T.R.
VAN YUZUNCU YIL UNIVERSITY
INSTITUTE OF NATURAL AND APPLIED SCIENCES
DEPARTMENT OF ANIMAL SCIENCE

THE RELATIONSHIP BETWEEN UDDER CHARACTERISTICS AND MILK QUALITY IN IRAQI AWASSI EWES

M.Sc. THESIS

PREPARED BY: Nazik MAHMOOD ILYAS
SUPERVISOR: Assoc. Prof. Dr. Ferda KARAKUŞ

VAN-2019

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ACCEPTANCE and APPROVAL PAGE

This thesis entitled "The Relationship Between Udder Characteristics and Milk Quality in Iraqi Awassi Ewes" presented by Nazik MAHMOOD ILYAS under supervision of Assoc. Prof. Dr. Ferda KARAKUŞ in the Department of Animal Science has been accepted as a M.Sc. Thesis according to Legislations of Graduate Higher Education on 07/03/2019 with unanimity of votes members of jury.

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This thesis has been approved by the committee of The Institute of Natural and Applied Science on 08/03/2019 with decision number 2019/8-4111

Signature

Director of Institute

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Enstitü Müdürü

THESIS STATEMENT

All information presented in the thesis obtained in the frame of ethical behavior and academic rules. In addition, all kinds of information that does not belong to me have been cited appropriately in the thesis prepared by the thesis writing rules.

Nazik MAHMOOD ILYAS

ABSTRACT

THE RELATIONSHIP BETWEEN UDDER CHARACTERISTICS AND MILK QUALITY IN IRAQI AWASSI EWES

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M.Sc. Thesis, Department of Animal Science
Supervisor: Assoc. Prof. Dr. Ferda KARAKUŞ
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The main objectives of this study were to determine udder measurements and type, test-day milk yield and milk composition, somatic cell count and total bacterial count, and to evaluate the relationships between these characteristics in Iraqi Awassi ewes.

The study was conducted on 50 head Awassi ewes raised at a commercial farm located in Summel/Duhok/Iraq. Test-day milk yield was recorded fortnightly from second week after parturition for three times. Milk samples were analyzed for fat, solid non-fat, protein, and lactose components. Udder morphological traits recorded in the study were udder width, udder circumference, udder length, teat diameter, teat length, distance between teats, udder height from the ground, teat height from the ground. Udder types in ewes were determined by subjective method. Total bacterial count and somatic cell count (SCC) in milk samples was determined.

As a result, udder type had no significant effect on test-day milk yield, SCC, and milk composition traits in Iraqi Awassi ewes. There were positive and negative but rather weak correlations between udder measurements and milk composition traits. Only udder length measurement from udder traits was significantly correlated with SCC ($p<0.05$). It was found that Iraqi Awassi ewes had a healthy mammary gland and consumable milk due to their low SCC (39.20 $x10^3$ cells/ml) and bacterial content. Since there is an increased risk of infection due to contact with the ground, ewes which have the cylindrical udder with upward and lateral teats can be selected instead of ewes which have the pear-shaped udder with downwards and inclined teats.

Keywords: Awassi, Udder type, Milk, Somatic cell count.

ÖZET

IRAK İVESİ KOYUNLARINDA MEME ÖZELLİKLERİ VE SÜT KALİTESİ ARASINDAKİ İLİŞKİLER

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Bu çalışmanın başlıca amaçları, Irak İvesi koyunlarında meme özellikleri ve tipi, test günü süt verimi ve süt kompozisyonu, sütte somatik hücre ve total bakteri sayısını belirlemek ve söz konusu özellikler arasındaki ilişkileri ortaya koymaktır.

Çalışma, Irak/Summel/Duhok bölgesinde bulunan ticari bir koyunculuk işletmesinde yetiştirilen 50 baş İvesi koyunu üzerinde yürütüldü. Test günü süt verimi, doğumdan sonraki ikinci haftadan itibaren üç denetim olmak üzere iki haftada bir kaydedildi. Süt örneklerinde yağ, yağsız kuru madde, protein ve laktoz içeriği analiz edildi. Çalışmada ele alınan morfolojik meme özelliklerini; meme genişliği, meme çevresi, meme uzunluğu, meme başı çapı, meme başı uzunluğu, meme başları arasındaki mesafe, memenin yerden yüksekliği ve meme başlarının yerden yüksekliği oluşturdu. Koyunlarda meme tipleri subjektif yöntemle belirlendi. Süt örneklerinde toplam bakteri sayısı ve somatik hücre sayısı (SHS) belirlendi.

Sonuç olarak, Irak İvesi koyunlarında meme tipinin, test günü süt verimi, somatik hücre sayısı ve süt bileşimi üzerine önemli etkisi bulunmadığı belirlendi. Meme özellikleri ve süt kompozisyonu özellikleri arasında pozitif ve negatif ancak oldukça zayıf korelasyonlar belirlendi. Yalnızca meme uzunluğu ölçüsünün, SHS ile korelasyonu önemli bulundu ($p<0.05$). Irak İvesi koyunlarının, sütlerindeki düşük SHS (39.20 x10^3 hücre/ml) ve bakteri içeriği nedeniyle sağlıklı bir meme bezi ve tüketilebilir süte sahip olduğu tespit edildi. Meme başlarının zemine temasından dolayı enfeksiyon riski arttığı için, meme başları yukarı ve yana doğru olan silindirik meme yapısına sahip koyunlar, meme başları aşağıya doğru ve eğimli olan armut biçimli meme yapısına sahip koyunlar yerine tercih edilebilir.

Anahtar kelimeler: İvesi, Meme tipi, Süt, Somatik hücre sayısı.

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Nazik MAHMOOD ILYAS

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1. INTRODUCTION

Awassi, the most widespread sheep breed in the Middle East countries, has been introduced to more than 30 countries in each continent of the world (Talafha and Ababneh, 2011). Awassi sheep is considered the most common breed in Iraq, it is about 55-60% of the sheep population. This breed of sheep is an important breed for milk production in Iraq (Alkass and Juma, 2005) and is the second-best milk producing breed of the world, and the highest milk-producing breed in Turkey (Gürsoy, 2005).

The interest in the anatomy and morphology of sheep udder has increased in recent years due to its relationship with milk production and milking ability (Makovicky et al., 2013). Udder size and type is very important in terms of milking-ability of the machines, less damage to the teat, labor savings in milking, the chance of staying in the breeding for a longer period. Also, in terms of lamb breeding, the udder type in sheep has a direct effect on suckling, and the development and survival of lambs (Kaygısız and Dağ, 2017).

In order to improve udder morphology and milk ability, it is recommended to use linear udder traits in practice (Rovai et al., 2004). The relationship of udder traits with milk yield in sheep has been investigated in many studies (Rovai et al., 2004; Kominakis et al., 2009; Makovicky et al., 2017). There are generally positive and significant correlations between size and type of udder and milk yield (Kaygısız and Dağ, 2017). Kominakis et al. (2009) also determined that milk yields on the day of the test were related to udder circumference and udder width as well as with udder height and teat length. A relationship between morphological udder measures and milk production in Awassi sheep was noted (Merkhan, 2014).

Milk yield and composition are the main selection goals for dairy sheep (Milerski et al., 2006). Milk composition is as important as the milk yield in sheep breeding. The most important biochemical properties separating sheep's milk from other milk are higher dry matter content, higher lecithin in milk oil, greater diameter of fat globules and rich in riboflavin (Paksoy, 2017).

The amount and quality of milk is influenced by genetics, environment, management and animal health. The term milk quality refers to the suitability of milk for drinking or for processing into milk products and the health status of the animal producing this milk (Leitner et al., 2016).

The somatic cell count (SCC) in milk is the terms of physiological and pathological traits (Fragkou et al., 2014). Since somatic cells are one of the major defense components of the mammary gland against infections, it is an indicator of udder health (Li et al., 2014). The normal range of SCC in bacteria free udders of goats (300 000 cells/ml) and sheep (200 000 cells/ml) is generally higher than in dairy cows (70 000 cells/ml) (Silanikove et al., 2010). Milk yield and milk composition parameters in dairy sheep show an impairment starting from 300 000 cells/ml. Therefore, SCCs that increase from 300 000 cells/ml to 1 000 000 cells/ml indicate that such secretion can be considered as transition milk from normal milk to mastitic milk (Olechnowicz and Jaskowski, 2014).

The microbiological quality of milk should also be high (Olechnowicz and Jaskowski, 2014). The specific composition of milk microbiota directly affects the development of dairy products. The microbial composition of milk is also important because of the negative impact of the consumption of raw milk contaminated with pathogens on health (Quigley et al., 2013). Total bacterial count is the guide of hygiene of dairy sheep flocks and can also provide a basis for payment systems for milk (Olechnowicz and Jaskowski, 2012).

The main objectives of this study were to determine:

1. Udder measurements and type,
2. Test-day milk yield and milk composition (fat, solid non-fat, protein, lactose),
3. Total bacterial count and somatic cell count, and
4. The relationships between these characteristics in Iraqi Awassi ewes.

2. LITERATURE REVIEW

2.1. Awassi Sheep

Awassi is a fat-tailed breed and kept for milk, meat and wool production (Bilgin et al., 2010). Awassi sheep are resistant to diseases and parasites and can walk for long distances for grazing. Awassi sheep have strong herd instinct and are resistant to poor management and feeding conditions, and high ambient temperatures (Talafha and Ababneh, 2011). The productivity of the Iraqi Awassi sheep was found to be low. Nevertheless, Awassi breed provides significant contributions to the national economy of Arab countries in particular and is the main source of income for rural families in marginal and dry lands (Reiad et al., 2010).

