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Effect of udder type on udder traits, milk yield and some physicochemical characteristics of milk in Awassi ewes

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ABSTRACT: In this study, it was aimed to determine the effects of udder type on milk yield, udder and teat traits, and some physicochemical properties of milk in Awassi ewes. For this purpose, 54 ewes of 3-4 years old were used.In this study, Type-3 udder, which was reported to be prevalent in breeded Awassi ewes. Type-4, Type-5, and Type-6 udders were not detected in ewes. The lactation period, lactation, and the daily average milk yield values were calculated as 208.33 days, 138.59 liters, and 659.49 ml, respectively. The 90th day of lactation measurements were as follows: udder circumference (44.58 ± 0.51 cm), udder width (13.20 ± 0.36 cm), udder depth (17.66 ± 0.58 cm), udder volume (881.25 ± 37.41 ml), teat length-right (3.84 ± 0.15 cm), teat length-left (3.64 ± 0.17 cm), teat diameter-right (2.07 ± 0.14 cm). The values of the physicochemical characteristics of milk generally showed an increase from the beginning to the middle periods of lactation and then decreased. In conclusion, udder type had no significant effect on the lactation period, milk yield, udder and teat characteristics and the physicochemical properties of milk in Awassi ewes. New studies are required in the determination of the yield and other characteristics of ewes in Turkey.

Keywords: Awassi, Lactation, Milk yield, Teattraits, Udder type

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INTRODUCTION

Proteins of animal origin are very important in a healthy and balanced diet of people. For this reason, sheep breeding makes significant contributions to meeting the protein needs of animal origin with both red meat and milk production (Emsen et al., 2008;Yerlikaya and Karagözlü, 2008). Sheep breeding is the most important source of livelihood and food security for the majority of the rural population, especially in developing countries (Birteeb et al., 2012). Its contribution to the economy in recent years in Turkey has also increased (Anonymous, 2018).

As in many livestock breeds, more research is required to determine the existing gene resources in ewes and to reveal their yield abilities. The yield characteristics of the Awassi breed, which has an important place among sheep breeds in Turkey, show great variations between the geographical regions where it is bred and even within the regions (Gül and Oflaz, 2021). The Awassi breed is among the ewes with high milk yield globally (Ugarte and Gabina, 2004). It adapts very well to hot and arid climatic conditions. Awassi ewes can produce 504 liters of milk with an average of 60-80 liters in a developed farming system during the lactation period. Between 1940-1990 in Israel, the genotype structure of Awassi sheep was improved and milk production was increased from 297 kg to 500 kg.Again in Syria, thanks to the improvement works carried out from 1974 to 2005, the average milk yield of Awassi sheep was increased from 128 kg to 335 kg. With the selection and outcrossing programs in Turkey, the milk yield of this breed was increased from 67 kg to 152 kg in 7 years (Ali et al.,2020). The breeding of this breed, which has such a wide variation in terms of the milk yield, is therefore very important (Gül and Oflaz, 2021).

Most of the genomic breeding programs in dairy sheep focused on milk yield and milk composition. Daily and lactation milk yields can be determined with various milk control methods applied at regular intervals (by hand, after oxytocin injection by machine, and by the weighing-breastfeeding-weighing method) (Yakan, 2012). However, due to the general changes in the targets of animal husbandry in recent years, studies focus on udder morphology, the number of somatic cells, and the composition of milk, which may be related to milk yield and milking characteristics (Ugarte and Gabina, 2004). Because the milking characteristics of dairy sheep (Casu et al., 2010) and udder morphology (Casu et al., 2010; Altinçekiç and Koyuncu, 2011) are important factors that determine the milking ability. In the process where manual milking gradually turns into machine milking, it is also important to investigate the relationship between the morphological udder characteristics and milk production (Makovicky et al., 2014). Besides, a better understanding of the morphological variations of udder and milking characteristics may allow the determination of the most appropriate characteristics for a synchronized selection program (Castañeda-Bustos et al., 2017). Therefore, recently, scientists have begun to pay more attention to the morphological and functional characteristics of udder traits (Makovický et al., 2019).

Milk production is an important factor that determines the size and shape of the udder (Lérias et al., 2014). The size of the udder, teat traits, and udder type are important features in terms of suitability for machine milking. Because these characters effect on less damage to the udder, saving labor in milking, the milked animal to stay in breeding for a longer time, and allowing the lamb to find and suck the udder easily after birth (Kaygısız and Dağ, 2017; Dzidic et al., 2019).

