Milk yield and milk quality characteristics of Awassi sheep under semi-intensive conditions

Research Article

Aydın Daş[1a]
Mücahit Kahraman[1b]
Gülşah Güngören[1c]
Besime Doğan Daş[2d]
Mustafa Ünal Boyraz[3e]

[1]Department of Animal Science, Faculty of Veterinary Medicine, Harran University, Şanlıurfa, Turkey
[2]Department of Animal Nutrition and Nutritional Diseases, Faculty of Veterinary Medicine, Harran University, Şanlıurfa, Turkey
[3]Department of Histology and Embryology, Faculty of Veterinary Medicine, Harran University, Şanlıurfa, Turkey

ORCİD-
[a]0000-0003-0371-5434
[b]0000-0002-7036-6230
[c]0000-0002-0360-7735
[d]0000-0003-2163-2632
[e]0000-0002-5455-0353

Correspondence
Aydın Daş
adas@harran.edu.tr

Article info
Submission: 26-09-2021
Accepted: 13-04-2022
Publication: 30-04-2022

e-ISSN: 2548-1150
doi prefix: 10.31797/vetbio
- http://dergipark.org.tr/vetbio

This work is licensed under a Creative Commons Attribution 4.0 International License

ABSTRACT

This study was carried out to determine the milk yield and milk quality parameters of Awassi sheep raised under semi-intensive conditions in Harran University Experimental Animal Research and Application Center. In the study, 2 and 3 years old, 46 heads of Awassi sheep were used as animal material. The ewes were cared for and fed in a manner routinely used at the Animal Research and Application Center. Average daily milk yield in Awassi sheep was determined as 1002.82±52.57 g. Lactation milk yield and lactation period were calculated as 168.10±8.44 kg and 166.10±2.11 days, respectively. In the study, the overall mean fat, protein, lactose and dry matter ratios were determined. %6.27±0.10; 5.12±0.05; 4.81±0.05 and 17.44±0.13 respectively. Somatic cell count and pH values in Awassi sheep milk were determined as 207.56±21.29 cell/ml and 6.29±0.03 respectively. L*, a* and b* values in sheep milk were determined as 72.69±0.16; -6.11±0.04 and 6.92±0.08. respectively. It was determined that the amount of butyric acid (C4:0), which is one of the short-chain fatty acids, was higher than the values reported for sheep milk in all groups examined in the study. As a result, it has been determined that there is a wide variation in milk yield in Awassi sheep. A rapid genetic improvement may be achieved by utilizing this variation

Keywords: Awassi, milk, fatty acid profile, sheep, somatic cell count

INTRODUCTION

Sheep breeding is carried out in various regions in the world. It is the most profitable livestock farming in regions with steppe climatic conditions, arid zones, and wide grasslands. Sheep are easy to manage, and the cost of sheep breeding is lower than other livestock husbandry practices. They are capable of using vegetation that cattle cannot make use of sheep farming is an important source of livelihood in areas where agriculture is not well developed and feed resources are limited (Akçapınar, 2000; Akçapınar et al., 2002).

Considering the geographical and climatic characteristics of Turkey, sheep breeding, which is one of the major livestock practices, is widely carried out in almost every region of this country. Especially in the Eastern and Southeastern Anatolia regions, sheep breeds constitute the majority of animal husbandry (TUİK, 2020). Sheep breeding in Turkey has combined production level including meat, milk, and wool. The yield of these products varies according to the breed and is often low; however, Awassi is an important breed for milk production (Akçapınar, 2000; Akçapınar and Özbeyaz, 1999).

How to cite this article
Daş, A., Kahraman, M., Güngören, G., Doğan Daş., B., Boyraz MÜ. (2022). Milk yield and milk quality characteristics of Awassi sheep under semi-intensive conditions. *Journal of Advances in VetBio Science and Techniques, 7*(1), 62-71. https://doi.org/10.31797/vetbio.1000968

Awassi is generally grown in the Southeastern Anatolia region of Turkey. The Awassi breed, called the Arabian sheep, originates from the Mesopotamia region located between the Euphrates and Tigris rivers. It is widely raised in the Arab countries, Israel, and North Africa surrounded by the Mediterranean coast. It is raised in low altitude provinces with desert-like climatic conditions including Gaziantep, Şanlıurfa, and Hatay, along the Syrian border of Turkey (Akçapınar, 2000; Kaymakçı, 2010).

Due to the habits and demand for dairy products containing sheep milk in Turkey, sheep milk is an important source of income for breeders in some regions (Esen and Özbey, 2002). Therefore, it is important to reveal the current characteristics of yield performance of breeds for milk production by pure breeding and selection breeding. Milk obtained from Awassi sheep in the Southeastern Anatolia region and Şanlıurfa province is used in the production of several local dairy products and is highly preferred by consumers. It is greatly important to determine the quality parameters of these products, which have a large effect on regional promotion, during the process of registration of geographical indication (Oraman, 2015).

In this study, we aimed to determine the milk yield and milk quality parameters of Awassi sheep raised under semi-intensive conditions in Harran University Research and Application Center for Experimental Animal.