Adult weight in Awassi ewes is 45-55 kg while the ram weighs 60-90 kg (Talafha and Ababneh, 2011). Usually rams have long curved horns (40-50 cm in length), while ewes have short horns. The body is covered with long coarse wool of creamy white color except for the face. The head is long and narrow with a curved forehead profile and predominantly brown but sometimes black. In Awassi sheep, the tail is approximately 18 cm long, 16 cm in width and 6 kg in weight, while in rams, it is about 30 cm long, 25 cm wide, and weighs around 12 kg (Hailat, 2005; Galal et al., 2008).

The breeding season of Awassi ewes is between early April and through September (Talafha and Ababneh, 2011). Fertility ranged from 76% to 95% in different countries (Galal et al., 2008). In order to increase the fertility of Awassi sheep, a new genotype carrying the FecB mutation, Afec-Awassi, was developed by crossbreeding with Booroola Merino, averaging about two lambs per lambing (Ahmed and Abdallah, 2013).

Milk production in Awassi ewes has wide variation among countries and depends on ewe age, weight at lambing, season of lambing, type of birth, sex of born lamb, the sheep management system and length of lactation period (Jawasreh and Khasawneh, 2007). Milk production of Awassi ewe is 40–60 kg of milk per 150-day lactation period under extensive production system and 70-80 kg under intensive production system. These levels except from the suckling period when milk is left for lambs. The amount of suckling milk in extensive production system ranged between 68-90 kg during a period of 81-93 days (Talafha and Ababneh, 2011).

The improved Awassi is considered the second best milk-producing breed of the world, and the highest milk-producing breed in Turkey. Average milk yield is between 97.5-360 kg in the lactation period of 95-222 days. Awassi ewes can nurse their lambs for 2 to 3 months, depending on the time of birth, state of pasture, and growth of the lamb. During suckling period Awassi ewes are milked twice a day at the first 3 to 4 months and only once during the following month until they go dry. Ewes are usually milked by hand. Mechanical milking is practiced in some governmental research stations (Talafha and Ababneh, 2011).

2.2. Factors Affecting Milk Yield

Knowing the milk potential of sheep can provide a way to predict the ability to successfully grow their lambs. Since oxytocin and prolactin secretion in response to teat stimulating are stimulated by the degree of suckling, milk production increases as the number of suckled lambs increases (Dhaoui et al., 2019).

Yılmaz et al. (2004) found significant effects of age ($p<0.001$), birth type ($p<0.001$) and body weights ($p<0.05$) on lactation milk yield in Norduz sheep. While the effects of age and birth type on daily milk yield were highly significant ($p<0.001$), the effect of live weight was insignificant.

Al-Barzinji (2005) determined that the repeatability value for milk yield for monthly cyclic test in Hamdani ewes was 0.40. The results indicated that the milk yield was maximized during the first month of lactation. Daily milk yield was affected significantly ($p\leq0.01$) by sex of lamb and age of dam.

On the other hand, Jawasreh and Khasawneh (2007) stated that the estimated heritability and repeatability in Awassi sheep were 0.26 and 0.27 for total milk yield (TDM) and 0.27 and 0.35 for test-day milk yield (TMY), respectively. No significant effect of birth type and birth weight on TDM and TMY was determined, while TDM and TMY was significantly affected by litter size, age and parity ($p<0.05$). TDM and

TMY were also affected significantly by year of lactation ($P<0.0001$) and ewe weaning weight ($p<0.001$).

Reiad et al. (2010) determined that milk yield was affected by ewe line, lambing year, parity, birth type, and ewe body weight at lambing ($p<0.01$). Total milk yield increased at a rate of 1.35 kg for each 1 kg the ewe. Similarly, Koncagül et al. (2012) reported that parity, lambing age and lambing month had a significant effect on lactation milk yield, but type of lambing had no significant effect on lactation milk yield. However, Gürsu and Aygün (2014) determined no effect ewe age and born lamb's gender on lactation milk yield in Awassi ewes.

The lambing season has a great effect on milk production. These effects have been attributed to climate factors and qualitative and quantitative differences in the present feeds (Abd Allah et al., 2011).

It was determined that ewes with twin parturitions produced more milk than ewes with single parturitions and the presence of female lambs affected milk yield positively (Abecia and Palacios, 2018). Similarly, Dhaoui et al. (2019) determined that the ewes reared multiple lambs had higher milk yield than the ewes reared single lambs. In the study, adult ewes produced more milk than younger and older ewes. Also, ewes with asymmetric udder structure produced less and more concentrated milk compared to ewes with symmetrical udder. Daily milk yield was affected by lambing season.

2.3. Factors Affecting Milk Composition

Sheep milk has a high nutritional value and high concentrations of protein, fat, minerals, and vitamins compared to the milks of other domestic species. Sheep milk is mainly used in the production of fine cheese varieties, yogurt, and whey cheeses (Balthazar et al., 2017).

The chemical composition of fresh sheep milk is affected by the stage of lactation, daily variation, season, environmental temperature, parity, type of birth, animal age and nutrition, genetic factors (species and breed), physiological status and health of udder (Abd Allah et al., 2011; Balthazar et al., 2017).

Oravcova et al. (2007) studied main factors which affect milk fat and protein content of Tsigai, Improved Valachian and Lacaune ewes. In the study, the effect of litter size on fat content was found significant ($p<0.01$, $p<0.05$) in Improved Valachian and Lacaune ewes. As for protein content, litter size had an effect highly significant ($p<0.01$) in Tsigai and Improved Valachian. Oravcova et al. (2007) also reported a significant effect of flock-test day ($p<0.01$) and the month of lambing ($p<0.01$, $p<0.05$) on fat and protein content.

Kuchtik et al. (2008) reported that the stage of lactation had a highly significant effect on the total solids (TS), solids non-fat (SNF), fat (F), protein (P), casein (CN), lactose (L) and urea nitrogen (UN) from milk components. The contents of TS, SNF, F, P, CN and UN were highly and positively correlated with each other. On the other hand, it was found negative and high ($p\leq0.001$) phenotypic correlations between milk yield and the contents of TS, SNF, F, P, CN and UN. Contrary to the findings of Kuchtik et al. (2008), Sadeghi et al. (2016) found that the stage of lactation had no a significant effect on fat, protein, SNF, dry matter in crossbred and pure ewes.

Milk with sufficient fat content is of great importance in meeting the energy needs of the suckled lambs (Dhaoui et al., 2019). Heritability estimates for fat content have been reported to increase from the beginning to the end of lactation. On the other hand, heritability in protein content increased after lambing, and then oscillated toward the end of lactation (Komprej et al., 2011).

Abd Allah et al. (2011) found that milk fat percentage was affected by age and body weights ($p<0.05$). Fat percentage was lower ($p<0.05$) in older ewes compared with that of younger ewes. On the other hand, the effect of age of ewe, birth type and body weight did not significant on total solids, protein, lactose and ash.

Dhaoui et al. (2019) investigated the effects of season of lambing, litter size, age of ewe and udder shape on milk production and composition over lactation in prolific D’man ewes. As for the effect of lambing season on the milk composition, fat and total proteins were the highest in autumn. Total solids, lactose, solids-not-fat, and ash were higher in winter than in autumn and summer. Ewes reared multiple lambs produced more milk than those reared singles. Dams nursing triplets or more had the highest milk total proteins, and the lowest total solids and fat levels. Adult ewes produced more milk compared to younger and older ewes, and their milk contained higher total solids, fat, and ash levels than milk from young ewes. In contrast, litter survival at weaning was positively correlated to the amounts of total milk, fat, and total proteins (Dhaoui et al., 2019).

2.4. Factors Affecting Udder Measurements

In all dairy animals, the udder is considered one of the most important physiological and conformational characteristics. The external udder traits in various dairy sheep breeds have been investigated by a number of authors (Kominakis et a1., 2009; Öziş Altınçekiç and Koyuncu, 2011; Dogan et al., 2013; Merkhan, 2014; Sezenler et al., 2016; Kaygısız and Dağ, 2017; Türkyılmaz et al., 2018).

A moderate association between the udder measurements and milk production was observed. None of the udder measurements or/and teat dimensions were found to be related with milk contents and/or somatic cell count. The highest correlations were observed between udder width and udder circumference (r=0.69) as well as between udder circumference at base and middle (r=0.62). Udder height was found to be positively correlated with cistern depth, udder width, udder circumference, and teat measurements. The correlation between teat length and circumference was also high (r=0.57) (Kominakis et a1., 2009).

Öziş Altınçekiç and Koyuncu (2011) reported that udder measurements may be suitable selection markers to improve milking ability of Tahirova, Kıvırcık and Karacabey Merino sheep breeds. Udder circumference had strong, positive correlation with udder width, udder length, and teat angle and udder volume in ewes.

The significant effects for breed, sheep within breed, and stage of lactation on udder traits were revealed by Martinez et al. (2011). Udder circumference, udder width, udder length, cistern height and teat size significantly decreased throughout lactation. Repeatabilities of all traits were between 0.17 and 0.60; the highest repeatability was for udder circumference. The udder circumference seemed to be a morphological trait of great interest based on its breed discriminatory power for dairy aptitude, relationship with milk yield, easy and rapid estimation, and high repeatability.

Lactation mik yield in Anatolian Merino sheep was significantly influenced by the udder types ($p<0.05$). However, the effect of udder types on milk components was found to be statistically non-significant (Dogan et al., 2013).

