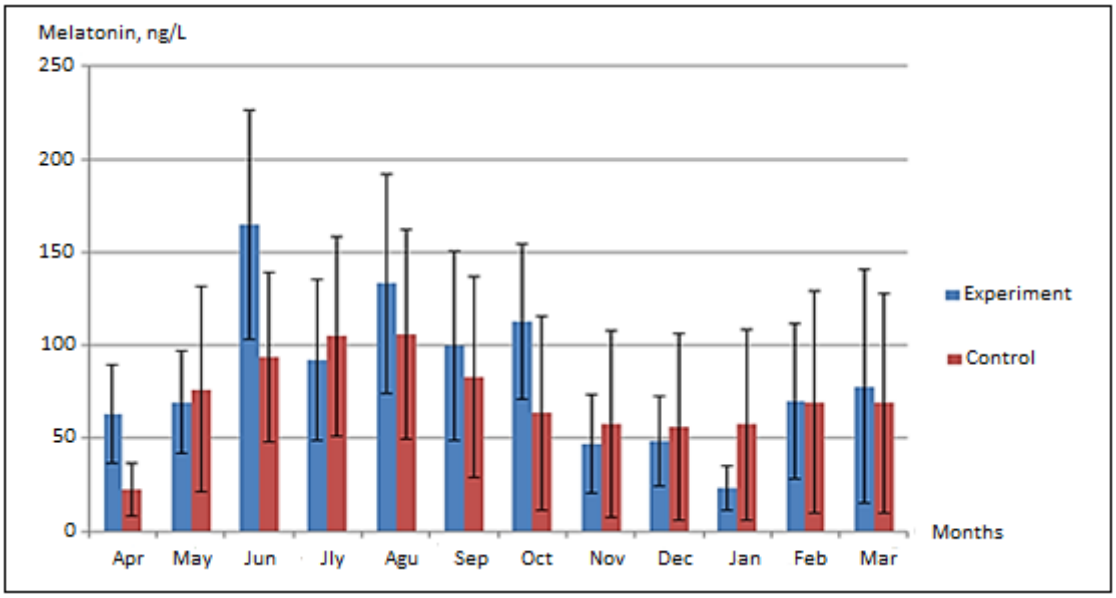

Figure 1. Monthly plasma melatonin levels of experimental and control groups, ng/L.

It can be seen that monthly kisspeptin levels of the experimental group were relaised like monthly melatonin. Kisspeptin levels were 209.8 ± 94.4 ng/L in April, and began to rise in May (293.5 ± 125.8 ng/L), the highest levels seen in June (514.2 ± 180.4 ng/L), continued to relaese in high levels until October and started to decrease in November (Table 2, Figure 2). Especially in summer and autumn months, kisspeptin levels in experimental group were quite higher than in the control but there was no statistically significance ($P > 0.05$) because of the large variations of individual values and less numbers of animals. Monthly linear increases between kisspeptin and melatonin levels suggest a relationship between these two hormones.

Table 2. Monthly plasma kisspeptin levels of experimental and control groups, ng/L.

Months	Experimental	Control	P Value
April	209.8 ± 94.4	92.6 ± 54.0	0.485
May	293.5 ± 125.8	238.7 ± 170.5	0.394
June	514.2 ± 180.4	356.6 ± 184.6	0.394
July	391.4 ± 181.4	291.4 ± 146.8	0.394
August	421.6 ± 174.6	330.9 ± 187.0	0.485
September	396.8 ± 179.7	268.6 ± 191.4	0.310
October	493.5 ± 187.2	216.4 ± 193.7	0.065
November	215.0 ± 124.8	187.8 ± 169.8	0.310
December	154.8 ± 70.3	131.4 ± 113.5	0.310
January	218.7 ± 155.6	215.0 ±197.0	0.310
February	288.3 ± 160.3	223.3 ± 199.2	0.240
March	242.9 ± 195.9	220.5 ± 199.7	0.589

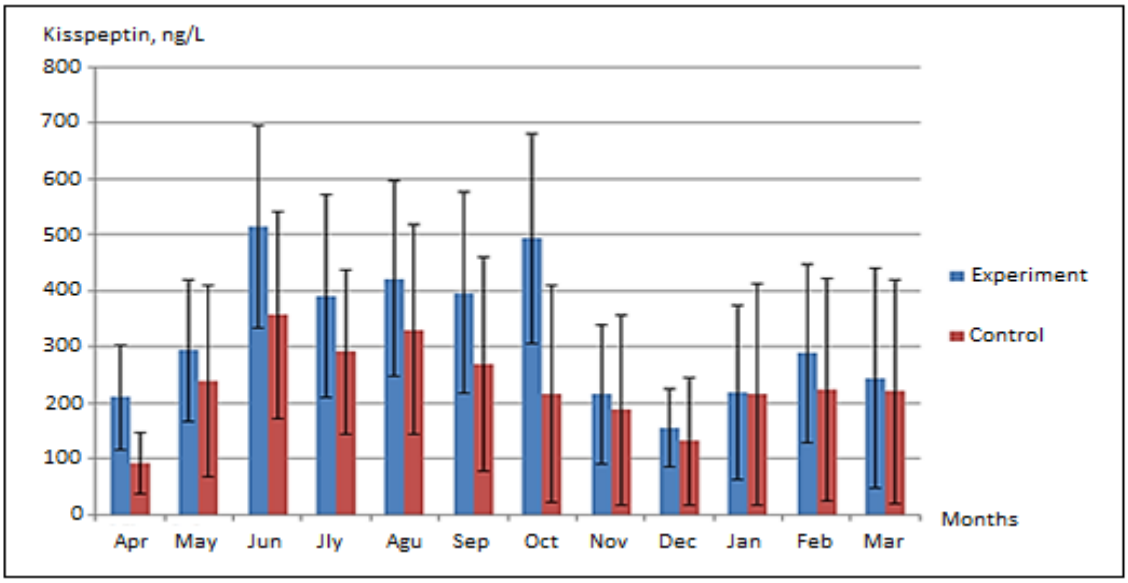

Figure 2. Monthly plasma kisspeptin levels of experimental and control groups, ng/L.

On the other hand, findings indicating a significant relationship between zinc and melatonin (Baltacı *et al*., 2003, Bediz *et al*., 2003, Song and Chen, 2009, Özturk *et al.,* 2008, Baltacı and Moğulkoç, 2017) and the data that kisspeptin acts a transporter role between GnRH and melatonin (Goodman *et al.,* 2010, Irwig *et al*., 2004, Ancel *et al.,* 2012, Revel *et al.,* 2006, Wagner *et al*., 2008, Clarke *et al.,* 2009a) and the study about kisspeptin-10 and zinc interaction (Quershi and Abbas, 2013) support the idea that there may be a relationship between kisspeptin and zinc in rams.