Many studies have been conducted in recent years in Turkey, examining, in particular, the udder morphology and the relationship between the udder morphology and the milk production yield, and suitability for machine milking. In some studies, it has been reported that the udder size and volume can be used as a useful tool for estimating milk yield in sheep. Because, there are high positive correlations between many of these characteristics and the lactation milk yield, lactation period, and the daily average milk yield (Seker et al., 2004;Merkhan, 2014;AL-Khazrajiand AL-Khuzai, 2017;Kaygısız and Dağ, 2017;Akdag et al., 2018;Arcos-Álvarez et al., 2020;Özyürek, 2020).

On the other hand, the physicochemical characteristics of milk are very important as they affect the quality and determine the processed product/milk ratio and thus the production cost. Several factors can affect the udder traits and chemical composition in dairy sheep. These include race, lactation number and period, weight, size, body condition, the health status of the animal and udder, reproductive system, and udder types (Makovicky et al., 2014). A positive correlation has also been reported between the measurements of the udder and teat and the total protein, fat, and non-fat dry matter in milk (Iñiguezet al.,2009).

Awassi, which is among the most important dairy sheep in the world, demonstrates a lot of variation in terms of yield between the countries, regions, and even provinces where it is bred, despite its superior potential. It is necessary to know the current potential of the breed in order to bring this potential to the highest level of yield. As known, phenotypic traits are important in breed identification, and the first step in characterizing the local genomic resources is to evaluate the variation of morphological traits, including those belonging to the udder (Yakubu et al., 2010).

Despite the presence of numerous studies conducted with Awassi ewes, it is observed that in terms of yield and some morphological characteristics, the targeted levels have not been reached, at least for Turkey. Therefore, it is obvious that new studies are needed in this field. In this context, the present study was conducted to determine the effect of udder type on milk yield, udder and teat characteristics, and some physicochemical properties of milk in Awassi ewes.

MATERIAL AND METHODS

This study was conducted in a private sheep farming located in the eastern province of Turkey, Malatya, between January and September 2020. The animal material of the study consisted of Awassi ewe raised in the hands of the breeder. In this study, all ewes that were 3-4 years old and gave birth to a single lamb in a herd of 340 heads of Awassi ewes in the farm were used. In this context, 54 ewes were included in the study. These sheep were marked with special dyes for tracking along with their ear numbers during the study. The average live weight of the sheep included in the study was around 50 kg. The animals consumed water ad libitum daily. Ewes were bred by free method during the mating period. No artificial insemination was applied to the ewe on the farm. In addition, no hormone application was applied in order to synchronize the birth time of the ewes. The study was approved by the Local Ethics Committee of the Experimental Animals of the Malatya Provincial Directorate of Agriculture and Forestry in Turkey (2020/73919507-280.01.01-E.909546).

In order to feed the sheep, straw and hay and average 500 g concentrate per animal were given as roughage in the last 40 days of pregnancy, and 300 g concentrated feed (Nutrient content of concentrated feed; crude protein 16.00%, crude fiber 12.00%, crude oil 3.75%, raw ash 9.00% and other - vitamins, minerals. Energy level 2500 kcal/kg) was given in addition to the roughage during the lactation period until they were regularly out on the pasture. In this process, the sheep were occasionally taken out to pasture during the daytime when the weather conditions were suitable, and they were housed in the corral at night. However, from the beginning of April, the sheep were taken out to the pasture regularly every day and continued to be grazed in the pasture until the end of October. Ewes were given an additional concentrate feed of approximately 1% of their live weight at the return of pasture.

Births began in mid-January and were completed in early March in the study flock. The lambs were kept in the same compartment with their mothers for three days after birth, and then the lambs were housed in a flock with their mothers until the pasture period. During the pasture period, sheep and lambs were kept together for 3 hours in the middle of the day and overnight. Dry alfalfa and lamb grower feed was started to be given to the lambs from the third week and weaning was applied at the age of 90 days. Sheep were started to be milked one week after birth, and lactation period and lactation milk yield were monitored with regular control milkings every month starting from the first month of lactation. Milking was done by hand, and control day milk yields were obtained in the form of both morning and evening milking. On the day before milking on the control day, the lambs were separated from their mothers at 20:00, and the milk obtained at 08:00 in the morning was measured and recorded, and then fed to the lambs with bottles. The lambs were kept apart from their mothers all day and after the evening control day milking was measured and recorded, the lambs were left with their mothers and the milk was given to the lambs with a bottle.