Udder traits affected by age of dam have been reported on Awassi ewes by Merkhan (2014). The age of ewes affected the diameter of left teat and length of right teat ($p<0.05$). Also, sex of lambs had a significant effect on right teat length ($p<0.05$). As the milk yield increased, there was an increase in udder circumference and teat diameter ($p<0.05$). Milk yield positively correlated with all udder measurements except with udder length and right teat length. Also, positive and high correlation coefficients were observed between udder circumference and udder width ($r=0.679$), distance between teat ($r=0.699$) and left teat diameter ($r=0.417$) as well as between udder width and distance between teats ($r=0.732$). A positive relationship ($p<0.01$) among teat measurements ($r=0.596$-0.908) was observed. The study results revealed that udder circumference and right teat length were the best predictors for milk yield in Awassi ewes.

Makovicky et al. (2014) determined the significant effects of ewe genotype, parity and stage of lactation on udder morphology traits. Parity had a significant effect on the udder depth ($p<0.001$), teat size ($p<0.001$), udder attachment ($p<0.001$), cistern depth ($p<0.01$), and teat position ($p<0.05$). Largest udders with the largest cisterns, teat position and teat size were in the third lactation sheep. Older ewes in most cases have significantly greater teat length than the first lactation ewes, but during the stage of lactation it became smaller. The morphological aptitude of the udder to mechanical milking became worse as parity number increased. It can be concluded that the stage of lactation was an important factor of sheep udder morphology, regardless of the genotype and the production potential of the individual ewe. The effect of lactation stage on udder and teat traits was also reported by Sadeghi et al. (2016).

Heritability coefficients estimated for linear udder traits were low and 0.09 for udder attachment and 0.30 for cistern depth (Makovicky et al., 2015).

Sezenler et al. (2016) also reported that udder circumference was significantly affected by parity and lambing types ($p<0.05$). Parity had also significant impact on udder width. However, teat length and teat diameter were not affected by parity and lambing types. The positive and significant correlations were observed between udder circumference and udder width and daily milk yield in Bandirma sheep.

High positive correlation was observed between udder length and solids non-fat in Morkaraman, Tuj and Awassi sheep breeds. The most ideal and suitable type for machine milking was found as pear-shaped udder type, which udder teats are downwards and inclined (Türkyılmaz et al., 2018).

2.5. Somatic Cell Count (SCC)

Somatic cells are mainly milk-secreting epithelial cells that have been shed from the lining of the gland and white blood cells (leukocytes) that have entered the mammary gland in response to injury or infection. The somatic cells composition in milk include 75% leucocytes, i.e. neutrophils, macrophages, lymphocytes, erythrocytes, and 25% epithelial cells. The normal composition of milk somatic cells, which vary according to the type of secretion or lactation cycle, is given in Table 2.1 (Sharma et al., 2011).

Table 2.1. Composition of somatic cell in different mammary secretions (Sharma et al., 2011)

Type of mammary secretion	Milk somatic cells (%)			
	PMN	Macrophage	Lymphocytes	Epithelial cells
Milk	3	80	16	2
Colostrum	62	35	4	0
Dry gland secretion	3	89	7	1

PMN = Polymorphonuclear cells

Sheep and goats normally have higher SCC than cows. They respond in a different way and at a higher intensity to infiltration of somatic cells into the milk, despite similar bacteria (Leitner et al., 2016). Herd size and farm management practices (vaccination, milking system, hygiene, grazing) had a significant impact on SCC and bacterial species (Alexopoulos et al., 2011).

In dairy sheep physiological and pathological thresholds of SCC are 0.25 to 1.0×10^6 cells/ml. The threshold between healthy and infected udders has been indicated as SCC of 250-300 x 10^3 cells/m1 (Olechnowicz et al., 2010).

SCC rising in milk adversely affects the quality of raw milk. Subclinical mastitis has always been associated with low milk production, changes in milk consistency (density), reduced possibility of adequate milk processing, low protein and high risk for milk hygiene because of pathogenic organisms (Sharma et al., 2011).

There was an association between the test day and SCC, with higher SCC values in the first 2 wk. In addition, significantly higher SCC values were found in the oldest animals compared to the other age groups (Hariharan et al., 2004).

Bonelli et al. (2013) determined a non-significant difference for SCC level of early, middle, and late lactation stage in Sarda ewes. On the other hand, Vrskova et al. (2015) found that lactose content decreased with increasing SCC and SCC was stable for each season at $250x10^3$ cells/ml in Tsgai ewes. It has been reported that decreased lactose content expresses mastitis formation and there is a need for bacteriological examination in milk.

Vrskova et al. (2015) also determined that purebred Tsigai 76% of ewes were below SCC $300\ x10^3$ cells/ml indicating a healthy status of experimental ewes which was at the first lactation 61% of sheep.

Toth et al. (2017) evaluated the effect of temperament on milk yield and somatic cell count of Lacaune ewes. Significant differences were found in milk SCC among the temperament categories. Calmer ewes had a lower somatic cell count in milk (5.17 log cm^{-3}) than more temperamental ones (5.67 log cm^{-3}; $p<0.05$). The application of temperament score test was beneficial for breeders due to the fact that the calmer ewes produced more milk with reduced somatic cell counts than nervous animals.

2.6. Total Bacterial Count (TBC)

The microbiological quality of milk can be affected by many factors such as contamination during and after milking, the presence of mastitis, method of milking, breed, animal health, stage of lactation, season, feeding and the hygiene of farms. Sheep milk has been shown to be a major source of infection by pathogenic bacteria associated with gastroenteritis, such as *Salmonella spp*, *Staphylococci*, *Enterococci* and *E. coli*. (Fatima et al., 2013).

Staphylococcus aureus is the most commonly isolated microorganism caused by clinical and subclinical mastitis in ruminants (Ismail et al., 2016). Hariharan et al. (2004) determined that 178 (38.1%) of the milk samples examined in the study were negative for bacterial growth and 117 (25.1%) were contaminated. Ten samples were positive for major pathogens, which included 1 *Staphylococcus aureus*, 3 *Streptococcus uberis*, 4 *Streptococcus spp.*, and 2 *Mannheimia (Pasteurella) haemolytica*. Thirty-six were positive for minor pathogens, which included 19 *Staphylococcus equorum*, 7 *S. xylosus*, 6 *S. simulans*, 1 *S. capitis*, 1 *Enterococcus faecium*, 1 *Corynebacterium spp.*, and 1 *Aerococcus spp.*

Alexopoulos et al. (2011) revealed significant positive correlation between total bacterial counts and preliminary incubation count (0.825). No statistically significant correlations observed among SCC with any of the bacterial species. Herd size and farm management practices had considerable influence on bacterial species.

The bacterial pathogens in raw milk samples of ewes and goats were investigated by Abd El-Fatah and Awad (2014). In the study, *coagulase negative staphylococci* were the most prevalent bacteria isolated in both ewes (34.6%) and goat (46.2%) milk samples. The milk samples with *Staphylocoous aureus* constituted about 23.1% of ewes and 15.4% of goat milk samples. *Escherichia coli* was isolated from 7.7% of goat milks.

Merlin Junior et al. (2015) studied the microbiological composition of sheep milk from South Brazil. Growth of *Staphylococcus aureus*, enterobacteria and coliforms occurred in 100% of the samples, and 45% of the samples showed growth of *Escherichia coli.*

Abo El-Makarem (2016) investigated chemical and microbiological quality of ewe milk and found *S. aureus* in 30% and coliform organisms in 22% of examined ewe's milk samples. The high count of *Staphylococcus aureus* and coliform bacteria was due to poor personal hygiene practices. The incidence of enterococci was zero, however yeast and mould count was 34 and 70%, respectively. It was reported that the high yeast and mold count was due to poor equipment hygiene during handling and processing of milk.

3. MATERIALS AND METHODS

3.1. Animals and Management

This study was conducted at a commercial farm located in Summel/Dohuk/Iraq. Animal material consisted of 50 head Awassi ewes in lactation period. The age of ewes was determined by examining their tooth. The breeding season was in July, while the lambing was in November. In this farm, the type of farming system was semi-intensive. The sheep were protected from high temperature, cold and adverse weather conditions. The farm also had good ventilation and all standard farm requirements. Feeder length was about one meter for each three ewes and drinker length was about 5 m for 6-8 ewes. The feeding was consisting of wheat, barley, flour. There was a 2x2 m lambing area for each pregnant sheep to avoid being exposed to abortions at the farm. Also it contained a place for hand milking and a warehouse for storing forage.

3.2. Methods

The procedures followed in the study are given in Figure 3.1.

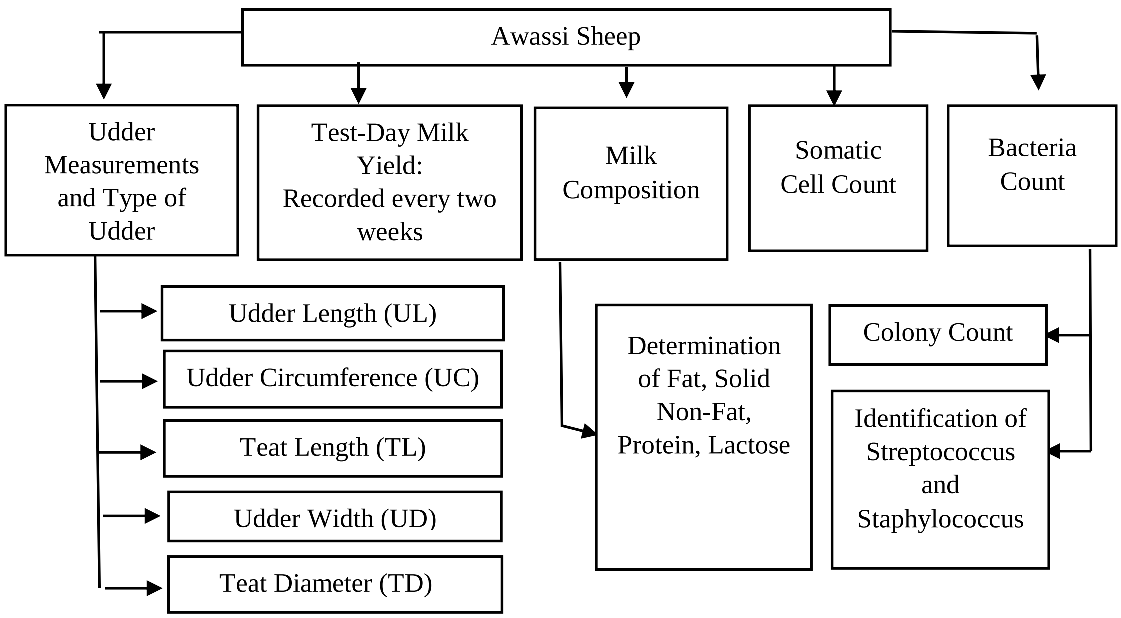

Figure 3.1. Procedure steps in the study.