Conclusion

Although zinc supplements increased melatonin and kisspeptin levels especially in September and October, there was no statistical difference due to the fact that individual hormone levels were very variable.

($P > 0.05$). It has been thought that kisspeptin and melatonin hormone studies must be carried out with large number of animals to get a define result.

Author contributions

All authors contributed that first author; sample collection, hormone assays, writing, while second author hormon assays writing- editing- statistical analysis.

Conflicts of interest

The authors declare that they have no known competing financial or non-financial, professional, or personal conflicts that could have appeared to influence the work reported in this paper.

Acknowledgments

Work supported by Selcuk University Scientific Research Projects Organization. Project number: 19202030.

References

Ancel, C., Bentsen, A.H., Sebert, M.E., Tena-Sempere, M., Mikkelsen, J.D., & Simonneaux, V. (2012). Stimulatory effect of RFRP-3 on the gonadotrophic axis in the male Syrian hamster: The exception proves the rule. *Endocrinology*, 153: 1352-1363. https://doi.org/10.1210/en. 2011-1622

Alvarado, M.V., Carrillo, M., & Felip, A. (2015). Melatonin-induced changes in kiss/gnrh gene expression patterns in the brain of male sea bass during spermatogenesis. *Comparative Biochemistry Physiology*, 185, 69-79. https://doi.org/10.101 6/j. cbpa.2015.03.010

Baltacı, A.K., Moğulkoç, R., Bediz, C.S., Kul, A., & Ugur A. (2003). Pinealectomy and zinc deficiency have opposite effects on thyroid hormones in rats. *Endocrine Research*, 29(4), 473-81. https:// doi.org/10.1081/erc-120026953

Baltacı, A.K., Mogulkoc R. (2017). Leptin, NPY, melatonin and zinc levels in experimental hypothyroidism and hyperthyroidism: The relation to zinc. *Biochemical Genetics*, 55(3), 223-233. https://doi.org/10.1007 /s10528-017 -9791-z

Bediz, C.S., Baltaci, A.K., & Moğulkoç, R. (2003). Both zinc deficiency and supplementation affect plasma melatonin levels in rats. *Acta Physiologica Hungarica*, 90(4), 335-339. https://doi.org/10. 1556/APhysiol.90.2003.4.7

Buchanan, K.L., Yellon, S.M. (1991). Delayed puberty in the male djungarian hamster: Effect of short photoperiod melatonin treatment on the GnRH neuronal system. *Neuroendocrinology*, 54(2), 96-102. https://doi.org/10.1159/00012 58

Carnevalli, O., Gioacchini, G., Maradonna, F., Olivotto, I., & Migliarini, B. (2011). Melatonin induces follicle maturation in Danio rerio. *Plos one 6*, e19978. https://doi.org/ 10.1371/journal.pone.0019978

Clarke, I.J., Qi, Y., Puspita, I., & Smith, J,T. (2009a). Evidence that RF-amid related peptides are inhibitors of reproduction in mammals. *Frontiers in Neuroendocrinology*, 30(3), 371-78. https://doi.org/10.1016/j.yfrne. 2009.04. 001.

Clarke, I.J., Smith, J.T., Caraty, A., Goodman, R.L., & Lehman M.N. (2009b). Kisspeptin and seasonality in sheep. *Peptides*, 30(1), 154-163. https://doi.org/10.1016/j.peptides.2008.08.022

Goodman, R.L., Jansen, H.T., Billings, H.J., Coolen, L.M., & Lehman, M.N. (2010). Neural systems mediating seasonal breeding in the ewe. *Journal of Neuroendocrinology*, 22(7), 674- 681. https://doi. org/10.1111/j.1365-2826. 2010.02014.x

Hanlein, G.F.W., Anke, M. (2011). Mineral and trace element research in goats- A Review. *Small Ruminant Research*, 95, 2-19. https://doi. org/10.1016/j.smallrumres.2010.11.00

Irwig, M.S., Fraley, G.S., Smith, J.T., Acohido, B.V, Popa, S.M, Cunningham, M.J., Gottsch, M.L., Clifton, D.K., & Steiner, R.A. (2004). Kisspeptin activation of gonadotropin releasing hormone neurons and regulation of Kiss1 mRNA in the male rat. *Neuroendocrinology*, 80(4): 264-272. https://doi. org/10.1159/000083140.

Lee, J.H., Miele, M.E., Hicks, D.J., Phillips, K.K., Trent, J.M., Weissman, B.E., & Welch, D.R. (1996). Kiss1, a novel human malignant melanoma metastasis-suppressor gene. *Journal of the National Cancer Institute*, 88,1731-37. https://doi.org/10.1093/ jnci/88.23.1731

Ohtaki, T., Shintani, Y., Honda, S., Matsumoto, H., Hori, A., Kanehashi, K., Terao, Y., Kumano, S., Takatsu, Y., Masuda, Y., Ishibashi, Y., Watanabe, T., Asada, M., Yamada, T., Suenaga, M., Kitada, C., Usuki, S., Kurokawa, T., Onda, H., Nishimura, O., & Fujino, M. (2001). Metastasis suppressor gene Kiss1 encodes peptide ligand of a G-protein-coupled receptor. *Nature*, 411(6837), 613-617. https://doi.org/10. 1038/35079135

Öztürk, G., Akbulut, K.G., & Afrasyap L. (2008). Age-related changes in tissue and plasma zinc levels: modulation by exogenously administered melatonin. *Experimental Aging Research*, 34(4), 453-462. https://doi.org/10.1080/0361 07308022 71922

Revel, F.G., Saboureau, M., Masson-Pévet, M., Pévet, P., & Mikkelsen, J.D. (2006). Kisspeptin mediates the photoperiodic control of reproduction in hamsters. *Current Biology*, 16, 1730-1735. https://doi.org/10.1016/j.cub.2006.07.025

Quershi, I.Z., Abbas, Q. (2013). Modulation of testicular and whole blood trace element concentrations in conjunction with testosterone release following kisspeptin administration in male rabbits (Oryctolagus cuniculus). *Biological Trace Element Research*, 154, 210-16. https://doi.org/10.1007/s 12011-013-9720-x

Song, Y.M., Chen, M.D. (2009). Effects of melatonin administration on plasma leptin concentration and adipose tissue leptin secretion in mice. *Acta Biologica Hungarica*, 60, 399-407. https://doi. org/10.1556/ABiol.60.2009.4.6

Viguie, C., Caraty, A., Locatelli, A., & Malpaux, B. (1995). Regulation of luteinizing hormone-releasing hormone (LHRH) secretion by melatonin in theewe. II. Changes in N-methyl-D,L- aspartic acid-

induced LHRH release during the stimulation of luteinizing hormone secretion by melatonin. *Biology of Reproduction*, 52(5), 1156-1161. https://doi.org/10.1095/biolreprod52.5.1156