MATERIAL and METHOD

Animal material

The study was conducted in the Livestock Unit of Harran University Research and Application Center for Experimental Animal (Harran /Turkey). A total of 46 Awassi ewes aged 2 and 3 years with single lamb were included.

Care and feeding

The care and feeding of sheep was performed as routinely followed by the sheep breeding unit, considering the pasture and climatic conditions. The sheep were fed in the barn during the lambing period. During the spring pasture period, the animals were not released into the pasture in the morning until the frost cleared, and they were kept in the shelter at night. They were fed with concentrated feed (18% CP, 2600 kcal/kg) and wheat straw in the evening when they returned to the pasture.

Milk yield and quality

To determine the milk yield and characteristics of milk quality, 46 ewes aged 2 and 3 were used. Ewes were selected on the days when the births increased, and care was taken to keep the date of lactation onset close to each other. Milk controls were started on day 15 after birth on average, and monthly controls were continued until the milk yield reduced to below 100 g. Milking was performed using semiautomatic mobile (Sezer) milking machine at around six in the morning and evening. On control days, the lambs were separated from their mothers at 18:00 on the previous day and left until after milking the next day. The morning and evening milk yields in the control milking were summed and the milk yield on the control day was calculated. The 15, 30, 45, 60, 75, 90, 105, 120, 135, 150, 165, and 180-day milk yields were determined from the milk yield records using the interpolation method. The calculated values were used to determine the lactation milk yield using the Trapeze II method (Fleischmann Method) (Ünal et al., 2008).

To determine the characteristics of milk quality, milk samples from each age group were collected four times during the early (mean 45th day), middle (mean 75th and 105th days), and late (mean 135th days) of lactation. A total of 100 mL of milk samples obtained from morning milking were used for the related analysis. Dry matter, fat, protein, and lactose ratios and somatic cell count (SCC) were determined at

Downloaded from https://cabidigitallibrary.org by 188.119.36.163, on 10/27/25.
Subject to the CABI Digital Library Terms & Conditions, available at https://cabidigitallibrary.org/terms-and-conditions

Istanbul University Faculty of Veterinary Medicine using the Bentley 150 Combi Milk Analyzer. The pH and color of the milk samples were determined using a portable pH meter and colorimeter, respectively, immediately after milking (Doğan and Boztepe, 2012; Priolo et al., 2003). Milk samples collected in the morning from eight randomly selected sheep from each age group on day 75 of lactation were used to detect fatty acid composition. For this purpose, 5 mL of hexane was added to 5 mL of milk and vortexed for 5 min. The resulting mixture was centrifuged at 4000 rpm for 15 min and kept in a dark room at +4°C for 24 h. Then, the clear hexane-containing supernatant was transferred to eppendorf tubes and brought to the Harran University Science and Technology Research Center in the cold chain. Milk fat samples were dissolved in 10 mL of hexane, and 0.5 mL of 2 N KOH–methanol solution was added, and then shaken in a vortex and kept in the dark for 1 h. The supernatant gas layer was sampled and read in the GC FID device (GC-FID: Shimadzu nexis GC 2030, Colon: Teknokroma tr882192 Capillary Column TR - CN 100).

Statistical analyzes

Independent sample t-test was used to compare age groups. SPSS package program was used for calculations (IBM SPSS 20.0 for Windows).

RESULTS

The statistical values of daily milk yield, additive milk yield, lactation milk yield, and lactation period in sheep at different periods of lactation are shown in Tables 1, 2, and 3. The difference between the age groups on day 105, 120, 135, and 150 of lactation was statistically significant ($P<0.05$ and $P<0.01$). Significant differences were observed in the groups in terms of added milk yield on day 165 and 180 of lactation ($P<0.05$). The lactation curve drawn according to the average daily milk yield of the sheep examined within the scope of the research is shown in Figure 1. The parameters of milk quality are shown in Table 4. No significant difference was observed in the quality parameters between the 2- and 3-year-old animal groups, except for the pH value on day 45. The fatty acid ratios determined in sheep milk and the index values calculated from these values are shown in Table 5.