3.2.1. Test-day milk yield and milk composition

Milk yield was recorded fortnightly from second week after parturition for three times. On the day of test, the lambs were separated from their dams at 8:00 p.m., and on the next day at 8.00 a.m., ewes were milked by hand. Milk quantity was recorded using cylinder (Figure 3.2). This amount was multiplied by two to estimate daily milk yield.

Composition (fat, solid non-fat, protein, lactose) of milk samples taken from ewes was determined by Eko-milk machine (Figure 3.3).

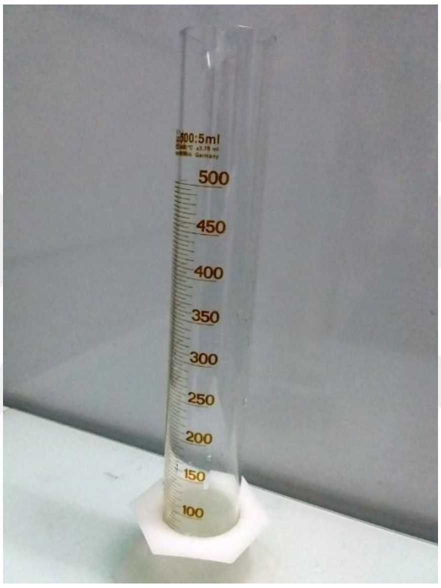

Figure 3.2. Cylinder (Brand Eterna Duran Germany) used to measure test-day milk yield in the study.

Figure 3.3. Eko-milk machine used for milk composition analysis in the study.

3.2.2. Udder measurements and type

Udder measurements included the following traits: udder width above teats at rear of udder (UW, cm), udder circumference above teats (UC, cm), right and left teat diameter in the middle of teat (TD, mm), right and left teat length from attachment of teat with udder to the end of teats (TL, mm), udder length from attachment to middle of udder (UL, cm), distance between two teats (DBT, cm), udder height from the ground (UHG, cm), teat height from the ground (THG, cm) (Figure 3.4, 3.5, 3.6, 3.7). Measurements of TD and TL was measured by using a caliper, the other udder measurements were measured by using a tape. All measurements were taken before the ewes were milked (Sezenler et al., 2016). Udder type was recorded by eye observation according to Epstein (1985) (Figure 3.8).

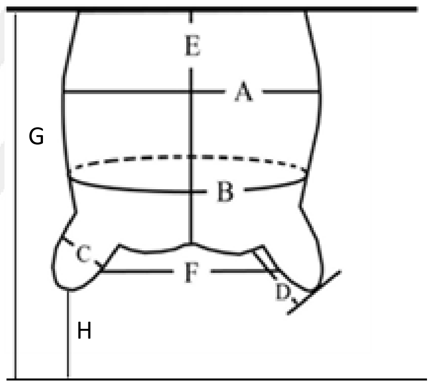

Figure 3.4. Udder measurements (Türkyılmaz et al., 2018).

A. Udder width (UW)
B. Udder circumference above teats (UC)
C. Teat diameter (TD)
D. Teat length (TL)
E. Udder length from attachment to middle of udder (UL)
F. Distance between teats (DBT)
G. Udder height from the ground (UHG)
H. Teat height from the ground (THG)

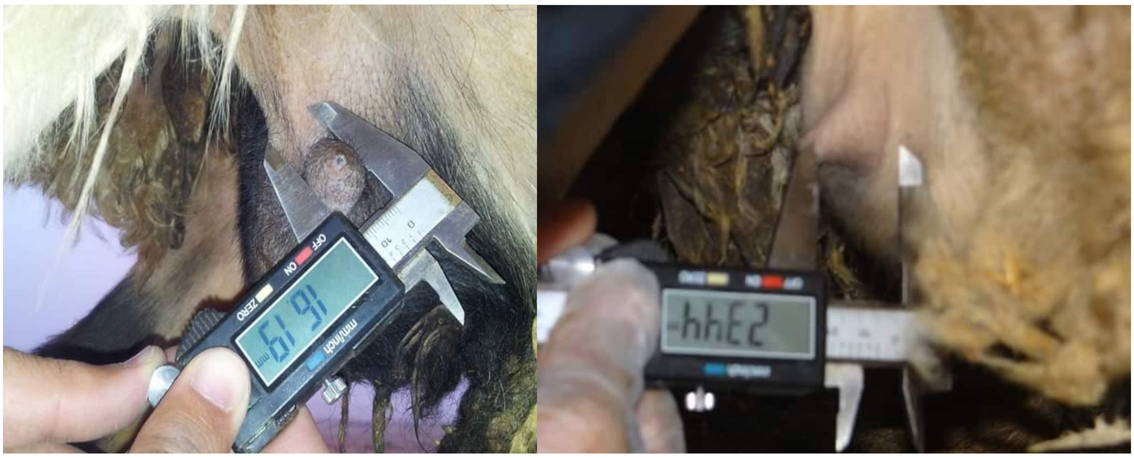

Figure 3.5. Determination of teat diameter (left) and teat length (right).

Figure 3.6. Udder height from the ground.

Figure 3.7. Udder circumference.

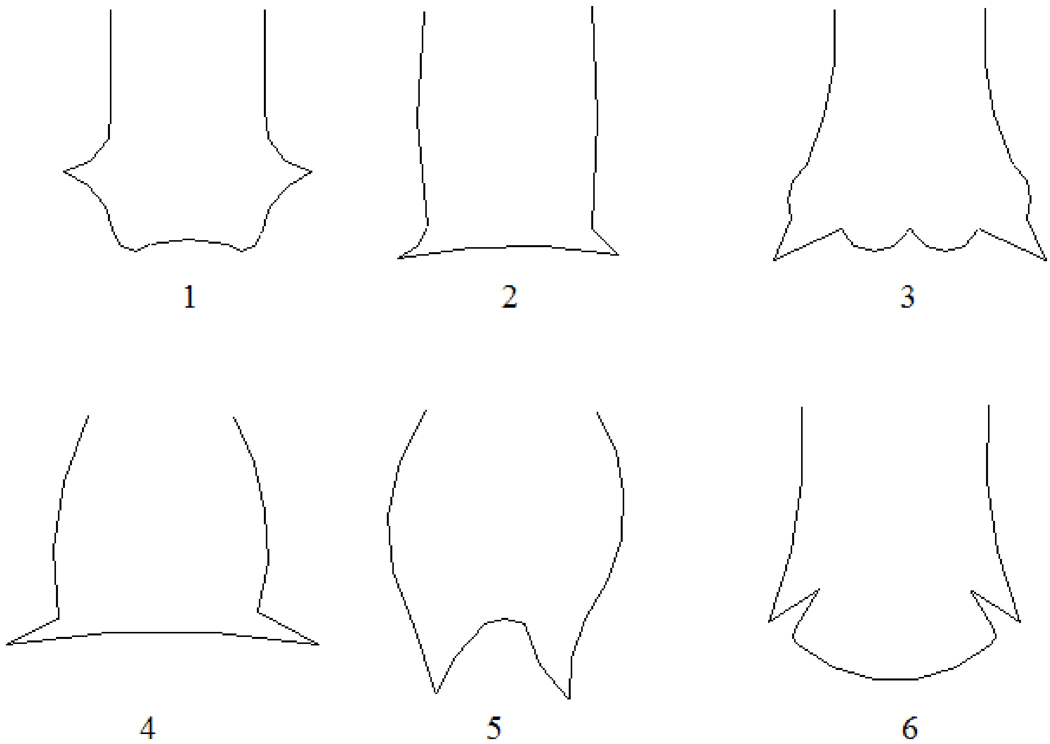

Figure 3.8. Udder types in sheep (Epstein, 1985).

1. Cylindrical udder, udder teats are upward and lateral
2. Cylindrical udder, udder teats are downwards and inclined
3. Pear-shaped udder, udder teats are downwards and inclined
4. Pear-shaped udder, udder teats are downwards and horizontal
5. Udder teats are big, udder which is downwards and vertical
6. Udder teats are upward and inclined udder

3.2.3. Somatic Cell and Total Bacteria Count

Milk samples were collected on the same test-day and somatic cell counts were measured by the direct microscopic method as described by Coles (1986) as follows:

1. Milk sample was mixed carefully, to be sure that cream dispersed throughout the specimen.
2. Loop (4 mm) was used to spread 0.01 ml of milk over of 1 cm^2 of slide by preparing a card that outlines 1 cm^2 over which the milk was spread.

3. Then the slide was dried on a flat surface without heating and stained with methyl blue by dropping it on the slide and left for 10 minutes to dry off and then washed by water to remove excess stain.
4. Microscopic examination was done by counting cells in 30 fields of each slide by oil immersion, and then the average was multiplied by microscopic factors X 100.