Wagner, G.C., Johnston, J.D., Clarke, I.J., Lincoln, G.A., Hazlerigg, D.G. (2008). Redefining the limits of day length responsiveness in a seasonal mammal. *Endocrinology*, 149, 32-39. https://doi.org/10.1210/en.2007-0658

Livestock Studies, 2022; 62(1): 37-46
http://doi.org/10.46897/livestockstudies.1122574

RESEARCH PAPER

LIVESTOCK STUDIES

Factors Affecting Consumer Perception of Goat Milk and Dairy Products in Ankara Province

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Article History
Received: 21 January 2022
Accepted: 09 March 2022
First Online: 28 May 2022

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Keywords
Goat milk products,
Consumer's perception
Consumer's preference
Ankara province

Abstract

The aim of this study is to determine the consumption of goat milk and dairy products according to the demographic characteristics of consumers residing in the urban areas of Ankara and to determine the factors affecting the buying and consuming behaviors of these products. Within the scope of the study, face-to-face questionnaires were conducted in supermarket chains with 269 consumers. The surveys were conducted in 9 districts of Ankara including Altındağ, Çankaya, Etimesgut, Gölbaşı, Keçiören, Mamak, Pursaklar, Sincan and Yenimahalle. The results of the research were analyzed with chi-square statistical method and cross table. Average monthly consumption of consumers was found to be 0.25 L for goat milk, 0.62 kg for goat cheese and 0.40 kg for goat ice cream. As a result of the chi-square analysis, the differences between consumption of goat cheese and ice cream with age distribution, consumption of goat milk and cheese with number of years in Ankara were found to be statistically significant. ($P < 0.05$). It is thought that the results will contribute to the studies aimed at increasing the consumption of goat milk and dairy products in Turkiye.

Introduction

Milk is obtained from many mammalian farm animals such as cows, buffaloes, sheep, goats and these are used at rural and industrial levels (Silanikove *et al*., 2010). In recent years, there has been a steady increase in the production of milk and *cheese* from mammalian farm animals in the world, the EU and Turkey (Table 1 and Table 2) (Anonim 2022, Anonymous 2022).

As can be seen from Table 1, goat's milk was the type of milk whose production increased the most compared to cow and sheep's milk in the EU and Turkey in the period 2009-2019. This increase in goat milk production has reached a very important level, especially in Turkey (200.3%). Also, in the period 2009-2019, there were significant increases in goat cheese production in parallel with goat milk production in the world and the EU (24.83% and 10.92%, respectively) (Table 2). As to in Turkey, the period of 2013-2019, there was a 39.82% decrease in the amount of cheese produced only from goat's milk, but there was an 11.84% increase in the amount of cheese produced mixed from goat, cow, sheep and buffalo milk (Table 3) (Anonim 2022). The following factors are shown as the reasons for the increase in goat milk and dairy products production in developed and developing countries: Increasing awareness of the positive effects of goat milk on human health, the abundance of product diversity and the economic importance of the goat milk sector at rural and industrial level etc. (Şentürklü and Arslanbaş 2010; Savran *et al*., 2011).

Goat's milk contains higher levels of protein than cow's milk and it is richer in some vitamins (vitamin A, Thiamine, Riboflavin, Niacin, B6) and minerals (Ca, P, Mg, Se, Cl, K) (Park *et al*., 2007). The fact that its physicochemical properties are close to breast milk makes its use as baby food widespread and it is preferred in the nutrition of children, young and old

people (Ribeiro 2010, Gürsoy, 2015). Goat milk is recognized a food product that can be easily consumed by people with lactose intolerance due to its lower lactose content compared to cow's milk, and by patients who have digestive problems due to its high digestibility (Park et. al. 2007). Conjugated lineoic acids, which are mostly found in meat and dairy products of ruminant animals (they have anti-oxidant and anti-carcinogenic, immune system-enhancing, cholesterol-balancing, obesity-preventing effects) are found at about 0.65% in goat milk (Jahreis et. al. 1999; Ulus and Gücükoğlu 2017). Goat milk is also very suitable for the production of new foods obtained by adding products such as fruit, honey, chocolate etc., which are appropriate for the taste of consumers and ıt is seen as a very suitable milk for the production of functional foods containing components such as probiotics, prebiotics and vitamins (Ribeiro, 2010).

As with other animal food products, consumer perception and preference come first among the factors that determine the changes in the consumption of goat milk and dairy products. Consumer perception and preference are also controlled by different economic and socio-cultural factors. Numerous studies have been conducted in many countries around the world aimed at analyzing consumer perception and preference for goat's milk and dairy products and and the results were transferred to the relevant sectors (Ryffel *et al*., 2008; Ozawa *et al*., 2009; Santoso *et al*., 2012; Costa *et al*. 2014; Machado *et al*. 2017; Idamokoro *et al*., 2019). However, it cannot be said that the number of research and study carried out in this field in Turkey is at sufficient levels. Therefore, in this study; The perceptions of consumers living in the city center of Ankara to goat milk and dairy products and the factors affecting the consumption of these products were determined and it is aimed that these results will contribute to the studies that the Turkey goat milk sector and other relevant stakeholders will do to increase the consumption of goat milk and dairy products.

Materials and Methods

Materials

The material of the study was composed of consumer surveys conducted in small-scale (single-M) Migros stores and other grocery stores located in the central districts of Ankara province and data collected through these surveys. The data obtained with the questionnaire forms were used as primary data and the

Table 1. Milk production in the world, EU and Turkey (Anonim 2022, Anonymous 2022).

Years		2009	2019	Change (%)
Cattle milk (tonne)	World	589.981.608	708.264.265	20,5
	EU	133.343.620	152.581.300	14,43
	Turkey	11.583.313	20.782.374	79,42
Sheep milk (tonne)	World	9.408.987	10.617.961	12,85
	EU	2.781.296	2.969.138	6,75
	Turkey	734.219	1.521.455	107,22
Goat milk (tonne)	World	17.437.436	20.066.359	15,08
	EU	2.056.328	2.466.666	19,95
	Turkey	192.210	577.209	200,3

Table 2. Goat cheese production in the world and EU (Anonymous 2022).

Years	World	EU
2009	456.476	190.405
2010	437.011	184.963
2011	444.062	186.506
2012	539.214	176.712
2013	541.786	180.953
2014	539.123	184.072
2015	537.387	184.904
2016	545.310	188.303
2017	573.626	211.531
2018	583.476	225.208
2019	569.832	211.202
Change (%) 2009-2019	24.83	10.92

Table 3. Goat cheese production in Turkey (Anonim 2022).