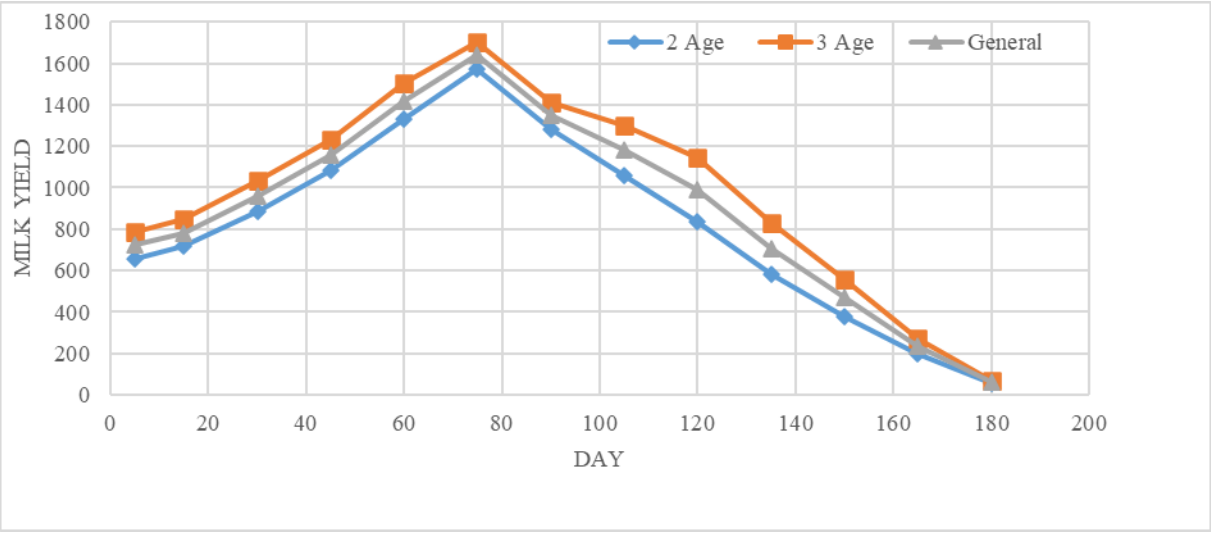


Figure 1. Lactation curve in Awassi sheep.

Downloaded from https://cabidigitallibrary.org by 188.119.36.163, on 10/27/25.
Subject to the CABI Digital Library Terms & Conditions, available at https://cabidigitallibrary.org/terms-and-conditions

Table 1. Statistical values of daily milk yield in various days of lactation in Awassi sheep (g)

Age		Day 15	Day 30	Day 45	Day 60	Day 75	Day 90	Day 105	Day 120	Day 135	Day 150	Day 165	Day 180	Daily Milk Yield
2	**n**	23	23	23	23	23	23	23	23	22	19	14	6	23
	X±SE	715.34±112.44	883.87±106.49	1084.05±106.88	1333.97±95.44	1575.18±108.41	1279.06±86.32	1059.28±76.7[a]	834.03±75.84[a]	579.62±66.45[a]	379.81±49.1[a]	198.09±37.30	57.16±9.29	937.97±75.85
	Min	39.35	141.71	244.06	278.45	361.50	355.50	328.30	232.37	28.87	82.80	28.00	15.33	215.30
	Max	2028.25	2198.88	2369.50	2273.33	2710.75	2026.23	1721.80	1565.80	1213.50	831.00	448.50	76.50	1889.99
	%V	75.38	57.78	47.28	34.31	33.01	32.37	34.74	43.61	53.77	56.29	70.46	39.80	38.78
3	**n**	23	23	23	23	23	23	23	23	23	20	17	9	23
	X±SE	848.52±121.38	1034.83±112.74	1232.98±110.42	1501.73±97.37	1703.07±120.64	1414.41±90.39	1301.21±82.8[b]	1145.94±87.0[b]	827.08±74.93[b]	556.6±54.96[b]	271.43±39.08	66.83±3.92	1067.67±71.90
	Min	58.29	300.06	314.18	516.13	539.25	417.53	404.53	366.60	260.10	153.60	34.87	56.27	353.19
	Max	1914.00	2159.07	2388.63	2485.19	2779.00	2103.93	1969.43	1981.97	1505.47	1028.97	552.47	90.53	1566.56
	%V	68.60	52.25	42.95	31.09	33.97	30.65	30.50	36.43	43.45	44.15	59.36	17.59	32.30
P		NS	NS	NS	NS	NS	NS	*	**	*	*	NS	NS	NS
Total	**n**	46	46	46	46	46	46	46	46	45	39	31	15	46
	X±SE	781.96±82.40	959.35±77.50	1158.52±76.78	1417.85±68.56	1639.12±80.76	1346.74±62.61	1180.25±58.64	989.99±61.63	706.1±53.04	470.5±39.18	238.31±27.63	62.96±4.38	1002.82±52.57
	Min	39.35	141.71	244.06	278.45	361.50	355.50	328.30	232.37	28.87	82.80	28.00	15.33	215.30
	Max	2028.25	2198.88	2388.63	2485.19	2779.00	2103.93	1969.43	1981.97	1505.47	1028.97	552.47	90.53	1889.99
	%V	71.47	54.79	44.95	32.79	33.41	31.53	33.70	42.22	50.39	52.01	64.55	26.95	35.55

a.b: The difference between the means with different letters in the same column is statistically significant (P<0.05).
NS: Nonsignificant (P>0.05); *: P<0.05; **: P<0.01

Downloaded from https://cabidigitallibrary.org by 188.119.36.163, on 10/27/25.
Subject to the CABI Digital Library Terms & Conditions, available at https://cabidigitallibrary.org/terms-and-conditions

Table 2. Statistical values of additive milk yield in various days of lactation in Awassi sheep (kg)