The ewes that gave milk below 100 ml during the control day milking were excluded from the milk control follow-up. The lactation milk yield was calculated according to the Trapeze II Method using the daily milk yield values of the sampling days (Maria andGabina 1992). The following formula was used in the milk yield calculation:

$$((k1\ A) + ((k1 + k2) / 2)\ a1 + \ldots\ldots\ldots + ((kn\text{-}1 + kn) / 2)\ an + (kn\ C))$$

a: Control range; n: Number of controls; k: The amount of milk obtained in the controls; A: The period between lambing date and first control date; C: The period between the last control day and the time of going into the dry.

The lactation periods (LP) of ewes were calculated according to Berger and Thomas, (2005).

LP =na– (a / 2 – A)

a: length of inter-control period (days),

A: time from birth to first control (days)

n: number of controls

Udder and teat measurements were made following Figure 1 (De La Fuente et al., 1996; Türkyılmaz et al., 2018) before morning milking on the 30th, 90th, and the 150th days of lactation.The depth and width of the udder and the distance between the teats, the diameter of the teat, and the length of the teat were measured with calipers, the teat height from the ground and the udder floor height from the ground were measured with a measuring stick, the udder volume was measured with a graduated measuring cup, and the udder circumference was measured with a tape measure.

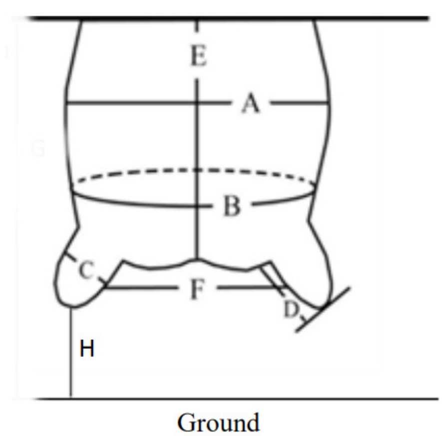

Figure 1. Measurement of udder and teat traits in ewes

A: udder width, **B:** udder circumference, **C:** teat diameter, **D:** teat length, **E:** udder depth, **F:** distance between teats, **H:** teat height from ground

Using the scheme reported by Epstein (1985) (Figure 2), the separation state of the udder lobes, which are observed and photographed from the back and sides, the depth of the teat sinus, the way the teats are attached to the udder, and the slope of the teats were taken into consideration in the typing of the udders.

Evaluation of the udder types of the sheep and the measurement of the udder and teat characteristics were carried out by the people in the research team, who are experts in these subjects and who had similar researches in the past.

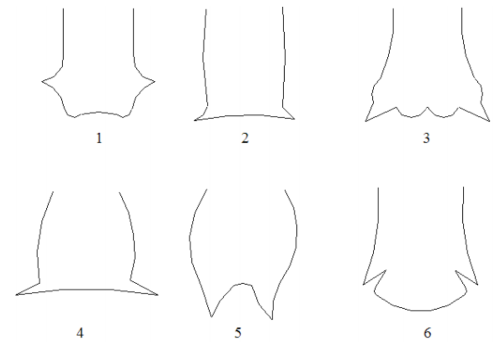

Figure 2. Udder types in ewes (Epstein, 1985)

The ewe's udder types were classified according to the following characteristics as defined by (Epstein, 1985) in the sturdy:

1. Cylindrical udder, teats up and sideways

2. Cylindrical udder, teats down and tilted

3. Pear-shaped udder, teats down and tilted

4. Pear-shaped udder, teats down and horizontal

5. Udder with large, down, and vertical teats

6. Udder with up and tilted teats

Fat (%), non-fat dry matter (%), density (g/ml), lactose (%), salt (%), protein (%), conductivity (mS/cm) and freezing point (°C) analyses of physicochemical properties of milk were measured in milk samples taken separately from each ewe in 50 ml tubes and thoroughly mixed, in the morning and evening milking on the 30th, 90th and 150th days of lactation. The Lactoscan MCC WS brand device was used in the analysis.

The descriptive statistics of the traits examined were calculated using the obtained data. It was examined whether the average daily milk yield, control day and lactation milk yields, lactation periods, udder and teat characteristics, and the data of some physicochemical (Fat (%), non-fat dry matter (%), density (g/ml), lactose (%), salt (%), protein (%), conductivity (mS/cm) and freezing point (°C)) properties of milk showed normal distribution and whether they provided parametric test assumptions. The Kruskal-Wallis variance analysis was used for the non-parametric properties that did not provide parametric test assumptions, and the Bonferroni Mann-Whitney U test was used for the follow-up of properties that were determined to be significant as a result of the analysis.