Years	Produced only from goat's milk	Produced mixed from goat, cow, sheep, buffalo milk
2013	452	24.180
2014	651	48.549
2015	337	26.008
2016	1.249	18.530
2017	370	25.937
2018	902	29.705
2019	272	27.043
Change (%) 2013-2019	-39.82	11.84

data obtained from the relevant literature studies and field observations were used as secondary data.

Methods

The proportional sample size formula given below was used to determine the number of consumers to be interviewed. As a result, the number of consumers to be surveyed was determined as 269 in 9 districts of Ankara, including Altindag, Çankaya, Etimesgut, Gölbaşı, Keçiören, Mamak, Pursaklar, Sincan and Yenimahalle (Aksoy 2012).

$$n = \frac{N_P(1-p)}{(N-1)\sigma_{P_x}^2 + p(1-p)}$$

n = Sample size,

N = Number of population in the region covered by the research,

$\sigma_{P_x}^2$ = Variance,

p ve q = Proportion of men and women (p+q=1 then 1-p =q)

The sample size was found 269 for N= 3706304 persons, 95% confidence interval and 5% margin of error. After determining the total number of samples, a proportional distribution was made according to the district populations in Ankara province and the number of surveys to be conducted in each district was determined. Surveys were conducted face to face with consumers. The data obtained from the questionnaires were analyzed using the SPSS package program. Chi-square test and crosstable were used by making use of the frequency distributions of the data (Düzgüneş, 1996):

$$\chi_h^2 = \sum_{i=1}^{k} = \frac{(G_i - B_i)^2}{B_i}$$

G_i = Observed frequency,

B_i = Expected frequency

Results and Discussion

Demographic characteristics of consumers and tendency in consumption of goat's milk and dairy products

The relationships between demographic characteristics and goat milk and dairy product consumption tendency of consumers in Ankara province based on chi-square test are given in Table 4. According to the results of this research, 48.7% of the consumers participating in the survey were men and 51.3% were women. Although the difference in terms of gender proportion was not statistically significant (*P > 0.05*), proportion of women (54.5%) consuming goat milk and dairy products was higher than men (45.5%). Unlike the results of this study, McLean-Meyinsse and Cavalier (2004); ın their survey conducted in the USA, they determined that male consumers consume more goat's milk than female consumers. Also Idamokoro *et al*. (2019) In their study conducted in smallholder's in the Republic of South Africa (GAC), they found that men farmers consume more goat's milk than women farmer. (62.3% and 37.6%, respectively).

According to the results of this research, the proportion of married and single consumers was 59.9% and 40.1%, respectively and the difference between both groups was not statistically significant (*P* > 0,05). On the other hand, the consumption of goat milk and dairy products by married consumers (58.6%) was higher than single consumers (41.4%). Furthermore, during the survey, it was observed that pregnant women and families with children were more conscious about the consumption of goat milk and dairy products. In a similar study conducted in the GAC, it was revealed that married people consume more goat's milk than singles (Idamokoro *et al*., 2019). According to these findings, it can be said that targeting women and married consumers in studies to increase the perception and preference of goat milk and dairy products can give more positive results.

In this study, 66.2% of the respondents were young and middle-aged people between the ages of 18-45. Goat milk and dairy products consumption has been occurred mostly between the ages of 25-35 (28.8%). As

a result of the statistical analyzes, no significant relationship was found between age distribution and consumption of goat milk and dairy products (*P > 0.05*). Similarly, Savran *et al*. (2016) in the study they carried out in Çanakkale; they found the relationship between age distribution and consumption of goat milk and dairy products to be insignificant (*P > 0.05*). However, in this study conducted in Ankara, when goat milk and dairy products were analyzed separately, it was determined that the difference between goat cheese and ice cream consumption and age distribution was significant (*P<0.05*). Unlike the findings of this study, Çebi *et al*. (2018); In their study in the province of Erzincan, they reported that the tendency to consume goat milk and dairy products is higher in consumers aged ≥ 46 years. According to these results; It can be suggested that identifying young and middle-aged consumers as the target audience will make a positive contribution, especially in studies aimed at increasing the consumption of goat cheese and ice cream.

According to the results of this research (Table 4), 7.1% of the respondents were primary school graduates, 4.1% secondary school, 30.5% high school, 8.6% associate degree, 49.7% undergraduate and graduate degrees. It was determined that 52.9% of the consumers who consumed goat milk and dairy products were undergraduate and graduate, and 27.2% were high school graduates. Additionally as the education level increases, the consumption of goat milk and dairy products increases. Smilarly ın a study conducted in Çanakkale, Istanbul and Ankara, it was determined that the consumption of goat milk and dairy products increased with the increase in education level (Savran *et al*., 2011). Considering the findings of both studies, it can be accepted that focusing on consumers with a high level of education can have a positive effect in publication studies aiming to increase the level of perception and demand for goat milk and dairy products.

In this study, 53.5% of the families to which the consumers belonged consisted of 3-4, 37.9% of 1-2, 8.6% of >5 individuals. The relationship between the number of individuals in families and consumption of goat milk and dairy products was not significant (P > 0.05*).* However, it was determined that families consuming goat milk and dairy products mostly consisted of individuals (52.4%) of 3-4 people. Contrary findings of this study, Savran *et al*. (2011), Tumer *et al*. (2016) and Engindeniz *et al*. (2017) in their studies; they determined that large families (>4) have higher consumption of goat milk and dairy products.

In this research, the period of time that consumers lived in Ankara was also examined. It was determined that 66.9% of the consumers lived in Ankara province for more than 20 years and 69.1% of these are consumed goat milk and dairy products. When goat milk and dairy products were analyzed separately, the differences between goat milk and cheese consumption and the period of time to lived in Ankara were found to be significant (*P < 0.05*). Consequently, as the number of years lived in this province increases, the consumption of these two products also increases.

Factors affecting consumers' behavior towards consuming/purchasing goat milk and its products

In Table 5, there are findings towards the purchasing behavior of consumers consuming goat milk and dairy products in Ankara province. According to these results;

While the proportion of consumers consuming at least one of the goat milk and dairy products is 71%, the proportion of those who do not consume is 29%. The most intensely consumed product types by consumers consuming goat milk and dairy products are respectively; cheese (52.8%), ice cream (43.5%), milk (29.7%), yogurt (15.2%), butter (5.6%), kefir and ayran (4.5%). As can be seen, the most preferred products are goat cheese and goat ice cream, respectively. Although goat ice cream is mostly consumed only in summer (82.1%), it is the second most consumed product. The rest of the respondents (17.9%) reported that they all the year round consumed goat ice cream 1-3 times a week (6%), once a month (%5.1), once every 15 days (3.4%), every day (1.7%) and only once (1.7%) respectively. In a similar study conducted on students studying at Çukurova University, it was determined that ice cream (18.6%) and cheese (15.3%) were consumed at the highest level among goat milk products too (Durmuş *et al*., 2019).