Age		Day 30	Day 45	Day 60	Day 75	Day 90	Day 105	Day 120	Day 135	Day 150	Day 165	Day 180
2	**n**	23	23	23	23	23	23	23	22	19	14	6
	X±SE	22.73±3.31	37.48±4.86	55.62±6.23	77.44±7.57	98.85±8.79	116.38±9.59	130.58±10.03	140.1±10.22	147.51±10.33	150.76±10.41[a]	151.78±10.46[a]
	Min	1.95	4.84	8.76	13.56	18.94	24.07	28.80	32.61	34.78	35.61	35.82
	Max	62.13	96.39	131.21	168.59	204.12	228.16	239.51	242.01	242.01	242.01	242.01
	%V	69.93	62.18	53.69	46.87	42.65	39.52	36.83	34.99	33.59	33.13	33.04
3	**n**	23	23	23	23	23	23	23	23	20	17	9
	X±SE	26.85±3.54	43.86±5.09	64.37±6.46	88.41±7.88	111.79±9.214	132.16±10.24	150.51±11.12	165.31±11.84	175.14±12.39	180.28±12.78[b]	181.98±12.96[b]
	Min	5.04	13.29	21.58	31.60	38.78	44.94	50.73	55.43	58.53	60.04	60.39
	Max	57.57	86.88	123.43	162.70	198.63	226.96	250.41	268.73	282.07	290.41	293.75
	%V	63.15	55.61	48.11	42.72	39.53	37.17	35.44	34.34	33.93	34.01	34.15
P		NS	NS	NS	NS	NS	NS	NS	NS	NS	*	*
Total	**n**	46	46	46	46	46	46	46	45	39	31	15
	X±SE	24.79±2.42	40.67±3.51	60.00±4.48	82.92±5.46	105.32±6.37	124.27±7.04	140.55±7.55	153.15±7.94	161.32±8.24	165.52±8.44	166.88±8.53
	Min	1.95	4.84	8.76	13.56	18.94	24.07	28.80	32.61	34.78	35.61	35.82
	Max	62.13	96.39	131.21	168.59	204.12	228.16	250.41	268.73	282.07	290.41	293.75
	%V	66.09	58.54	50.67	44.67	41.02	38.41	36.44	35.17	34.63	34.60	34.69

Table 3. Statistical values of lactation milk yield and lactation period in Awassi sheep

Lactation Milk Yield (kg)				
Age	**n**	**X±SE**	**Min**	**Max**
2	23	152.84±10.36	36.96	237.93
3	23	183.37±12.76	61.65	297.15
P		NS		
Total	46	168.10±8.44	36.96	297.15
Lactation Period (Day)				
Age	**n**	**X±SE**	**Min**	**Max**
2	23	163.04±3.37	125.00	180.00
3	23	169.26±2.44	145.00	180.00
P		NS		
Total	46	166.15±2.11	125.00	180.00

Downloaded from https://cabidigitallibrary.org by 188.119.36.163, on 10/27/25.
Subject to the CABI Digital Library Terms & Conditions, available at https://cabidigitallibrary.org/terms-and-conditions

Table 4. Milk quality characteristics of Awassi sheep (%)

			Day 45	Day 75	Day 105	Day 135	Total
Traits	**Age**	**n**	**X±SE**	**X±SE**	**X±SE**	**X±SE**	**X±SE**
Fat Percentage (%)	2	23	5.12 ±0.26	5.73±0.18	6.78±0.21	7.37±0.24	6.27±0.10
	3	23	5.01±0.20	6.16±0.14	6.80±0.25	7.21±0.23	
Protein Percentage (%)	2	23	4.69±0.12	4.90±0.09	5.59±0.12	5.48±0.13	5.12±0.05
	3	23	4.69±0.09	4.87±0.10	5.41±0.12	5.36±0.23	
Laktose Percentage (%)	2	23	5.25±0.04	5.26±0.04	4.69±0.10	4.19±0.15	4.81±0.05
	3	23	5.18±0.05	5.19±0.05	4.62±0.09	4.07±0.15	
Dry Matter Percentage (%)	2	23	16.42±0.31	17.28±0.23	18.33±0.30	18.09±0.40	17.44±0.13
	3	23	16.23±0.26	17.58±0.21	18.06±0.34	17.62±0.55	
Freezing Point	2	23	0.58±0.00	0.58±0.00	0.57±0.00	0.57±0.01	0.57±0.00
	3	23	0.57±0.00	0.58±0.00	0.57±0.00	0.56±0.01	
SCC (x10^3 cell/ml)	2	23	206.17±52.49	240.61±77.28	190.70±51.06	341.35±108.54	207.56±21.29
	3	23	187.17±48.68	175.74±34.46	139.43±25.75	178.78±36.15	
pH	2	23	6.70±0.02^a	6.55±0.01	6.02±0.06	5.89±0.05	6.29±0.03
	3	23	6.65±0.02^b	6.55±0.02	6.00±0.05	5.93±0.05	
L*	2	23	72.29±0.37	71.17±0.63	73.43±0.22	72.22±0.45	72.69±0.16
	3	23	73.16±0.37	72.51±0.65	73.83±0.24	72.92±0.41	
a*	2	23	-6.31±0.09	-6.67±0.12	-5.93±0.10	-5.83±0.09	-6.11±0.04
	3	23	-6.14±0.10	-6.41±0.11	-5.85±0.13	-5.73±0.13	
b*	2	23	6.62±0.17	6.39±0.17	6.83±0.20	7.61±0.28	6.92±0.08
	3	23	6.74±0.15	6.66±0.20	6.81±0.21	7.69±0.24	

a,b: The difference between the means with different letters in the same column is statistically significant (P<0.05).