One-way analysis of variance (ANOVA), followed by the Duncan multiple comparison test as a posthoc test, was used for the parametric features showing a normal distribution. Also, the correlation coefficients between the lactation period and the milk yield values were calculated by the Pearson correlation analysis (Akgül, 2005). The SPSS 22.0 version program was used for these analyses and calculations (SPSS, 2015).

RESULTS AND DISCUSSION

In the present study, Type 1 (n = 20, 37%), Type 2 (n = 9, 16.7%) and Type 3 (n = 25, 46.3%) udders were determined in Awassi ewes, while Type 6 was never found.

Kukovics et al., (2006) found medium or large Type 2 udder in most Awassi ewes, and almost equal Type 2 and Type 3 udder types in Awassi crossbreds (Merino x Awassi F1). While the highest rate determined for Type 3 in our study differs from what other researchers reported for the Awassi breed, it was similar to those reported for F1 ewes.

A study conducted by Kaygısız and Dağ (2017) was determined the most common udder type being Type 3 in awassi ewes. This result was similar to our study findings. Also, in both studies, that Type 6 udder not having been seen at all, is important. It is thought that this similarity may be due to the fact that the sheep in our study were raised indoors and in this respect, they resemble the sheep used by other researchers (Kaygısız and Dağ, 2017).

In the current study, the determined lactation periods and milk yields (lactation, daily milk production, control day) have been presented in Table1.

In this study, the highest values in terms of the lactation period and milk yield (lactation, daily milk production, control day) belonging to Awassi ewes were determined in ewes with Type 2 udders. However, no statistical significance was found between these values and the values of other udder types ($P>0.05$). In the study, the lactation period, lactation milk yield, and daily average milk yield values were calculated as 208.33 ± 4.39 days, 138.59 ± 5.19 liters, and 659.49 ± 19.29 ml, respectively. The lowest values for the listed characteristics were found in ewes with Type 1 udder. As of the 30th, 90th and 150th days of lactation, it was also determined that the highest milk yield belonged to the 90th day (1012.41 ± 33.39 ml) (Table1).

It was reported by Seker et al., (2004) that the average daily milk yield, lactation milk yield, and lactation period were determined as 0.677 kg, 102.9 kg, and 150 days in Awassi ewes, respectively. The lactation period calculated for Awassi ewes in our study was found to be higher than the values reported by Seker et al., (2004) in the Awassi ewes.

In another study conducted on Awassi ewes, the lactation period and the lactation milk yield were found to be 184.3 ± 2.11 days and 196.5 ± 5.60 kg, respectively (Üstüner and Oğan, 2013). The lactation period value determined in this study was higher than the values for the lactation period (Üstüner and Oğan, 2013). Due to the longer lactation period detected in Awassi ewes in our study, it was expected that the lactation milk yield would also be high indirectly.

Kaygısız and Dağ, (2017) found the effects of the udder type, delivery type, year, and lactation order on the lactation milk yield significant ($P<0.01$). They also reported the effects of factors other than the delivery type as important, on the lactation period ($P<0.05$, $P<0.01$). Also, the lactation milk yield was found to be higher in Type 4 and Type 1 udders than in the other three udder types. On the contrary, in our study, the effect of udder type on the lactation milk yield and the lactation period was found to be insignificant.

Özyürek, (2020) did not find a significant effect of the udder type on lactation traits in Awassi ewes ($P>0.05$) and reported that ewes with Type I udders had higher values in terms of lactation traits. It was

Table 1. Milk yields and lactation period according to udder types in Awassi ewes (Mean ± SE)

Factor	n	30th day control Milk yield (ml)	90th day control Milk yield (ml)	150th day control Milk yield (ml)	Lactation Milk yield (lt)	Daily average Milk yield (ml)	Lactation period (days)
Type 1	20	615.00±25.61	989.00±39.64	549.00±37.47	130.34±7.53	630.63±21.62	204.50±7.31
Type 2	9	705.56±45.95	1070.00±70.75	631.11±68.34	157.83±13.80	749.48±80.96	215.00±12.25
Type 3	25	639.60±30.51	1010.40±60.44	580.00±42.21	138.28±8.06	650.19±23.24	209.00±6.25
P		0.267	0.720	0.577	0.202	0.101	0.721
Total	54	641.48±18.79	1012.41±33.39	577.04±26.31	138.59±5.19	659.49±19.29	208.33±4.39

determined that the udder type was similar to the current study results in terms of its effect on lactation traits, but there was a difference in terms of the highest values of lactation traits found in ewes having Type 1 udder, because, in our study, the highest values of lactation traits were determined in ewes with Type 2 udders.