In this study, the amount of monthly per capita goat milk consumption of consumers was calculated as 0.25 L on average. In a similar study conducted in the provinces of Çanakkale, Istanbul and Ankara, amount of the average monthly consumption of goat's milk by family members was found to be 0.35 L (Savran *et al*., 2011). Respondents reported that they consume goat milk as 53.8% pasteurized, 33.8% raw and 12.4% UHT, respectively. Similar to these findings, conducted in Brazil by Dos Santos Sauzo *et al*. (2019) in their studies it was determined that consumers mostly buy goat milk as pasteurized (31.3%) and raw (31.3%).

In this research, the goat milk packaging preferences of the consumers are respectively; glass bottle (75%), UHT cardboard box (12.5%), plastic bottle (10%), loose milk (1.25%) and pasteurized cardboard box (1.25%) were determinated. This is in line with the findings of Engindeniz *et al*. (2017) who reported that the highest proportion of goat milk packaging preference (61.5%) was glass bottle. Also in Güney and Sangün (2019); In their study they conducted in Adana and Mersin, they determined that the tendency of consumers to consume goat milk in glass bottles was higher.

In this study, consumers reported that they consumed goat's milk because they liked the taste the most (32.5%). This in order; high nutritional value (16.3%), health benefit (13.7%), curiosity (12.5%), baby and child nutrition benefit (12.5%), habit (11.25%) and self-production (1.25%) followed the causes. Similarly;

Table 4. Demographic characteristics of consumers and consumption trends of goat milk and dairy products.

Factor	Group	Consuming		Not consuming		Total	
		Number	Proportion	Number	Proportion	Number	Propotion
Gender	Male	87	45.5	44	56.4	131	48.7
	Female	104	54.5	34	43.6	138	51.3
	Total	191	100	78	100	269	100
Marital status	Married	112	58.6	49	62.8	161	59.9
	Single	79	41.4	29	37.2	108	40.1
	Total	191	100	78	100	269	100
Age*(years)	18-24 between	30	15.7	16	20.5	46	17.1
	25-35 between	55	28.8	28	36	83	30.9
	36-45 between	40	20.9	9	11.5	49	18.2
	46-55 between	40	20.9	10	12.8	50	18.6
	>55	26	13.7	15	19.2	41	15.2
	Total	191	100	78	100	269	100
Education level	Primary school	12	6.3	7	9	19	7.1
	Secondary school	8	4.2	3	3.8	11	4.1
	High school	52	27.2	30	38.5	82	30.5
	Associate degree	18	9.4	5	6.4	23	8.6
	Undergraduate and graduate	101	52.9	33	42.3	134	49.7
	Total	191	100	78	100	269	100
Household size	1-2 people	73	38.2	29	37.2	102	37.9
	3-4 people	100	52.4	44	56.4	144	53.5
	5+ people	18	9.4	5	6.4	23	8.6
	Total	191	100	78	100	269	100
Number of years lived*	1-7 years	31	16.2	10	12.8	41	15.3
	8-20 years	28	14.7	20	25.7	48	17.8
	>20 years	132	69.1	48	61.5	180	66.9
	Total	191	100	78	100	269	100

* $P < 0.05$

Savran *et al*. (2011) and Güney and Sangün (2019), in their studies, determined that the main reason for goat milk consumption is its taste. Equally, in a study conducted by Kamarubahrin (2019) on Muslim consumers in the city center of Indonesia; determined that the taste was more effective on goat milk consumption. On the other hand, Ozawa *et al*. (2009) traditional causes/habit (> 70%), Güney and Ocak (2013) found that the health benefit (47.96%) and Engindeniz *et al*. (2017) determined that the nutritional value (48.42%) had a higher effect on goat milk consumption.

According to the findings of this research, consumers do not consume goat milk mostly (60.3%) due to lack of habits. This in order; dislike of smell (12.2%), dislike of taste (9.52%), inability to find it in bazaar and markets (8.47%), height of price (6.88%) and other (2.63%) factors (lack of knowledge, allergic reactions, etc.) follows the causes. Similarly, Savran *et al*. (2011), Güney and Ocak (2013), Ocak and Önder (2014), Engindeniz *et al*. (2017) and dos Santos Souza *et al*. (2019) in their studies; they determined that the most important reason for not consuming goat's milk is the lack of habit.

In this study, the amount of monthly per capita consumption of goat cheese by consumers was calculated as 0.62 kg. This finding, Tümer *et al*. (2016) in Kahramanmaraş, it was similar to the result determined in the study (0.64 kg per month). Respondents mostly consume goat cheese as traditional cheese made from cow + sheep + goat milk (38.1%), traditional cheese made from only goat milk (23.2%), and artisan cheese only goat milk (20.4%) respectively. The remaining 16.2% prefer to consume goat cheese made from sheep + goat's milk as traditional or artisan cheese. The proportion of consumption of artisan cheese made from cow+sheep+goat milk is 2.1%. These finding is similar to the results of some studies. Savran *et al*. (2011) in their study conducted in Istanbul, Ankara and Çanakkale provinces, the consumption proportions of cheese made from cow + sheep + goat milk and goat milk only were 29% and 3%, respectively and Engindeniz

Table 5. Behaviors towards consumption of goat milk and dairy products.

Goat Milk and It's Products Consumption	**Number**	**Proportion**	**Goat Milk Consumption Type**	**Number**	**Proportion**
Consume	191	71	Pasturized	43	53.8
Not consume	78	29	Raw	27	33.8
Products			UHT	10	12.4
Goat Cheese	142	52.8	**Reasons for Consuming Goat Milk**		
Goat Ice cream	117	43.5	Liking the taste	26	32.5
Goat Milk	80	29.7	High nutritional value	13	16.3
Goat Yogurt	41	15.2	Health reasons	11	13.7
Goat Butter	15	5.6	Curiosity	10	12.5
Others (Kefir and buttermilk)	12	4.5	Benefit in infant and child nutrition	10	12.5
			Consumption habit	9	11.25
Goat Cheese Consumption Type			Other	1	1.25
Cow+ Sheep+ Goat traditional	54	38.1	**Reasons for Not Consuming Goat Milk**		
Traditional made from goat's milk	33	23.2	Lack of habit	114	60.3
Artisan made from goat's milk	29	20.4	Dislike of the smell	23	12.2
Sheep+Goat traditional	23	16.2	Not liking the taste	18	9.52
Others (Cow+Sheep+ Goat artisan)	3	2.1	Not available in the market	16	8.47
Goat milk packaging Preference			High price	13	6.88
Glass bottle	60	75	Others	5	2.63
UHT cardboard box	10	12.5	**Reasons for Consuming Goat Cheese**		
Plastic bottle	8	10	Consumption habit	64	45.1
Pasteurized cardboard	1	1.25	Liking the taste	45	31.7
Loose	1	1.25	Curious about the taste	20	14
			Self-produced	13	9.2
Goat Ice Cream Consumption Preference			**Reasons for Not Consuming Goat Cheese**		
Packaged	55	47	Lack of habit	84	66.1
Cardboard box	42	35.9	Dislike of taste and smell	21	12.6
Bowl (in cafe and restaurant)	16	13.7	Not available in the market	12	9.5
Cone (Street seller)	4	3.4	High price	10	7.9
Goat Ice cream Consumption Frequency			Others	5	3.9
Only summer time	96	82.1	**Reasons for Consuming Goat Ice Cream**		
1-3 times a week	7	6.0	Liking the taste	98	83.8
Once a month	6	5.1	Health reasons	11	9.4
Every 15 days	4	3.4	Curious about the taste	8	6.8
Every day	2	1.7	**Reasons for Not Consuming Goat Ice Cream**		
Only once	2	1.7	Lack of habit	102	67.1
			Dislike of taste and smell	17	11.3