Table 5. Milk fatty acid ratios and index values in Awassi sheep (%)

Fatty Acid	Age	n	X±SE
Butyric Acid (C4:0)	2	8	3.41±0.46
	3	8	4.02±0.1
Caproic Acid (C6:0)	2	8	3.60±0.27
	3	8	4.03±0.09
Caprylic Acid (C8:0)	2	8	3.97±0.17
	3	8	4.28±0.16
Capric Acid (C10:0)	2	8	13.83±0.7
	3	8	14.77±0.57
Undecanoic Acid (C11:0)	2	8	0.34±0.02
	3	8	0.35±0.03
Lauric Acid (C12:0)	2	8	7.23±0.41
	3	8	7.48±0.30
Myristic Acid (C14:0)	2	8	16.20±0.35
	3	8	16.67±0.48
Myristoleic Acid (C14:1)	2	8	0.27±0.01
	3	8	0.29±0.02
Pentadecanoic Acid (C15:0)	2	8	0.82±0.05
	3	8	0.92±0.05
Palmitic Acid (C16:0)	2	8	29.08±1.18
	3	8	28.48±0.98
Palmitoleic Acid (C16:1)	2	8	0.48±0.03
	3	8	0.43±0.04
Trans-Elaidic Acid (C18:1n9t)	2	8	3.91±0.23
	3	8	3.71±0.11
Stearic Acid (C18:0)	2	8	3.46±0.15
	3	8	3.26±0.24
Cis-Oleic Acid (C18:1n9c)	2	8	13.28±0.70
	3	8	11.51±0.62
Cis-Linoleic Acid (C18:2n6c)	2	8	0.75±0.07

Downloaded from https://cabidigitallibrary.org by 188.119.36.163, on 10/27/25.
Subject to the CABI Digital Library Terms & Conditions, available at https://cabidigitallibrary.org/terms-and-conditions

	3	8	0.61±0.08
Linolenic Acid (C18:3n6)	2	8	0.23±0.01
	3	8	0.20±0.02
Total Saturated Fatty Acid	2	8	80.08±0.79^{b}
	3	8	84.25±0.72^{a}
Total Monounsaturated Fatty Acid	2	8	18.94±0.74^{a}
	3	8	14.94±0.66^{b}
Total Poliunsaturated Fatty Acid	2	8	0.98±0.08
	3	8	0.80±0.10
Total Unsaturated Fatty Acid	2	8	19.92±0.79^{a}
	3	8	15.75±0.72^{b}
Nutritional Value	2	8	0.69±0.03
	3	8	0.62±0.04
Atherogenic Index	2	8	3.78±0.25^{b}
	3	8	5.02±0.34^{a}

a.b: The difference between the means with different letters in the same column is statistically significant (P<0.05).

DISCUSSION

In this study, in addition to the lactation data of Awassi sheep, fatty acid profile, which is an important milk quality parameter for healthy nutrition in humans, and some characteristics of milk quality (dry matter, fat, protein, lactose ratios, SCC, and pH) were determined. The values of milk yield (Tables 1, 2, and 3) of 3-year-old Awassi sheep were higher. As milk yield in sheep is a characteristic that increases with age (Akçapınar, 2000; Akçapınar and Özbeyaz, 1999; Kaymakçı, 2010), high yields are expected in the elderly group. In the present study, the average daily milk yield for Awassi sheep was higher than that reported in studies conducted in Konya Ereğli (Yalçın and Aktaş, 1969) and in Awassi sheep raised in the Duhok region in the north of Iraq (Merkhan, 2014), whereas these values were similar to those reported for Turkish Awassi (Al-Samarai et al., 2015) raised at the Abu Garip Research Station located in Iraq. The daily milk yield obtained in the present study was lower than that reported in the improved Awassi sheep kept in intensive conditions (Pollott and Gootwine, 2001). Awassi sheep examined within the scope of the research reached the highest milk yield on day 75 of lactation (Figure 1), and the average lactation peak value was calculated to be 1639.12±80.76 g. This lactation peak value was between the values reported by Dağ and Zülkadir (2004) and that reported by Dağ (1996). In the present study, the total milk yield (82.92±5.46 kg) obtained until day 75, when the highest milk yield was observed, constituted 50% of the total milk yield (166.88±8.53 kg) obtained throughout the lactation period (Table 2). According to the results of this study, Awassi sheep reached approximately half of the lactation yield during the peak period of lactation and the remaining half was obtained in the last 90 days. In terms of additive milk yield, the ratio of peak milk yield to total milk yield varies between breeds (Esen and Özbey, 2002; Ünal et al., 2002; Yardımcı and Özbeyaz, 2001; Kahraman and Yüceer Özkul, 2020).