The calculation of the microscopic factor was conducted as follows:

1. By using a stage micrometer ruled in 0.1 to 0.01 mm, it was measured the diameter of the field to the third decimal place.
2. The microscopic factor was calculated by using the formula:

M.F = 40000/3.1416*d

Where: M.F = macroscopic factor

d = diameter

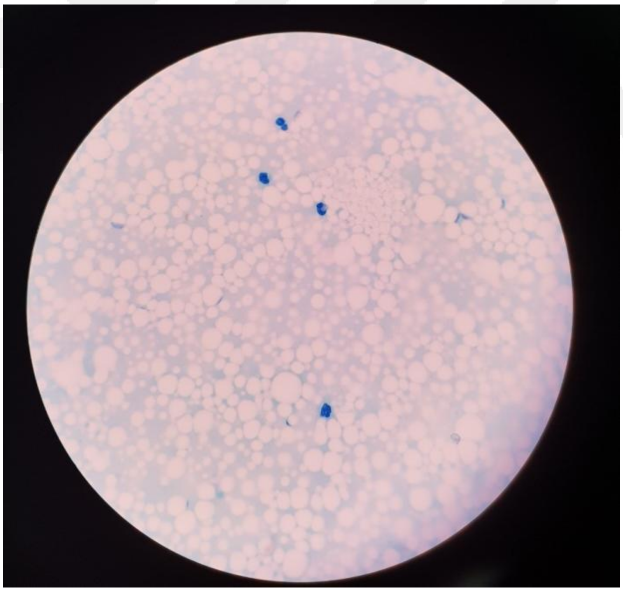

Figure 3.9. Somatic cell under the microscope.

A sample about 50 ml of milk was taken for microbiological test (bacterial identification and counting) under sterilized conditions. Total Viable count (TVC) was recorded according to Yousef and Carlstrom (2003). TVC, nutrient plates were used by spread platting under sterilized conditions. The plates were incubated for 24 hours at 35-37 ˚C. The TVC were recorded by using colony counter (Figure 3.9).

Figure 3.10. Colony counter stuart scientific SC5.

For streptococcus and staphylococcus, blood agar (Figure 3.12) and mannitol salt were used also under sterilized conditions. The plate was incubated for 24 hours at 35-37 ℃ and then peptone water was prepared which is called serial dilution by adding 10 ml of milk to 90 ml of peptone water. It would be 100 ml and 4 to 5 dilution were used by taking 1 ml of solution (peptone water + milk) to 9 ml of peptone water and so on. Second and third dilution was used for blood and mannitol salt agar by adding 0.1 ml of dilution to each agar. Fourth and fifth dilution were used to nutrient agar by swap or lope the 0.1 ml spread on agar then put it on incubator 24-28 hours, after incubation smear was taken and putted them on sterilize slide and stained with gram stain the procedure showed below.

Figure 3.11. Total bacteria count in the laboratory.

Peptone broth:

15 mg of broth to 1 liter distil water soak 10 minute then was poured to tube 9 ml and glass bottol (90 ml) and sterilize to autoclave 121 ˚C for 15 minute and left to cool to 45 ˚C then 10 ml of milk was added to 90 ml and 1 ml of solution (peptone water + milk) to 9 ml of peptone water and so on. Second and third dilution was used for blood and mannitol salt agar by adding 0.1 ml of dilution to each agar.

Mannitol salt agar (CONDA):

Suspend 111 mg of medium to 1 liter of distill water mix well and dissolve by heating with frequent agitation. Boil for one minute until complete dissolution in autoclave at 121 ˚C for 15 minutes, cool to 45-50 ˚C mix well and dispense in to Petri dish.

Blood ager (CONDA):

- 39.5 gm to 1liter soak
- 10 minute sterilize to autoclave 121 ˚C for 15-minute
- cool to 47 ˚C
- add 5-7% of blood mix well then pour to petri dish and then dry the agar.

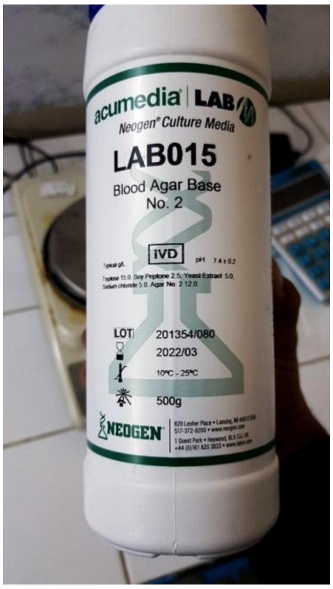

Figure 3.12. Blood agar.

Nutrient agar (CONDA):

Add 23 mg of the medium in to one litter of distil water dissolve by heating with frequent agitation. Boil for one minute until complete dissolution dispense and sterilize in to autoclave at 121 ˚C for 15 minutes.

Gram stain:

a. Flood the fixed smear with grams' crystal violet solution. Let stand for 60 seconds

b. Pour off stain gently wash with tape water from a faucet or a plastic water bottle.

c. Flood with Grams' iodine solution. allow it to remain for 60 second

d. Pour off the iodine solution and gently wash with tape water

e. Decolorize with grams decolorize solution until the blue dye no longer flows from the smear. Further delay will cause excess decolonization in the gram positive cells and the purpose of staining will be defected.

f. Gently wash the smear with tape water

g. Counterstain with safranin solution for 60 second

h. Then washing the safranin solution with tape water. let it to dry

i. Examine the finished slide under microscope (oil immersion objective).

Figure 3.13. Solutions used in total bacterial counts.

3.3. Statistical Analysis

In the study, the effects of ewe age and udder type on test-day milk yield, milk composition, SSC, udder measurements, and total bacteria count were investigated. The data were analyzed by least squares means using the general linear models in SAS (2005). Duncan's multiple-range test was used to compare differences between the means of the sub-groups. Pearson correlation coefficient analysis was used to measure of linear association among the traits.

The statistical analysis was based on the general linear model:

$$Y_{ijk} = \mu + a_i + b_j + e_{ijk}$$

Where: Y_{ijk} = Observation value of the measured or assessed trait

μ = The overall mean

a_i = The effect of age of ewes (i = 1-1.5, 2-2.5, 3-3.5, 4)

b_j = The effect of udder type (j = 1st type, 3rd type)

e_{ijk} = The random error

4. RESULTS

Least-squares means and standard errors for test-day milk yield and somatic cell count (SCC) according to the control times are shown in Table 4.1 and 4.2. The mean test-day milk yields for I. control, II. control, III. control and average of controls were 355.40, 544.40, 568.70 and 489.50 ml, respectively. When examined test-day milk yields according to the ages of ewes, it was seen that 3-3.5 aged ewes had the highest and 4 aged ewes had the lowest milk yield in all the control times. These differences were found statistically significant ($p<0.05$).

Table 4.1. Least-squares means and standard errors for test-day milk yield according to the control times in Iraq Awassi ewes

Factors	**n**	**Test-day milk yield (ml)**			
		I. Control	**II. Control**	**III. Control**	**Average of controls**
		$\bar{x} \pm S_{\bar{x}}$	$\bar{x} \pm S_{\bar{x}}$	$\bar{x} \pm S_{\bar{x}}$	$\bar{x} \pm S_{\bar{x}}$
General	50	355.40±18.48	544.40±26.17	568.70±25.47	489.50±22.07
Age		*	*	*	*
1-1.5	9	365.56±41.97^{ab}	550.00±67.04^{ab}	583.33±64.72^{ab}	499.63±55.84^{ab}
2-2.5	15	351.33±37.34^{ab}	542.00±50.99^{ab}	562.33±51.50^{ab}	485.22±45.85^{ab}
3-3.5	21	381.43±26.27^{a}	586.67±34.46^{a}	606.67±33.44^{a}	524.92±26.99^{a}
4	5	240.00±47.75^{b}	364.00±73.86^{b}	402.00±66.66^{b}	335.33±61.48^{b}
Udder type					
1	24	345.00±25.24	524.17±33.64	547.08±31.73	472.08±27.92
3	26	365.00±27.19	563.08±39.89	588.65±39.45	505.58±33.96

*: $p<0.05$
a, b : Means values with different letters are significant ($p<0.05$).

The cylindrical udder (1; udder teats are upward and lateral) and pear-shaped udder (3; udder teats are downwards and inclined) type from the udder types reported by Epstein (1985) for sheep was only observed in the study animals. No significant differences were found between udder types in terms of test-day milk yields. Average milk yields for all control times in ewes with 1st and 3rd udder type were determined as 472.08 ml and 505.58 ml, respectively ($p>0.05$).

The mean SCC values for I. control, II. control, III. control and average of controls were 40.20, 39.44, 37.96 and 39.20 x10^3 cells/ml, respectively. In all control times, SCC of milk samples taken from 3-3.5 aged ewes was found lowest. However, the differences between age groups were not statistically significant (p>0.05).

Table 4.2. Least-squares means and standard errors for somatic cell count (SCC) according to the control times in Iraq Awassi ewes

Factors	n	SCC ($x10^3$ cells/ml) I. Control	II. Control	III. Control	Average of controls
		$\bar{x} \pm S_{\bar{x}}$	$\bar{x} \pm S_{\bar{x}}$	$\bar{x} \pm S_{\bar{x}}$	$\bar{x} \pm S_{\bar{x}}$
General	50	40.20±3.03	39.44±2.65	37.96±2.31	39.20±2.44
Age					
1-1.5	9	47.22±8.93	47.56±8.54	37.78±7.04	44.19±7.64
2-2.5	15	41.80±7.05	41.33±5.53	38.87±4.92	40.67±5.60
3-3.5	21	34.14±2.18	33.71±2.69	34.86±1.91	34.24±1.57
4	5	48.20±11.85	43.20±7.44	48.60±10.40	46.67±9.42
Udder type					
1	24	39.33±3.19	35.63±2.97	36.25±2.91	37.07±2.58
3	26	41.00±5.10	42.96±4.24	39.54±3.58	41.17±4.07

As for udder types, milk samples of ewes with 1st udder type had lower SCC than those ewes with 3rd udder type. Average SCC values obtained for all control times in ewes with 1st and 3rd udder type were determined as 37.07 and 41.17 $x10^3$ cells/ml, respectively (p>0.05).