The effect of the udder type on udder and teat traits determined on the 30th, 90th, and 150th days of lactation in Awassi ewes have been presented in Table2.

In this study, the 90th day of lactation measurements were measured as follows: udder circumference (44.58 ± 0.51 cm), udder width (13.20 ± 0.36 cm), udder depth (17.66 ± 0.58 cm), distance between teats (17.96 ± 0.24 cm), udder volume (881.25 ± 37.41 ml), teat height from the ground-left (23.59 ± 0.54 cm), udder floor height from the ground (24.16 ± 0.56 cm), teat length-right (3.84 ± 0.15 cm), teat length-left (3.64 ± 0.17 cm), teat diameter-right (2.07 ± 0.14 cm) and teat diameter-left (1.84 ± 0.12 cm).

In a study conducted by Seker et al., (2004), udder height, udder depth, udder circumference, right udder length, right teat diameter, the distance between teats and udder volume in Awassi ewes were determined as 28 cm, 14.4 cm, 40.7 cm, 4.2 cm, 2.3 cm, 16.1 cm, and 833.6 ml, respectively. In the present study, the udder circumference, udder depth, udder volume, and the distance between teats of Awassi ewes belonging to the 90th day of lactation were found to be higher than the values found in the study of Seker et al., (2004), and lower in terms of the udder floor height from the ground, right teat length, and right teat diameter.

In the study conducted by Özyürek, (2020), the measurements of Awassi ewes were as follows: udder circumference (37.61 ± 0.9 cm), teat height from the ground (27.11 ± 0.8 cm), udder width (11.33 ± 0.4 cm), right teat length (1.47 ± 0.06 cm), left teat length (1.46 ± 0.12 cm), right teat diameter (1.38 ± 0.07 cm), left teat diameter (1.36 ± 0.05 cm), distance between teats (12.33 ± 0.5 cm) and udder depth (12.13 ± 0.5 cm). Also, it was determined that the udder type had no effect on udder and teat sizes, and ewes with Type 1 udder had higher values in terms of udder sizes. Similarly, in our study, although the highest values for the measurements of the height of the teat from the ground and the distance between the teatswere determined in ewes with Type 1 udder, the measurements of all other traits were recorded as the lowest values in ewes with Type 1 udders. In this respect, it differed from the results reported by Özyürek, (2020). It is thought that the differences detected between the findings of our study, and Özyürek, (2020)'s findings may be due to genotype, age, lactation count, birth type, lactation period, and the care and feeding conditions because the milk yield and udder morphology traits are affected by various factors such as sheep breed, age, lactation stage, season, milking system and nutrition (Ayadi et al., 2014).

Table 2. Udder and teat characteristics according to udder types in Awassi ewes (Mean ± SE)

Factor	n	Udder circumference (cm)			Udder width (cm)			Udder depth (cm)			Distance between teats (cm)		
		30th day	90th day	150th day	30th day	90th day	150th day	30th day	90th day	150th day	30th day	90th day	150th day
Type 1	20	41.20±1.39	44.56±1.34	35.18±1.33	11.43±0.35	13.83±0.89	11.04±0.65	18.77±0.81	16.25±1.40	14.36±0.82	17.55±0.56	18.75±0.56	16.36±0.82
Type 2	9	41.70±2.74	43.50±1.31	35.00±1.20	11.15±0.76	14.75±1.55	12.00±0.62	16.95±1.01	18.00±1.51	11.00±0.7	16.05±0.93	17.50±0.34	18.00±0.73
Type 3	25	41.69±1.07	44.84±0.61	35.73±0.83	11.76±0.21	12.60±0.29	10.63±0.30	19.39±0.76	18.04±0.70	15.45±0.55	16.33±0.49	17.81±0.31	15.36±0.41
P		0.962	0.674	0.935	0.558	0.073	0.683	0.211	0.463	0.165	0.1945	0.209	0.365
Total	54	41.51±0.85	44.58±0.51	35.44±0.74	11.52±0.21	13.20±0.36	10.89±0.34	18.71±0.50	17.66±0.58	14.74±0.50	16.75±0.35	17.96±0.24	15.96±0.45