The first and second lactation data of Awassi sheep in the present study had an average value compared to that reported in literature. Milk yield is characterized by various factors (Akçapınar, 2000; Akçapınar and Özbeyaz, 1999; Kaymakçı 2010). Part of the difference in milk yield is due to environmental differences. On the other hand, when milk yield in Awassi sheep was examined, a wide variation within the breed was observed. Using this variation, elite herds with high milk production were obtained through breeding studies conducted in Awassi sheep in different parts of the world. Following these selection studies, a good level of genetic improvement was achieved in milk

Downloaded from https://cabidigitallibrary.org by 188.119.36.163, on 10/27/25.
Subject to the CABI Digital Library Terms & Conditions, available at https://cabidigitallibrary.org/terms-and-conditions

yield, and dairy herds were formed within the breed (Pollott and Gootwine, 2001). Therefore, it is thought that the genetic and biochemical factors as well as the environmental effects contribute to the difference in milk yield in Awassi sheep. Indeed, the average lactation milk yield in low- and high-yielding sheep was found to be 36.96 and 297.15 kg, respectively in the present study (Table 3). It can be concluded that the difference in yield observed between these groups, which have similar environmental conditions, mode of delivery, and milking type, is due to the genetic effect in favor of increased milk yield. This variation among the Awassi breeds allows rapid genetic improvement within the breed to develop high-yielding herds. High-yielding Awassi sheep can be used as a parent line to raise dairy breed sheep.

Milk fat ratio, one of the quality parameters examined in the present study, inversely increased with milk yield from early lactation, and the maximum fat rate value was observed on day 135 of lactation. This change observed in milk fat ratio during lactation was consistent with that reported in some indigenous and crossbred sheep (Kahraman and Yüceer Özkul, 2020) and Akkaraman and Awassi breeds (Aktaş, 1970). The total average fat content during lactation for Awassi sheep in the present study was lower than that reported for Awassi and Akkaraman sheep (Yalçın and Aktaş, 1969) and for Awassi sheep reported by Gürsu and Aygün (2014). The values of fat ratio in the present study were similar to those reported for Awassi sheep by Aktaş (1970); however, they were similar or higher than those reported for indigenous and crossbred sheep by Kahraman and Yüceer Özkul (2020).

During the lactation period, the protein ratio in milk tends to increase from early lactation, and the highest protein ratio was achieved on day 105 of lactation. The total average protein ratio was similar to that reported by Özder (2002) for Türkgeldi sheep and lower than that value for Awassi breed by Konar et al. (1991) and Şahan et al. (2005).

The milk lactose values of Awassi sheep in the present study were similar to those reported for Akkaraman sheep by Kahraman and Yüceer Özkul (2020) and higher than those reported in Awassi sheep by Konar et al. (1991).

Dry matter ratio increased from the start of lactation to day 105 in the present study. It was considered that the increase in dry matter observed during this lactation period was due to the increase in fat and protein ratios and decline in the amount of milk during the same period. Indeed, many studies have reported high level of positive correlation between dry matter and fat and protein ratios (Çelik and Özdemir, 2003; Kahraman and Yüceer Özkul, 2020). The total average dry matter ratio determined for sheep milk in the present study was lower than that reported in a study that examined the chemical change during lactation in Awassi sheep milk (Şahan et al., 2005) as well as that reported for Awassi sheep by Gürsu and Aygün (2014). The results of the present study were consistent with those reported for Tuj sheep (Karaoğlu et al., 2001); however, they were lower than those reported by Özyürek (2020). There are different reports on sheep milk composition in literature. These differences are due to genetic and environmental factors such as breed, milking processes, feeding, breeding, and climatic conditions (Akçapınar and Özbeyaz, 1999; Çelik and Özdemir, 2003; Pugliese et al., 2000). The differences in the device and method used in the analysis of milk content should not be ignored while evaluating these results.

SCC decreased from the start of lactation to the middle period of the study and tended to rapidly increase during the last period. This change in SCC was similar to that reported in literature (Pirisi et al., 2000; Kahraman and Yüceer Özkul, 2020). SCC calculated throughout the lactation period in the present study was within the range reported for healthy

Downloaded from https://cabidigitallibrary.org by 188.119.36.163, on 10/27/25.
Subject to the CABI Digital Library Terms & Conditions, available at https://cabidigitallibrary.org/terms-and-conditions

sheep milk (Yağcı and Kaymaz, 2006). During lactation, the pH value showed a steady decreasing trend, which was in accordance with the continuous decrease in Awassi sheep (Şahan et al., 2005) reported in a previous study.

In the present study, the L* and a* values of 72.69±0.16 and −6.11±0.04, respectively, were lower than those reported by Priolo et al. (2003), Doğan and Boztepe (2012), and Yüceer et al. (2015). The b* value in the present study was higher than that reported by Priolo et al. (2003) and Yüceer et al. (2015), whereas it was similar to that reported by Doğan and Boztepe (2012). The differences in color data of sheep milk are due to several genetic and nongenetic variables, such as feeding, disease, sampling, and lactation period (Doğan and Boztepe, 2012).