Table 4.3. Least-squares means and standard errors for milk composition traits in Iraq Awassi ewes

Factors	n	Fat (%)	Solid not-fat (%)	Protein (%)	Lactose (%)
		$\bar{x} \pm S_{\bar{x}}$	$\bar{x} \pm S_{\bar{x}}$	$\bar{x} \pm S_{\bar{x}}$	$\bar{x} \pm S_{\bar{x}}$
General	50	6.72±0.19	9.50±0.06	4.53±0.06	4.33±0.02
Age				*	*
1-1.5	9	6.78±0.31	9.73±0.16	4.80±0.17^{a}	4.37±0.03^{ab}
2-2.5	15	7.02±0.41	9.38±0.14	4.42±0.11^{b}	4.26±0.04^{a}
3-3.5	21	6.54±0.29	9.43±0.07	4.47±0.08^{ab}	4.39±0.05^{b}
4	5	6.42±0.70	9.68±0.28	4.55±0.20^{ab}	4.26±0.08^{ab}
Udder type					
1	24	6.46±0.23	9.52±0.08	4.60±0.10	4.36±0.05
3	26	6.95±0.30	9.47±0.10	4.46±0.07	4.31±0.02

*: p<0.05
a, b : Means values with different letters are significant (p<0.05).

Table 4.3 shows least-squares means and standard errors for milk composition traits. The mean fat, solid non-fat, protein and lactose percentages were 6.72%, 9.50%, 4.53% and 4.33%, respectively. There was no significant effect on the fat and solid non-fat percentages of the age of ewe ($p>0.05$).

Milk samples taken from ewes aged 1-1.5 years had a higher protein content (4.80%) than those ewes aged 2-2.5 years (4.42%) ($p<0.05$). Similarly, milk samples of ewes aged 3-3.5 years had higher lactose content (4.39%) than those ewes aged 2-2.5 years (4.26%) ($p<0.05$).

Milk composition of ewes with 1st udder type was 6.46% fat, 9.52% solid non-fat, 4.60% protein and 4.36% lactose, respectively. Similarly, fat, solid non-fat, protein and lactose content in milk of ewes with 3rd udder type was 6.95%, 9.47%, 4.46% and 4.31%, respectively. Udder types did not have a significant effect on the milk composition.

Table 4.4. Total bacteria and the isolated bacteria count in Iraq Awassi ewes

Traits	$\bar{x} \pm S_{\bar{x}}$
Total bacteria counts	56.94±7.72
The isolated bacteria	**n (%)**
Streptococcus spp.	2 (4%)
Staphylococcus aureus	15 (30%)

Total bacterial counts and the isolated bacteria counts in Iraq Awassi ewes are shown in Table 4.4. Total bacterial count was 56.94 in the milk samples taken during the study. Streptococcus spp. which is the main cause of mastitis was only found 2 milk samples (4%), and Staphylococcus aureus was found 15 milk samples (30%).

Least-squares means and standard errors for udder measurements in Iraqi Awassi ewes are shown in Table 4.5. The highest UC value was determined in 2-2.5 years old ewes (41.93 cm), while the lowest UC value was in 1-1.5 years old ewes (39.78 cm). However, the measurement of UC was not affected by the age of ewes. The effect of udder type on UC was statistically significant ($p<0.01$). Ewes with 3rd udder type had higher UC value (42.06 cm) than those ewes with 1st udder type (39.13 cm).

Similar to UC measurement, the age of ewes had insignificant effect on UW measurement. On the other hand, the value of UW in ewes with 3rd udder type was higher (21.03 cm) than those obtained from ewes with 1[st] udder type (19.56 cm) (p<0.01).

Udder length (UL) increased as the animal ages. Therefore, UL measurement was significantly affected by age of ewes (p<0.01). In ewes aged 1-1.5, 2-2.5, 3-3.5 and 4 years, UL value was determined as 18.61 cm, 19.13 cm, 20.19 and 22.40 cm, respectively. However, UL measurements of ewes which had different udder types were similar (p>0.05).

Table 4.5. Least-squares means and standard errors for udder measurements in Iraq Awassi ewes

Factors	**n**	**UC (cm)** $\bar{x} \pm S_{\bar{x}}$	**UW (cm)** $\bar{x} \pm S_{\bar{x}}$	**UL (cm)** $\bar{x} \pm S_{\bar{x}}$	**DBT (cm)** $\bar{x} \pm S_{\bar{x}}$
General	50	40.65±0.43	20.33±0.22	19.81±0.26	14.81±0.37
Age				**	*
1-1.5	9	39.78±0.72	19.89±0.36	18.61±0.41^{a}	14.44±0.84^{ab}
2-2.5	15	41.93±0.64	20.97±0.32	19.13±0.33^{a}	16.30±0.81^{a}
3-3.5	21	40.24±0.83	20.12±0.41	20.19±0.41^{b}	14.05±0.43^{b}
4	5	40.10±0.71	20.05±0.36	22.40±0.43^{c}	14.20±1.20^{ab}
Udder type		**	**		*
1	24	39.13±0.52	19.56±0.26	19.98±0.39	13.65±0.35
3	26	42.06±0.56	21.03±0.28	19.65±0.35	15.88±0.57

UC: Udder Circumference, UW: Udder Width, UL: Udder Lenght, DBT: Distance between Teats
*: p<0.05, **: p<0.01
a, b, c : Means values with different letters are significant (p<0.05).

Table 4.5. Least-squares means and standard errors for udder measurements in Iraq Awassi ewes (continued)

Factors	**n**	**TL (mm)** $\bar{x} \pm S_{\bar{x}}$	**TD (mm)** $\bar{x} \pm S_{\bar{x}}$	**UHG (cm)** $\bar{x} \pm S_{\bar{x}}$	**THG (cm)** $\bar{x} \pm S_{\bar{x}}$
General	50	2.85±0.09	16.92±0.35	42.93±0.40	20.27±0.40
Age		*		**	*
1-1.5	9	2.79±0.18^{ab}	16.03±0.83	39.77±0.61^{a}	18.37±0.87^{a}
2-2.5	15	2.63±0.14^{a}	16.67±0.73	42.18±0.82^{b}	20.42±0.83^{ab}
3-3.5	21	2.92±0.14^{ab}	17.36±0.49	44.21±0.34^{c}	21.10±0.56^{b}
4	5	3.28±0.30^{b}	17.39±1.20	45.48±0.77^{c}	19.80±1.01^{ab}
Udder type					
1	24	2.91±0.11	16.64±0.51	43.14±0.54	20.25±0.67
3	26	2.78±0.13	17.17±0.49	42.74±0.60	20.30±0.48

TL: Teat Length, TD: Teat Diameter, UHG: Udder Height from the Ground, THG: Teat Height from the Ground
*: p<0.05, **: p<0.01
a, b, c, d : Means values with different letters are significant (p<0.05).

The highest DBT value was determined in 2-2.5 years old ewes (16.30 cm), while 3-3.5 years old ewes had the lowest DBT value (14.05 cm) ($p<0.05$). The value of DBT measurement in ewes with 3rd udder type (15.88 cm) was higher than ewes with 1st udder type (13.65 cm) ($p<0.05$).

The mean TL values of ewes aged 1-1.5, 2-2.5, 3-3.5 and 4 years were 2.79 mm, 2.63 mm, 2.92 mm and 3.28 mm, respectively. The difference between 2-2.5 and 4-years old ewes was found statistically significant ($p<0.05$). Udder type had no significant effect on TL measurement of ewes.

As shown in Table 4.5, teat diameter (TD) measurement was the lowest in 1-1.5 aged ewes (16.03 mm) and the highest in 4 aged ewes (17.39 mm). However, the effect of ewe age on TD was insignificant ($p>0.05$). Similar to the effect of ewe age, udder type had insignificant effect on TD.

The age of ewes had significant effect on udder height from the ground (UHG). When animal become older, the height of udder from the ground was more than that in young animals. Values of UHG in ewes aged 1-1.5, 2-2.5, 3-3.5 and 4 years were 39.77 cm, 42.18 cm, 44.21 cm, and 45.48 cm, respectively ($p<0.01$). The effect of udder type on UHG was not significant. Values of UHG were 43.14 cm and 42.74 cm in ewes with 1st and 3rd udder type.

As for the height of teat from the ground (THG), the effect of ewe age was significant. Values of THG in ewes aged 1-1.5, 2-2.5, 3-3.5, and 4 years were 18.37 cm, 20.42 cm, 21.10 cm, and 19.80 cm, respectively. The difference between 1-1.5 and 3-3.5 aged ewes was found statistically significant ($p<0.05$). On the other hand, the udder type had no significant effect on THG ($p>0.05$).

Table 4.6. Correlation coefficients among milk composition traits, test-day milk yield and somatic cell count

	Solid non-fat	Protein	Lactose	TDMY	SCC
Fat	-0.06741	0.11903	0.06145	0.26581	-0.26493
Solid non-fat		0.63730***	0.27650*	-0.15915	0.06020
Protein			0.35088**	0.07190	-0.11813
Lactose				0.21547	-0.29025*

TDMY: Test Day Milk Yield, SCC: Somatic Cell Count
*: $p<0.05$, **: $p<0.01$, ***: $p<0.001$

Correlation coefficients among milk composition traits, test-day milk yield and somatic cell count are shown in Table 4.6. A negative and weak correlation (-0.06741) was determined between fat and solid non-fat content. The correlations of fat with protein, lactose, and TDMY were positive but weak. The correlation coefficient between fat and SCC was found as r= -0.26493.