Factor	n	Teat length-right (cm)			Teat length-left (cm)			Teat diameter-right (cm)			Teat diameter-left (cm)		
		30th day	90th day	150th day	30th day	90th day	150th day	30th day	90th day	150th day	30th day	90th day	150th day
Type 1	20	2.87±0.12	3.02±0.30^{A}	2.56±0.22	2.78±0.11	2.81±0.28^{A}	2.40±0.16^{A}	1.48±0.16	1.63±0.06^{A}	1.43±0.10^{A}	1.47±0.16	1.61±0.09^{A}	1.49±0.07^{A}
Type 2	9	3.21±0.23	4.53±0.36^{B}	3.20±0.15	3.10±0.26	4.56±0.53^{C}	3.00±0.15^{AB}	1.82±0.14	2.68±0.25^{B}	1.70±0.08^{AB}	1.62±0.05	2.58±0.46^{B}	1.80±0.06^{AB}
Type 3	25	3.02±0.12	3.98±0.17^{B}	3.10±0.18	3.00±0.12	3.68±0.16^{B}	3.22±0.25^{B}	1.65±0.07	2.14±0.18^{AB}	1.84±0.11^{B}	1.68±0.06	1.80±0.14^{A}	1.90±0.11^{B}
P		0.324	0.003	0.163	0.297	0.003	0.04	0.262	0.018	0.034	0.712	0.018	0.013
Total	54	2.99±0.08	3.84±0.15	2.86±0.14	2.93±0.08	3.64±0.17	2.82±0.16	1.67±0.04	2.07±0.14	1.63±0.08	1.65±0.04	1.84±0.12	1.70±0.07

Factor	n	Teat ground clearance-left (cm)			Udder floorground clearance (cm)			Udder volume (ml)		
		30th day	90th day	150th day	30th day	90th day	150th day	30th day	90th day	150th day
Type 1	20	27.95±0.99	25.00±1.10	27.09±0.92	26.35±0.9647	24.19±1.28	24.64±1.44	457.14±38.31	875.00±38.95	687.27±90.89
Type 2	9	27.40±1.58	22.25±1.79	29.00±0.93	26.70±1.70	24.17±1.167	31.00±1.23	416.67±89.37	892.86±56.09	900.00±89.95
Type 3	25	27.17±0.97	23.46±0.62	27.09±1.07	26.33±0.99	24.15±0.75	26.36±1.08	402.17±33.93	880.00±57.23	659.09±54.69
P		0.854	0.298	0.854	0.977	0.999	0.303	0.620	0.989	0.655
Total	54	27.51±0.62	23.59±0.54	27.17±0.66	26.41±0.64	24.16±0.56	25.74±0.89	426.41±25.61	881.25±37.41	683.04±50.52

$^{A, B, C}$: Differences between means of different letters in the same column are significant ($P < 0.05$)

In this study, the effect of udder type on teat length (right-left) and teat diameter (right-left) on the 90th day and the 150th-day values (excluding teat length-right) were found to be significant ($P<0.05$). Generally, the lowest values were observed in ewes with Type 1 udder. During lactation, the teat lengths and the teat diameters increased from the 30th day to the 90th day and were found to decrease from the 150th day. This situation is thought to be due to the increase in the amount of milk as the lactation period progresses, as well as the mechanical effects caused by the milking and sucking of the lamb. The decrease in the milk yield after the 90th day may be due to the hormonal effects that change depending on the progression of the lactation period and the weaning of lamb (Table2).

Similar to our study, Kukovics et al., (2006) observed that most ewes had small or medium teats and medium or small udders.

In the study, it was also determined that the udder circumference and the udder width displayed a parallel change with the teat length and teat diameter. A similar situation was found in Type 1 and Type 2 udders for the distance between teats, and only in Type 2 udder for the udder depth. The effect of udder types on the udder circumference, udder width, udder depth, and the distance between teats was not found to be significant ($P>0.05$) (Table2). Unlike the findings of this study, in a study conducted in ewes, the effect of the udder type on udder width was statistically significant ($P<0.05$) (Sarı et al., 2015).