Table 5. Behaviors towards consumption of goat milk and dairy products (cont.)

Monthly Consumption Amount		Not available in the market	16	10.5
Goat milk	0.25 L	High price	6	3.9
Goat cheese	0.62 kg	Others	7	4.6
Goat ıce cream	0.40 kg	Allergic reaction	4	2.6
Place of Purchase			**Number**	**Proportion**
Supermarket			117	61.3
Sending family or relative			22	11.5
Dairy market			22	11.5
Market			17	8.9
Neighbor			8	4.2
Village			3	1.6
Own production			2	1
Total			191	100
Information Resources			**Number**	**Proportion**
Family			65	34
Tags on Market Shelves			49	25.8
Advertisements in TV			35	18.3
Occupation			21	11
Friend			19	9.9
Other			2	1
Total			191	100

et al. (2017) found this rate to be 61.4% and 41% in the study they conducted in Balıkesir, İzmir and Çanakkale.

According to the findings of this research the reasons for the consumption of goat cheese are having a habit (45.1%), liking the taste (31.7%), curiosity (14%) and producing it by oneself (9.2%) respectively and the reasons for not consuming goat cheese are respectively lack of habit (66.1%), dislike of its taste and smell (12.6%), not being able to find it in markets and bazaar (9.5%), high price (7.9%) and other (3.9%) reasons (lack of knowledge about its benefits, allergic reactions, etc.) are shown. Contrary to these findings, Ryfell *et al*. (2008) in their study in Switzerland determined that consumers consume goat cheese mostly because they like the taste (50%).

In this study, the amount of average consumption of goat ice cream by consumers was determined as 0.40 kg / month / person. A study conducted in Izmir, Çanakkale and Balıkesir provinces by Engindeniz *et al*. (2015) considering that the annual average consumption of goat ice cream is 0.65 kg, it can be said that the amount of goat ice cream determined in this research is quite high. In a study conducted in Izmir, Çanakkale and Balıkesir provinces by Engindeniz *et al*. (2015) considering that the annual average consumption of goat ice cream is 0.65 kg, it can be said that the amount of goat ice cream determined in this research is quite high. An important finding obtained from this research is that consumers consume goat ice creams containing cow-goat milk at a high proportion (43.5%). This is due to the fact that ice creams made from 100% goat milk are generally not available in supermarkets, markets, cafes and restaurants in Ankara province. It was determined that the consumers' goat ice cream consumption style was packaged package (47%), cardboard box (35.9%), ice cream bowl in cafe and restaurant (13.7%) and cone (3,4%). When the researches on this subject were examined, no study was found on the consumption style of goat ice cream. Studies on ice cream consumption style have generally focused on cow's milk; Çelik *et al.* (2005), Akbay and Tiryaki (2007), Sütütemiz *et al*. (2009), Onurlubaş and Yılmaz (2013) determined that consumers mostly prefer to consume packaged milk.

In this study, consumers reported that they consumed goat ice cream because they liked the taste the most (83.8%). This in order; health benefit (9.4%) and curiosity (6.8%) were followed. Consumers stated that they liked the ice cream produced from cow + goat milk more than the ice cream produced from cow's milk. Similar to this finding, Akın and Konar (2001) and Pandya and Ghodke (2007); In their study, it was determined that the ice creams produced from goat milk were more preferable than those produced from cow's milk. The reasons why consumers do not consume goat ice cream are respectively; lack of habit (67.1%), dislike of taste and smell (11.3%), not being able to find it in markets and bazaars (10.5%), high price (3.9%), lack of knowledge about its benefits, (3.9%), allergic reaction (2.6%) and prejudice (0.7%). No other

study could be found that could compare these results.

According to the findings of this research, a significant portion (61.3%) of consumers consuming goat milk and dairy products buy these products from supermarkets and ıt's followed by dairy market (11.5%), relative (11.5%), market (8.9%), neighbor (4.2%) and village (1.6%). 1% of consumers produce these products themselves.

In this study, consumers who consume goat milk and products stated that they reach information about these products through family (34%), tag on market shelves (25.8%), advertisements in TV (18.3%) occupation (11%), friends (9.9%) and other (social media devices, personel investigation) (1%), respectively. At the same time all consumers who responded advertisement reported that they saw only ice cream among goat products in advertisements on TV. Similarly, Güney and Ocak (2013) in their study in Adana reported that consumers have the most information about goat milk and dairy products through television (34.8%).

Conclusion and Recommendations

According to the results of this research;

1- It was determined that consumers who prefer goat milk and dairy products in Ankara province are usually women (51.3%), married (59.9%), 25-35 years old (28.8%), at least bachelor's degree (52.9%), living in a family of 4 (52.4%) and individuals who have been residing in Ankara for many years (66.9%). Also, as the level of education increases, the consumption of goat milk and dairy products also increases. When these results are taken into consideration, the selection of consumers with these characteristics as the target audience in studies aimed at increasing consumer perception and preference for goat milk and dairy products will have a positive effect.

2- Cheese and ice cream are consumed the most among goat milk and dairy products in Ankara (0.62 kg/month, 0.40 kg/month, respectively). It can be said that these products are more odorless than other goat milk products has a positive effect on consumer perception and preference.

3-In the province of Ankara, consumers reported that they were influenced by television advertisements for the consumption of goat milk and dairy products only for ice cream. Therefore, it can be expected that the promotion of goat milk and dairy products in social media, especially on television, will have a positive effect on increasing consumption. In addition, it can be argued that the sale of goat ice cream in Ankara Atatürk Forest Farm during certain periods facilitates the supply of this product and allows it to be consumed more than other goat milk products.