The amount of butyric acid (C4:0), which is one of the short-chain fatty acids, was higher in all groups in the present study than that previously reported for sheep milk. Milk and dairy products obtained from Awassi sheep are fondly consumed with their unique taste and flavor, especially in XXXX. Therefore, this flavor plays an important role in the choice of milk and dairy products by the local people. Butyric acid (C4:0), which involved in the formation of the characteristic flavor of sheep milk (Park et al. 2007), found in different amounts in Awassi sheep milk, together with other proportionally different fatty acids, has an important effect on breed-specific milk flavor. However, the high amount of short- and medium-chain fatty acids (C4:0 and C6:0, C8:0 and C10:0) in the milk of Awassi sheep was considered to have negative effect on the milk quality. Previous studies on the comparison of fatty acids in sheep milk have reported different results. This is due to the fact that the composition of fatty acids is affected by the rations used in animal nutrition, genotypic differences, and ration × breed interactions (Chilliard and Ferlay, 2004; Tsiplakou and Zervas, 2013).

CONCLUSION

There is a wide variation in milk yield within Awassi sheep breed. These variations may allow rapid genetic improvement to establish dairy elite herds of Awassi breed. The values of milk quality parameters were in range of those reported for sheep milk.

ACKNOWLEDGMENT

Ethical approval: Ethical approval: Animal Experiments Local Ethics Committee of Harran University. Approval no: 2021-002, 01-06.

Conflict of interest: The authors declare that they have no conflict of interest.

REFERENCES

Akçapınar, H. (2000). *Koyun yetiştiriciliği*. TR: İsmat Matbaacılık.

Akçapınar, H., Özbeyaz, C. (1999). *Hayvan yetiştiriciliği temel bilgileri*. TR: Kariyer Matbaacılık Ltd. Şti.

Akçapınar, H., Ünal, N., Atasoy, F., Özbeyaz, C., Aytaç, M. (2002). Karayaka ve Bafra koyunlarının Lalahan Hayvancılık Araştırma Enstitüsü şartlarına uyum kabiliyeti. *Lalahan Hayvancılık Araştırma Enstitüsü Dergisi*, *42*(1), 11-24.

Aktaş, G. (1970). İvesi ve Akkaraman koyunlarının bazı verim özellikleri ve bunların yaş ve laktasyon ayları ile ilişkisi. *Lalahan Hayvancılık Araştırma Enstitüsü Dergisi*, *10*(1-2), 1-7.

Al-Samarai, W. I., Al-Kazraji, W. J., Al-Jelawi, J. R., Ajeel, H.M. (2015). The effect of some environmental factor in some growth traits and milk production in Turkish Awassi sheep. *Diyala Journal of Agricultural Sciences*, *7*(2), 59-68.

Chilliard, Y., Ferlay, A. (2004). Dietary lipids and forages interactions on cow and goat milk fatty acid composition and sensory properties. *Reproduction Nutrition Development*, *44*, 467-492.

Çelik, Ş., Özdemir, S. (2003). Morkaraman ırkı koyun sütlerinin bazı kimyasal ve fizikokimyasal parametrelerinin laktasyon boyunca değişimi. Atatürk Üniversitesi Ziraat Fakültesi Dergisi, *34*(3), 263-268.

Dağ, B. (1996). *TİGEM Gözlü tarım işletmesinde yetiştirilen Akkaraman ve İvesi sürülerinde süt ve yapağı verimi özelliklerini etkileyen bazı faktörlerin parametrelerinin tahmini.* [Yayımlanmamış doktora tezi]. Selçuk Üniversitesi.

Dağ, B., Zülkadir, U. (2004). Relationships among udder traits and milk production in unimproved

Downloaded from https://cabidigitallibrary.org by 188.119.36.163, on 10/27/25.
Subject to the CABI Digital Library Terms & Conditions, available at https://cabidigitallibrary.org/terms-and-conditions

Awassi sheep. *Journal of Animal and Veterinary Advances*, *3*, 730-735.

Doğan, Ş., Boztepe, S. (2012). Anadolu Merinosu koyunlarında meme tipleriyle sütün elektrik iletkenliği ve süt rengi arasındaki ilişkiler. Lalahan Hayvancılık Araştırma Enstitüsü Dergisi, *52*, 11-19.

Esen, F., Özbey, O. (2002). Akkaraman, Sakız x Akkaraman melez (F1) koyunlarda döl ve süt verim özellikleri. *Turkish Journal of Veterinary and Animal Sciences*, *26*, 503-509.

Gürsu, G., Aygün, T. (2014). Some characteristics of milk yield in Awassi ewes maintained at village conditions. *Journal of Advanced Agricultural Technologies*, *1*(1), 19-23. 10.12720/joaat.1.1.19-23.

Kahraman, M., Yüceer Özkul, B. (2020). Milk yield and some milk quality traits of Akkaraman, Bafra and Bafra x Akkaraman F1 sheep. *Eurasian Journal of Veterinary Sciences*, *36*(2), 86-95.