On the other hand, solid non-fat had positive (0.63730) and highly important ($p<0.001$) correlation with protein. The relationship between solid non-fat and lactose was also significantly important ($p<0.05$). However, a negative and weak relationship was determined between solid non-fat and test day milk yield (-0.15915). The correlation between solid non-fat and SCC was also extremely weak (0.06020).

The content of protein was correlated with lactose ($p<0.01$). The correlation coefficient between protein and lactose was found as r= 0.35088. Protein content of milk had weak correlations with TDMY and SCC. However, lactose content of milk had a negative and significant correlation with SCC (r= -0.29025, $p<0.05$).

As for correlation coefficients values among udder measurements (Table 4.7), a complete correlation between UC and UW was found (r=1.00000, $p<0.001$). Therefore, correlation coefficients of UC and UW measurements with the other udder measurements were found similar. While UC and UW were positively and significantly correlated with DBT (r=0.43107, $p<0.01$), the correlations with TL, UHG, and THG were negative and weak.

Table 4.7. Correlation coefficients between udder measurements

	UW	UL	DBT	TL	TD	UHG	THG
UC	1.00000***	0.11727	0.43107**	-0.10113	0.15552	-0.09747	-0.15061
UW		0.11727	0.43107**	-0.10113	0.15552	-0.09747	-0.15061
UL			-0.11928	0.04117	0.19210	0.35866**	-0.29387*
DBT				-0.23289	0.02864	-0.09240	0.03421
TL					0.09062	-0.00391	-0.24291
TD						0.24178	0.09778
UHG							0.76455***

UC: Udder Circumference, UW: Udder Width, UL: Udder Length, DBT: Distance between Teats, TL: Teat Length, TD: Teat Diameter, UHG: Udder Height from the Ground, THG: Teat Height from the Ground

*: $p<0.05$, **: $p<0.01$, ***: $p<0.001$

In this study, a positive and significant correlation (r=0.35866, $p<0.001$) was found between UL and UHG measurements, however the correlation between UL and THG was negatively significant (r= -0.29387, $p<0.05$).

The correlations among DBT, TL, TD, UHG, and THG were found as quite low and insignificant. However, high correlation coefficient was determined between UHG and THG measurements (r=0.76455, p<0.001).

Table 4.8. Correlation coefficients among udder measurements, milk composition traits, test-day milk yield and somatic cell count

	Fat	SNF	Protein	Lactose	TDMY	SCC
UC	-0.07293	-0.01961	-0.05309	-0.01846	0.25120	-0.13967
UW	-0.07293	-0.01961	-0.05309	-0.01846	0.25120	-0.13967
UL	-0.08086	-0.07689	0.04037	-0.13304	-0.06955	-0.32876*
DBT	0.00976	0.01190	-0.13162	0.00526	0.10002	0.00976
TL	-0.09993	0.27761*	0.15216	0.17138	-0.10134	0.21553
TD	0.06916	0.17483	0.05803	-0.02334	0.22637	-0.11798
UHG	-0.03395	0.12017	0.02840	0.16984	-0.07961	-0.15870
THG	0.03938	0.10974	-0.03003	0.21771	-0.01295	0.00738

UC: Udder Circumference, UW: Udder Width, UL: Udder Length, DBT: Distance between Teats, TL: Teat Length, TD: Teat Diameter, UHG: Udder Height from the Ground, THG: Teat Height from the Ground, SNF: Solid Non-Fat, TDMY: Test Day Milk Yield, SCC: Somatic Cell Count
*: p<0.05

As shown in Table 4.8, it was found positive and negative but rather weak correlations between udder measurements and milk composition traits. The highest correlation was found between teat length (TL) measurement and solid non-fat (SNF) content of milk (r= 0.27761) (p<0.05).

In addition, measurements of length and height of udder such as UL, TL, UHG, and THG showed negative and extremely weak correlations with test-day milk yield (TDMY). The correlation coefficient between UL measurement and SCC were found to be significant (r= -0.32876, p<0.05).

Table 4.9. Correlation coefficients between test-day milk yields and somatic cell counts according to the control times

	TDMYII	TDMYIII	SCCI	SCCII	SCCIII	SCC
TDMYI	0.72228***	0.73117***	-0.33012*	-0.18555	-0.36886**	
TDMYII		0.99287***	-0.30072*	-0.15709	-0.41407**	
TDMYIII			-0.32991*	-0.18569	-0.44018***	
TDMY						-0.34427**

TDMY: Test Day Milk Yield, SCC: Somatic Cell Count
*: p<0.05, **: p<0.01, ***: p<0.001

The correlations between milk yields according to the control times were high and statistically significant (P<0.001). The highest correlation coefficient (r= 0.99287) was found between test-day milk yields in II and III control times (p<0.001).

It was determined that test-day milk yields were negatively correlated with SCC in all control times. On the other hand, the correlation coefficient was determined as r= -0.34427 between average test-day milk yield and SCC in the study (p<0.01).

5. DISCUSSION AND CONCLUSION

Average test-day milk yield in Iraqi Awassi ewes was found as 489.50 ml for 3 control times. This value was significantly lower than the values reported by Serrano et al. (2001) for Manchega and Latxa ewes, ranging from 657.06-1237.03 ml at 4 test days. Gutierrez et al. (2007) found 1660.5 mg test-day milk yield obtained from six test-day records per lactation in Spanish Assaf dairy sheep. In Anatolian Merino sheep, the mean test-day milk yields for 4 control times ranged from 0.391-0.637 kg (Doğan et al., 2013).

Age of ewes had significant effect on test-day milk yield. It was found that 3-3.5 aged ewes had the highest (524.92 ml) and 4 aged ewes had the lowest (335.33 ml) milk yield ($p<0.05$). Jawasreh and Khasawneh (2007) also found the effect of ewe age on test-day milk yield. The effect of ewe age and parity on lactation and daily milk yield was reported by Yılmaz et al. (2004), Reiad et al. (2010), Abd Allah et al. (2011).

Contrary to the study findings, Alkass et al. (2009) reported that milk yield increased from 2 to 4 years old and then gradually decreased in Awassi and Assaf x Awassi crossbred sheep. This increase in milk yield has been reported to be due to the development of the secretory tissue of the udder together with maturation of sheep. The highest milk yield was determined in 4th lactation group by Kiper (2015) in Karayaka sheep. Dhaoui et al. (2019) revealed that adult D'man ewes with 3 to 5 years old produced more milk amount compared to younger and older ewes.

As shown in Table 4.1, the cylindrical udder with upward and lateral teats (1st udder type) was observed in 24 ewes, and 26 ewes had pear-shaped udder with downwards and inclined teats (3rd udder type). Type 2, 4, 5, and 6 from the udder types described by Epstein (1985) was not observed in Iraqi Awassi ewes. Dağ and Zülkadir (2004) determined that the most common udder type (74.18%) in unimproved Awassi sheep was the cylindrical udder facing the ground. On the other hand, Doğan et al. (2013) studied 59 heads of Anatolian Merino sheep and stated that the number of sheep with the 1st, 2nd, 3rd, 4th and 6th udder type was 13, 12, 13, 10 and 11, respectively. The 5th udder type was not found in the research herd.

Kaygısız and Dağ (2017) reported that the ratio of sheep with 1^{st}, 2^{nd}, 3^{rd}, 4^{th} and 6^{th} udder type was 31%, 1%, 42%, 3% and 23%, respectively in improved Awassi sheep. Similarly, the 5^{th} udder type had not been found in the improved Awassi sheep.

In the study, udder type had no effect on test-day milk yield. Similar to the finding, Dağ and Zülkadir (2004) reported that milk production was not influenced by udder types. Contrary to the study findings, Doğan et al. (2013) and Kaygısız and Dağ (2017) determined significant effect of udder types on lactation milk yield. Doğan et al. (2003) found the highest milk yield in ewes with 6^{th} udder type and lowest milk yield in ewes with 4^{th} udder type ($p<0.05$). Lactation milk yield in the improved Awassi with 1^{st} and 4^{th} udder types were higher than the other three breast types ($p<0.01$) (Kaygısız and Dağ, 2017).

Berthelot et al. (2006) reported that a mammary gland with $<0.5x10^6$ cells/ml values indicate a healthy situation, and a mammary gland with $>1.0x10^6$ cells/ml values indicate clinical or subclinical mastitis. SCC value of samples were ranged from 33.71 x10^3 cells/ml to 48.60 x10^3 cells/ml with an average of 39.20 x10^3 cells/ml in the study (Table 4.2).

The SCC values observed in this study were higher than SCC value (4.09 x10^3 cells/ml) reported for Manchega sheep by Arias et al. (2012). However, SCC values in Iraqi Awassi ewes were lower than SCC values of 108.8, 102.5, and 155.9 x10^3 cells/ml reported for Sardi ewes in early, middle, and late lactation stage (Bonelli et al., 2013). Contrary to study findings, Arias et al. (2012) found highly significant effect of ewe age on SCS, increasing with the age.

Vrskova et al. (2015) determined that 76% of purebred Tsigai ewes were below SCC 300 x10^3 cells/ml. Al-Zubaidy and Salari (2016) investigated SCC of milk in Iraqi Awassi ewes. The threshold SCC values for healthy, sub-clinical and clinical mastitis were reported as ≤175 000, >175 000 to ≤1 150 000 and >1 150 000 cells/ml of milk, respectively. For different purebred and crossbred sheep of Slovakia, Tancin et al. (2017) reported that 82.03% of examined milk samples were below 400 x10^3 cells/ml and only 8.89% over 1000 x10^3 cells/ml. According to the results of the studies conducted on different sheep breeds, it can be said that Iraqi Awassi ewes in the study had a healthy mammary gland and consumable milk.