In this study, it was determined that the udder volume, like other parameters (excluding the height of the udder floor and teats from the ground), increased on the 90th day and then decreased again. Again, it is thought that the increase in udder traits up to the 90th day is due to the mechanical effects of milking and sucking of the lamb, as well as the increase in the amount of milk, and the decrease after this period is due to the changing hormonal effects and the weaning of the lamb. It can be said that the decrease in the height of the udder and the udder floor from the ground from the 30th day to the 90th day is caused by the increase in milk production during the peak period, the filling of the udder with milk, and the continuation of this process until the decrease, and the sagging of the udder downwards with milking and sucking of the lamb. The increase in these measurements until the 150th day can be explained by the shortening of the milking period due to the weaning of the lamb and the decrease in milk (Table2).

The effect of the lactation period on udder circumference, udder depth, upper and lower udder height, and udder width was found to be statistically significant ($P<0.01$, $P<0.001$) (Sarı et al., 2015).

In the study, the effects of the udder type on some physicochemical properties of the milk on the 30th, 90th, and 150th days of lactation in Awassi ewes have been presented in Table 3.

The effect of the udder type on the physicochemical properties of milk was not found to be statistically significant ($P>0.05$) (Table 3).

Similar to the results of this study, in the study conducted by Sarı et al. (2015), the effect of the udder type on the chemical composition of milk was found to be statistically insignificant ($P>0.05$). In another study conducted on Awassi ewes, similarly, it was determined that the udder type did not have a significant effect on the lactation characteristics and physicochemical properties of milk (Özyürek,2020).

In this study, it was determined that the values of the physicochemical properties of milk increased

Table 3. Physico-chemical properties of milk according to udder types in Awassi ewes (Mean ± SE)

Factor	n	Fat (%)			Non-fat dry matter (%)			Density (g/ml)			Protein (%)		
		30th day	90th day	150th day	30th day	90th day	150th day	30th day	90th day	150th day	30th day	90th day	150th day
Type 1	20	6.29±0.46	7.37±0.44	9.63±0.39	10.95±0.28	12.01±0.13	11.07±0.17	1.036±0.00	1.039±0.00	1.035±0.00	3.83±0.11	4.29±0.05	3.94±0.08
Type 2	9	5.83±0.32	6.76±0.90	9.35±1.05	10.57±0.21	12.04±0.26	11.26±0.05	1.035±0.00	1.039±0.00	1.036±0.00	3.75±0.07	4.30±0.10	4.05±0.05
Type 3	25	5.95±0.21	6.82±0.48	10.10±0.44	10.45±0.09	11.86±0.10	11.63±0.19	1.035±0.00	1.039±0.00	1.036±0.00	3.74±0.03	4.25±0.03	4.17±0.08
P		0.688	0.711	0.662	0.179	0.592	0.138	0.586	0.794	0.325	0.653	0.719	0.153
Total	54	6.06±0.21	7.00±0.31	9.85±0.29	10.66±0.13	11.94±0.08	11.38±0.13	1.035±0.00	1.039±0.00	1.036±0.000	3.77±0.05	4.27±0.03	4.06±0.05

Factor	n	Lactose (%)			Salt (%)			Conductivity (mS/cm)			Freezing point (° C)		
		30th day	90th day	150th day	30th day	90th day	150th day	30th day	90th day	150th day	30th day	90th day	150th day
Type 1	20	5.83±0.16	6.50±0.07	6.00±0.09	0.80±0.03	0.91±.01	0.81±0.01	5.00±0.04	4.80±0.07	4.80±0.09	-0.77±0.02	-0.87±0.01	-0.81±0.01
Type 2	9	5.71±0.12	6.52±0.15	6.10±0.00	0.81±0.01	0.90±0.00	0.80±0.00	5.05±0.08	4.98±0.14	4.75±0.15	-0.73±0.02	-0.86±0.02	-0.83±0.01
Type 3	25	5.64±0.06	6.41±0.06	6.08±0.18	0.79±0.01	0.90±0.01	0.86±0.02	5.07±0.03	4.90±0.07	4.64±0.06	-0.73±0.01	-0.85±0.01	-0.86±0.02
P		0.4567	0.569	0.928	0.869	0.879	0.113	0.383	0.459	0.327	0.691	0.523	0.179
Total	54	5.73±0.07	6.46±0.04	6.05±0.10	0.79±0.01	0.90±0.01	0.83±0.01	5.04±0.02	4.88±0.04	4.71±0.05	-0.75±0.02	-0.86±0.00	-0.84±0.01

from the beginning to the middle period of lactation and decreased towards the end. When the features based on udder types were considered separately, no regular change was detected during the lactation period.