Karaoğlu, M., Macit, M., Aksoy, A. (2001). Tuj koyunlarının yarı entansif koşullarda süt verim özellikleri. *Turkish Journal of Veterinary and Animal Sciences*, *25*, 249-253.

Kaymakçı, M. (2010). *İleri Koyun Yetiştiriciliği*. TR: Meta Basım.

Konar, A., Akın, M. S., Şahan, N., Güven, M. (1991). Laktasyon döneminde ivesi koyun sütü bileşimindeki değişmeler. Turkish Journal of Agriculture and Forestry, *15*, 958-967.

Merkhan, K. Y. (2014). Milk traits and their relationship with udder measurements in Awassi ewes. *Iranian Journal of Applied Animal Science*, *4*, 521-526.

Oraman, Y. (2015). Türkiye'de coğrafi işaretli ürünler. *Balkan ve Yakın Doğu Sosyal Bilimler Dergisi*, *1*(1), 76-85.

Özder, M. (2002). Türkgeldi Koyun tipinin gelişme ve süt verim özellikleri bakımından ıslahı. TÜBİTAK VHAG-1349'nolu Projenin Sonuç Raporu

Özyürek, S. (2020). Investigation of relationship between udder morphology, lactation traits and milk components in morkaraman and Awassi. *Gümüşhane Üniversitesi Fen Bilimleri Enstitüsü Dergisi*, *10*(1), 268-274.

Park, Y. W., Ju´Arez, M., Ramosc, M., Haenlein, G. F. W. (2007). Physico-chemical characteristics of goat and sheep milk. *Small Ruminant Research*, *68*, 88–113.

Pirisi, A., Piredda, G., Corona, M., Pes, M., Pintus, S., Ledda, A. (2000). Influence of somatic cell count on ewe's milk composistion, cheese yield and cheese qality. *Proceedings of Sixth Great Lakes Dairy Sheep Symposium*, Guelph, Canada, 47-59.

Pollott, G. E., Gootwine, E. (2001). A Genetic analysis of complete lactation milk production in improved Awassi sheep. *Livestock Production Science*, *71*, 37-47.

Priolo, A., Lanza, M., Barbagallo, D., Finocchiaro, L., Biondi, L. (2003). Can the reflectance spectrum be used to trace grass feeding in ewe milk? *Small Ruminant Research*, *48*(2), 103-107.

Pugliese, C., Acciaioli, A., Rapaccini, S., Parisi, G., Franci, O. (2000). Evolution of chemical composition, somatic cell counts and rennetimg properties of the nilk of Massese ewes. *Small Ruminant Research*, *35*, 71-80.

Şahan, N., Say, D., Kacar, A. (2005). Changes in chemical and mineral contents of Awassi ewe's milk during lactation. *Turkish Journal of Veterinary and Animal Sciences*, *29*, 589-593.

Tsiplakou, E., Zervas, G. (2013). Changes in milk and plasma fatty acid profile in response to fish and soybean oil supplementation in dairy sheep. *Journal of Dairy Research*, 80, 205-213.

TUİK, (2020). Hayvansal üretim istatistikleri. https://www.tuik.gov.tr/

Ünal, N., Akçapınar, H., Atasoy, F., Yakan, A., Uğurlu, M. (2008). Milk yield and milking traits measured with different methods in Bafra sheep. *Revue de Medecine Veterinaire*, *159*(10), 494-501.

Ünal, N., Atasoy, F., Aytaç, M., Akçapınar, H., (2002). Akkaraman, Sakız x Akkaraman F1, Kıvırcık x Akkaraman F1 ve Sakız x Karayaka G1 koyunlarda ilk laktasyon süt verim özellikleri. *Turk Journal of Veterinary and Animal Science*, *26*, 617-622.

Yağcı, İ. P., Kaymaz, M. (2006). Koyunlarda klinik mikrobiyolojik ve biyokimyasal metotlar ile subklinik mastitislerin saptanması. *Ankara Üniversitesi Veteriner Fakültesi Dergisi*, *53*(1), 31-35.

Yalçın, B. C., Aktaş, G. (1969). Ergin İvesi ve Akkaraman koyunlarının Konya Ereğlisi şartlarındaki performansları. *Lalahan Hayvancılık Araştırma Enstitüsü Dergisi*, *9*(3-4), 1-14.

Yardımcı, M., Özbeyaz, C. (2001). Akkaraman, Sakız x Akkaraman melezi F1 koyunlarının süt verimi ve meme özelliklerinin karşılaştırılması. *Lalahan Hayvancılık Araştırma Enstitüsü Dergisi*, *41*(2), 63-77.

Yüceer, B., Ünal, N., Özbaşer, F. T. (2015). Halk elinde ekstansif koşullarda yetiştirilen Sakız X Akkaraman G1 koyunlarda süt verimi ve bazı kalite özellikleri. *Lalahan Hayvancılık Araştırma Enstitüsü Dergisi*, *55*(1), 7-14.

Downloaded from https://cabidigitallibrary.org by 188.119.36.163, on 10/27/25.
Subject to the CABI Digital Library Terms & Conditions, available at https://cabidigitallibrary.org/terms-and-conditions