4-In the province of Ankara, it was stated that the taste and aroma of goat milk and ice cream were mostly liked by consumers as the reason for consuming it. Considering the misperception that these products smell at the beginning of the factors that negatively affect the consumption of goat's milk and meat in Turkey, this result is very important. For this reason, it is necessary to more detailed investigate the effect of this feature on consumer perception in the consumption of goat milk and dairy products throughout the country, especially in big cities, and to transfer the results to the relevant sectors.

5-The main reason for consumption of goat cheese in Ankara is that there is a consumption habit against this product. The fact that only goat's milk-containing and goat-milk mixed cheeses are easier to find in supermarkets and markets than goat's milk and ice cream has a positive effect on this situation.

6-It was determined that the most common reason for not consuming goat's milk, cheese and ice cream in Ankara province was the lack of habit. Inadequate availability in markets and bazaars and the high prices are other important reasons for not consuming.

7-In Ankara province, there is a perception among consumers that consuming ice cream in winter will cause health problems (sore throat, etc.). Informing and raising awareness of consumers in the written and visual media will be effective in changing this misperception and popularizing the consumption of 4-season ice cream in Turkey.

8-A significant portion of consumers (61.3%) in Ankara province buy goat milk and dairy products from supermarkets. Therefore, taking into account that the habit of goat milk and dairy products will develop over time, the availability of these products in certain quantities in the markets will positively affect the increase in the habit and consumption. Indeed, Dellal *et al*. (2013) in a study on the analysis of sheep and goat meat consumption perception; A significant portion of consumers (17%) reported that they do not know the kid meat because it is not available in the markets, but they can consume it if it is available in the markets. In addition, the sale of goat products such as yoghurt, butter and kefir, which are rarely found in the markets in Ankara, will make a significant contribution to their preference by consumers.

9-The vast majority of consumers (75%) in Ankara province prefer to consume goat's milk in glass bottles. This finding is an indication that consumers act consciously about their packaging preference. Besides that, selling goat's milk in glass bottles will have a positive effect on the increase in the consumption of this product.

10-According to the oral interviews in Ankara province ıt was determined that some consumers prefer goat's milk in the feeding of babies and children who are allergic to cow's milk due to the doctor's advice and some consumers used goat milk formulas as supplementary food for their babies. Accordingly, it can be argued that raising consumers' awareness of these characteristics of goat milk will lead to an increase in goat milk consumption.

11-Although consumers in Ankara mostly consume goat cheese in the form of traditional made from cow + sheep + goat milk, they generally do not know what type and structure of goat cheese they buy. They also reported that the labels on the product are too small. For this reason, the fact that the goat cheese labels on the shelves are large enough to be read and they provide sufficient information about the structure of the product will contribute to ensuring food safety and increasing consumption of these products.

12-One of the factors affecting consumers' not consuming goat's milk, cheese and ice cream in Ankara is the high prices of these products (respectively; 6.88%, 7.9%, 3.9%). Therefore, studies to ensure that the prices of these products are at a level that can compete with cow's milk will have a positive effect on the increase in their consumption.

13-A significant portion of the consumers (11.5%) in Ankara province stated that they did not buy goat milk and its products, but were provided by their families living in their hometowns. According to this result, it can be suggest that regional/geographical origins and habits are also effective in the consumption of goat milk products. The relationship between the consumption of goat milk and dairy products in Turkey and the regional origins of consumers and the transfer of the obtained results to the relevant sector will contribute positively to the increase in the consumption of these products.

14-According to the findings of this research carried out in Ankara; It can be said that different strategies should be developed for the promotion and marketing of goat milk and dairy products. For this, the creation of markets toward for niche products obtained from goat's milk taking into account regional consumption habits, will positively affect consumer preference and perception, and increase the consumption of these products. In addition, more effective use of instruments such as television, social media, and workshops in order to raise awareness of consumers about the benefits of goat milk and dairy products and their different uses (cosmetics, cleaning, etc.) will also contribute positively to the consumption of these products.

*This study was produced from the Master's thesis of Simge TÜTENK. (2019)

Author Contributions

All authors contributed equally to the study.

Acknowledgments

We would like to thank Migros officials and employees who provided the opportunity to carry out the survey process of this study.

Ethical Statement

According to the articles of your journal as "Scientific Research Publication Policy"; We declare that our research, the information of which is given above, is among the studies that do not require ethical committee approval, since it was produced from a graduate study published before 2020.

Conflict of interest

We certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

References

Akbay, C., & Tiryaki, G. Y. (2007). Consumers' packed and unpacked milk consumption behavior: A Case study in Kahramanmaras. *KSÜ Fen ve Mühendislik Dergisi*, 10(1), 89-96.

Akın, M. S., & Konar, A. (2001). A Comparative study on microbiological qualities of fruit-aroma yoghurts made from cow's and goat's milk and stored for 15 days. *Gıda*, 26(2).

Aksoy, A., & Yavuz, F. (2012). Analysıs on the reasons for quıttıng sheep and goat rearıng of farmers: A case of East Anatolıa Regıon. *Anadolu Tarım Bilimleri Dergisi*, 27(2), 76-79.

Anonim 2022. TÜİK. www.tuik.gov.tr [accessed 20.02.2022]

Anonymous 2022. FAO. www.fao.org [accessed 20.02.2022]

Costa, M. P., Balthazar, C. F., Franco, R. M., Mársico, E. T., Cruz, A. G., & Junior, C. C. (2014). Changes on expected taste perception of probiotic and conventional yogurts made from goat milk after rapidly repeated exposure. *Journal of dairy science*, 97(5), 2610-2618.

Çebi, K. , Özyürek, S. & Türkyılmaz, D. (2018). The factors affecting consumer choices in dairy products: the case of Erzincan. *Yüzüncü Yıl Üniversitesi Tarım Bilimleri Dergisi* , 28 (1) , 70-77.

Çelik, Y., Karlı, B., Bilgiç, A., & Çelik, Ş. (2005). The Level of Milk Consumption and Consumption Pattern of Consumers In Sanliurfa Urban Areas. *Tarım Ekonomisi Dergisi*, 11(1 ve 2), 5-12.

Dellal İ., Kolsarıcı N., Dellal G., Tatlıdil F.F., Aktürk D., Köksal Ö., Pehlivan E., & Ünüvar G., 2013. *Türkiye'de koyun ve keçi eti tüketimini etkileyen sosyo ekonomik özelliklerin belirlenmesi*. Araştırma-Geliştirme Destekleri Proje Sonuç Raporu. Ankara.