However, some researchers reported that the lactation period, like many genetic and environmental factors, affected some physicochemical properties of milk (Makovicky et al., 2014). When the changes in the fat content of milk during the lactation period of ewes are examined, the reason for the high-fat rate on the 90th day compared to the 30th day is considered to be because the ewes find abundant pasture support and the opportunity to feed with quality roughage especially in this period. The reason for the decrease between the 90th and the 150th days in ewes is thought to be the effect of both the decrease in the milk yield and the decrease in quality of pasture and roughage (Table3).

In a study, the milk protein percentage was determined as 5.19%, fat as 5.82%, lactose as 5.12%, ash as 0.96%, and non-fat dry matter as 11.25% in Awassi ewes (Çelik et al., 2003). The protein rate determined in that study was higher than in our study, while the rates of fat, lactose, and non-fat dry matter were lower. In the study conducted by Şahan et al., (2005) in Awassi ewes, the average composition of ewe's milk was as follows: 17.54 ± 1.35% dry matter, 6.61 ± 1.33% fat, 10.93 ± 0.44% non-fat dry matter, 5.68 ± 0.48% protein and 4.34 ± 0.27% lactose. Unlike our research, Şahan et al., (2005) reported that the effect of the lactation period on the dry matter and fat of milk was significant (P<0.01). In a study, the total dry matter of milk was reported as 17.1%, protein as 5.2-5.3%, fat as 5.7-6.1%, lactose as 4.9-5.3%, non-fat dry matter as 11.0-11.4% in Awassi ewes (Çelik and Özdemir,2006).The fat content of milk is a component that changes the most in milk composition depending on environmental factors such as care and nutrition (Akgün and Koyuncu, 2020). In contrast to the results, we obtained in our study, some researchers found that the lactation period had a significant effect on the density of milk fat, protein, total dry matter, and lactose parameters (Yılmaz et al., 2011; Sarı et al., 2015;Akgün and Koyuncu, 2020) and the electrical conductivity value (Akgün and Koyuncu, 2020). The lowest milk fat and protein rates were reported at the beginning of lactation (6.20% and 5.72%, respectively) and the highest were reported at the end of lactation (6.44% and 6.80%, respectively) (Yılmaz et al., 2011).These differences are thought to be caused by genotype, lactation period, age, lactation order, care, and feeding conditions.

The correlation coefficients between the lactation period and milk yield values of Awassi ewes have been presented in Table 4.

Except for the correlation coefficient between daily average milk yield and the lactation period in this study, all correlation coefficients calculated were found to be positive and statistically significant (P<0.05, P<0.001). Similar to the findings of this study, Özyürek, (2020) reported positive correlations between the lactation milk yield and the lactation period (0.593, P<0.05), lactation milk yield and the daily milk yield (0.976, P<0.01), and the daily milk yield and the lactation period (0.413, P> 0.05) in Awassi ewes.

CONCLUSION

In Awassi ewes, there are quite a lot of variations in terms of udder types in Turkey and other countries as well. There are similar situations in terms of the lactation period, the lactation milk yield, and the daily average milk yield. In this study, Type 3 udder type, which was reported to be common in bred Awassi ewes, was observed at the highest rate. Although some differences were determined between the values of the parameters considered and the results of the studies in other provinces, regions, and countries, in general, the findings of this study were determined to be at the level of the average values recorded for the Awassi breed. In this study, despite the determination

Table 4. Correlation coefficients between lactation period and milk yield values in Awassi ewes (r) (n=54)

	Lactation period (days)	Lactation Milk yield (lt)	Daily average Milk yield (ml)	30th day control Milk yield (ml)	90th day control Milk yield (ml)
LactationMilk yield (liters)	0.77**				
Daily averageMilk yield (ml)	0.27	0.81**			
30th day control Milk yield (ml)	0.76**	0.68**	0.31*		
90th day control Milk yield (ml)	0.73**	0.82**	0.54**	0.63**	
150th day control Milk yield (ml)	0.88**	0.85**	0.47**	0.73**	0.79**

*: P<0.05. **: P<0.01

of a strong relationship between some udder traits and the milk yield, no clear relationship was determined between the udder types and the lactation characteristics, and the physicochemical properties of milk. On the other hand, determination of the potential yield properties owned by the Awassi breed in Turkey and conducting similar studies in larger populations to develop as in Israel and Syria, and planning studies with a wider selection and genetic properties have been concluded to be necessary and beneficial.

CONFLICT OF INTEREST

The authors declare there is no conflict of interest.

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