Dos Santos Souza, M. F., Passetti, L. C. G., Gonçalves, T. R., Passetti, R. A. C., & de Arruda Santos, G. R. (2019). Characterisation of goat product consumers and goat farming systems in the Brazilian Northeast region. *Small Ruminant Research*, 179, 7-13.

Durmuş, M., Agossou, D. J., & Koluman, N. (2019). Determination of Consumption Habits of Goat Milk and Products in Cukurova University Students. *Cappadocıa*, Turkey, 382.

Düzgüneş O. 1996. Hayvan Islahı. *Ankara Üniversitesi Ziraat Fakültesi Yayınları*, 298, Ankara.

Engindeniz, S., Savran, A. F., Aktürk, D., Koşum, N., Taşkın, T., T., Kesenkaş, H., Gökmen, M., & Uzmay, A. (2015). *İzmir, Çanakkale ve Balıkesir İllerinde Güvenli Keçi Sütü ve Ürünleri Üretiminin Geliştirilmesi ve Alternatif Pazar Olanaklarının Saptanması* Program Kodu: 1001.

Engindeniz, S., Aktürk, D., Savran, A. F., Koşum, N., Taşkın, T., Kesenkaş, H., Gökmen, M., Uzmay, A., & ÇINAR, G. (2017). A Research on Analysis of Goat Milk and Products Consumption in Izmir, Canakkale and Balıkesir Provinces. *Ege Üniversitesi Ziraat Fakültesi Dergisi*, 54(4), 385-395.

Güney, O. İ., & Sangün, L. (2019). Determination of consumers' intention to purchase goat milk: The case of the Mediterranean Region. *Anadolu Tarım Bilimleri Dergisi*, 34(3), 289-295.

Gürsoy A. 2015. Süt Kimyası ve Biyokimyası 70. Ankara https://www.foodelphi.com/sutun-bilesimi-ve-ozellikleri-ayse-gursoy/

Idamokoro, E. M., Gunya, B., & Aliber, M. (2019). Farmers' perception and willingness to consume goat milk and goat milk products: A case study of the central Eastern Cape, South Africa. Pastoralism, 9(1), 1-8.

Jahreis, G., Fritsche, J., & Kraft, J. (1999). Species-dependent, seasonal, and dietary variation of conjugated linoleic acid in milk. Advances in conjugated linoleic acid research, 1, 215-225.

Kamarubahrin, A. F. (2019). Muslim consumer intention toward goat milk purchasing behaviour in Malaysia: A preliminary findings. International Journal of Management, Accounting and Economics, 6(1), 62-79.

Machado, T. A. D. G., de Oliveira, M. E. G., Campos, M. I. F., de Assis, P. O. A., de Souza, E. L., Madruga, M. S., Pacheco, M. T. B., Pintado, M. M. E., & do Egypto, R. de C. R. (2017). Impact of honey on quality characteristics of goat yogurt containing probiotic Lactobacillus acidophilus. *Lwt*, 80, 221-229.

McLean-Meyinsse, P. E., & Cavalier, M. D. (2004). An empirical investigation of factors influencing consumption or interest in consuming goat cheese and goat milk. *Journal of Food Products Marketing*, 10(3), 45-60.

I, Güney., & S.Ocak. (2013). Consumer Preference for Goat Milk in Turkey. *Global Advanced Research Journal of Agricultural Science*, 2(7), 181-188.

Ocak, S., & Önder, H. (2014). Factors Affecting Consumer Preferences of Dairy Products and Food Safety Knowledge. *Hayvansal Üretim*, 55(2), 9-15.

Onurlubaş, E., & Yılmaz, N. (2013). The factors affecting milk consumption preferences of the consumers in Edirne Keşan township. *Journal of Food, Agriculture & Environment*, 11(3 & 4), 516-518.

Ozawa, T., Mukuda, K., Fujita, M., & Nishitani, J. (2009). Goat milk acceptance and promotion methods in Japan: The questionnaire survey to middle class households. *Animal Science Journal*, 80(2), 212-219.

Pandya, A. J., & Ghodke, K. M. (2007). Goat and sheep milk products other than cheeses and yoghurt. *Small Ruminant Research*, 68(1-2), 193-206.

Park, Y. W., Juárez, M., Ramos, M., & Haenlein, G. F. W. (2007). Physico-chemical characteristics of goat and sheep milk. *Small ruminant research*, 68(1-2), 88-113.

Ribeiro, A. C., & Ribeiro, S. D. A. (2010). Specialty products made from goat milk. *Small Ruminant Research*, 89(2-3), 225-233.

Ryffel, S., Piccinali, P., & Bütikofer, U. (2008). Sensory descriptive analysis and consumer acceptability of selected Swiss goat and sheep cheeses. *Small Ruminant Research*, 79(1), 80-86.

Santoso, S. I., Setıadı, A., Kisworo, A. N., & Nuswantara, L. K. (2012). Analysis various factors that influence the purchasing behavior of goat milk in Bogor Regency, Indonesia. *International Journal of Engineering & Technology*, 12(5).

Savran, F., Aktürk, D., Dellal, İ., Tatlıdil, F., Dellal, G., & Pehlivan, E. (2011). The Factors Effected on Consumption of Goat Milk and Its Products in Some Selected Cities in Turkey. *Kafkas Üniversitesi Veteriner Fakültesi Dergisi*, 17(2), 251-256.

Savran, F., Köksal, Ö., Aktürk, D., Gün, S. K. G., & Kaya, G. (2016). Assessment of awareness levels on goat milk and products: The case of Çanakkale. Assessment, Scientific Papers Series Management, *Economic Engineering in Agriculture and Rural Development*, 16(2).

Silanikove, N., Leitner, G., Merin, U., & Prosser, C. G. (2010). Recent advances in exploiting goat's milk: Quality, safety and production aspects. *Small Ruminant Research*, 89(2-3), 110-124.

Sütütemiz, N., Çiftyildiz, S. S., & Konuk, F. A. (2009). Importance of Perception for Packaged Milk and Influence of Packaging on Purchasing Behavior of Consumers: A case study of İstanbul. *Akademik Gıda*, 7(6), 18-28.

Şentürklü S. & Arslanbaş E. 2010. *Entansif keçi yetiştiriciliği. Ulusal Keçicilik Kongresi.* 24–26 Haziran, 184-188, Çanakkale.

Tümer, E. İ., Akbay, C., Ünal, S. A., & Koşum, T. (2016). Analysis of the Factors Affecting Goat Cheese Consumption in the Center of Kahramanmaraş Province. *Gaziosmanpaşa Bilimsel Araştırma Dergisi*, 13, 125-132.

Ulus, C. A., & Gücükoğlu, A. (2017). Conjugated Linoleic Acid and Importance to Health. *Turkish Journal of Agriculture-Food Science and Technology*, 5(1), 98-102.