There was no statistically significant difference in SCC of ewes with different udder types in the study, while ewes with 1^{st} udder type had lower SCC than those ewes with 3^{rd} udder type. Average SCC values obtained for all control times in ewes with 1^{st} and 3^{rd} udder type were determined as 37.07 and 41.17 x10^3 cells/ml, respectively ($p>0.05$). These SCC values were lower than values reported by Doğan (2009) for Anatolian Merino ewes. The mean SCC values of Anatolian Merino ewes with the 1^{st}, 2^{nd}, 3^{rd}, 4^{th} and 6^{th} udder types were 424 136 cells/ml, 631 263 cells/ml, 475 741 cells/ml, 570 804 cells/ml and 520 956 celss/ml.

In the study, the mean fat, solid non-fat, protein and lactose percentages were 6.72%, 9.50%, 4.53% and 4.33%, respectively (Table 4.3). No significant effect of ewe age on fat and solid non-fat contents was determined. Iraqi Awassi ewes had higher milk fat content and lower solid non-fat, protein, and lactose content compared to the values reported by Alexopoulos et al. (2011), Abd Allah et al. (2011), Tancin et al., (2017) for various sheep breeds. Especially, milk with sufficient fat content is very important in meeting the energy needs of lambs during the suckling period (Sezenler et al., 2016). However, all of milk composition percentages determined in this study were lower than reported values by Türkyılmaz et al. (2018) for Morkaraman, Tuj and Awassi sheep.

Ewe age had statistically significant effect on protein and lactose ($p<0.05$). The protein content of milk obtained from ewes aged 1-1.5 years was higher than that obtained from ewes aged 2-2.5 years. As for lactose content, ewes aged 3-3.5 had higher milk lactose than those ewes aged 2-2.5. Contrary to study findings, Abd Allah et al. (2011) reported the significant effect of ewe age on fat content ($p<0.05$), but no significant differences in percentages of solid non-fat and protein.

Milk composition content of ewes with 1^{st} udder type was found as 6.46% fat, 9.52% solid non-fat, 4.60% protein and 4.36% lactose, respectively. Similarly, fat, solid non-fat, protein, and lactose percentages in milk of ewes with 3^{rd} udder type were 6.95%, 9.47%, 4.46% and 4.31%, respectively (Table 4.3).

Doğan et al. (2013) found that fat, solid non-fat, protein, and lactose percentages of Anatolian Merino sheep milk with 1^{st} udder type were 7.19%, 11.08%, 5.13%, and 4.94%, respectively. The same milk composition percentages for ewes with 3^{rd} udder type were 7.34%, 11.24%, 5.30%, and 4.93%, respectively. Compared with the percentages of milk composition according to udder types, Iraqi Awassi ewes with 1st and 3rd udder type had lower milk composition content than those Anatolian Merino ewes. Similar to the study findings, Doğan et al. (2013) determined no significant effect of udder types on the milk composition.

Total bacterial counts and the isolated bacteria counts in Iraq Awassi ewes are shown in Table 4.4. Total bacterial count was 56.94 in the milk samples taken during the study. *Streptococcus spp.* which is the main cause of mastitis was only found 2 milk samples (4%), and *Staphylococcus aureus* was found 15 milk samples (30%). The bacteria determined in the study carried out by Hariharan et al. (2004) in a Scottish farm were *Staphylococcus equorum* (19 times), *S. xylosus* (7 times), *S. simulans* (6 times), *Staphylococcus aureus* (1 time), *Streptococcus uberis* (3 times) and other *streptococci* (4 times).

Alexopoulos et al. (2011) also determined that *Staphylococcus aureus* was the most common pathogen in all farms studied. Flock size and farm management practices such as vaccination, milking system, hygiene, grazing had considerable influence on bacterial species. Abo El-Makarem (2016) reported that *Staphylococcus aureus*, *coliform bacteria*, *Enterococci*, yeast and mould counts were found in 15 (30%), 11 (22%), 0 (zero), 17 (34%), and 35 (70%) of examined ewe's milk samples.

Udder measurements are shown in Table 4.5. The measurements of UC, UW, and TD were not affected by the age of ewes, whereas the effect of ewe age on UL, DBT, TL, UHG, and THG was significant ($p<0.05$, $p<0.01$). Dağ and Zülkadir (2004) determined no significant effect of the age of ewe on studied all udder measurements. Merkhan (2014) found significant effect of the age of ewe only on left teat diameter and right teat length measurements in Awassi sheep.

It was found that Iraqi Awassi ewes had higher udder circumference (UC), udder width (UW), and teat length (TL) and lower udder length (UL) measurements compared to Tahirova, Kıvırcık, and Karacabey Merino sheep breeds (Öziş Altınçekiç and Koyuncu, 2011). However, Dağ and Zülkadir (2004) determined longer teats in unimproved Awassi sheep compared to Iraqi Awassi ewes in this study.

The effect of udder type on UC, UW, and DBT from udder measurements was statistically significant ($p<0.01$, $p<0.05$). However, measurements of UL, TL, TD, UHG, and THG were not affected by udder type in the study. However, Doğan et al.

(2013) reported that the height of udder from the floor, front height of udder, length of right udder teat ($p<0.05$), and distance between udder teats ($p<0.001$) in Anatolian Merino sheep was significantly influenced by the udder types.

In the study, there was significant relations among solid non-fat, protein and lactose content. The correlations of milk composition traits with TDMY and SCC, except for correlation between lactose content and SCC, were not strong and significant.

When the correlations between udder measurements were examined, it was seen that UC, UW, and DBT measurements were related with each other (Table 4.7). Udder length (UL) had statistically significant correlations with udder height from the ground (UHG) and teat height from the ground (THG) ($p<0.01$, $p<0.05$).

It was found positive and negative but rather weak correlations between udder measurements and milk composition traits in the study (Table 4.8). The highest correlation was found between teat length (TL) measurement and solid non-fat (SNF) content of milk ($p<0.05$). Contrary to the findings of this study, the positive correlation between udder circumference and milk components was found by Iniguez et al. (2009). Between udder teat length and milk components was determined the negative correlation by Emediato et al. (2008) and Iniguez et al. (2009). In addition, Morkaraman and Tuj sheep was found to be correlated with udder circumference, udder width and milk fat content, but not Awassi. This is due to the increase in fat content as the udder width and the circumference of the udder increases and the decrease in milk yield (Türkyılmaz et al., 2018).

In the study, measurements of length and height of udder such as UL, TL, UHG, and THG showed negative and extremely weak correlations with test-day milk yield (TDMY). The correlation coefficient between UL measurement and SCC were found to be significant ($p<0.05$). Kominakis et al. (2009) revealed that none of the udder measurements were correlated with milk contents and somatic cell count.

It was found the test-day milk yield was negatively and significantly correlated with SCC in Iraqi Awassi ewes in the study (Table 4.9). Similar to the study findings, a trend toward lower milk production with higher SCC was stated by Vrskova et al. (2015) and Tancin et al. (2017). Because high SCC values in milk are associated with udder infection, infected udder tissue results in reduced milk production.

As a result, the udder type had no significant effect on test-day milk yield, somatic cell count, and milk composition traits in Iraqi Awassi ewes. As expected, the morphological characteristics of the udder changed by udder type. There were positive and negative but rather weak correlations between udder measurements and milk composition traits. Only udder length measurement from udder traits was correlated significantly but negative with somatic cell count ($p<0.05$).

It was found that Iraqi Awassi ewes had a healthy mammary gland and consumable milk due to their low SCC (39.20 $x10^3$ cells/ml) and bacterial content. Since there is an increased risk of infection due to contact with the ground, ewes which have the cylindrical udder with upward and lateral teats (1st udder type) can be selected instead of ewes which have the pear-shaped udder with downwards and inclined teats (3rd udder type). Moreover, further researches with larger numbers on Iraqi Awassi ewes are required to confirm these results.

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EXTENDED TURKISH SUMMARY (GENİŞLETİLMİŞ TÜRKÇE ÖZET)

IRAK İVESİ KOYUNLARINDA MEME ÖZELLİKLERİ VE SÜT KALİTESİ ARASINDAKİ İLİŞKİLER

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ÖZ

Orta Doğu ülkelerinde en yaygın koyun ırkı olan İvesi, dünyanın her kıtasındaki 30'dan fazla ülkeye yayılmıştır. Irak'taki en yaygın ırk olarak kabul edilen İvesi, koyun popülasyonunun yaklaşık % 55-60'ını oluşturur. Ivesi, Irak'ta süt üretimi için önemli bir koyun ırkı olup dünyada en iyi ikinci süt üreten ve Türkiye'de en yüksek süt üreten koyun ırkıdır. Ivesi koyunu, ekstansif koşullar altında 150 günlük laktasyon süresince 40-60 kg, devlet üretme çiftliklerinde ise entansif koşullarda ise 70-80 kg süt üretir.

Son yıllarda koyun meme dokusunun anatomisi ve morfolojisine olan ilgi, hayvanın süt üretimi ve sağım kabiliyeti ile olan ilişkisi nedeniyle artmıştır. Meme büyüklüğü ve tipi, makineli sağım kabiliyeti, meme başının daha az zarar görmesi, sağımda işgücü tasarrufu ve hayvanların daha uzun süre damızlıkta kalma şansı açısından çok önemlidir. Ayrıca, kuzu büyütme açısından, koyunlardaki meme tipi emzirme ve kuzuların gelişimi ve yaşama gücü üzerinde doğrudan etkiye sahiptir.

Meme morfolojisini ve süt verim kabiliyetini iyileştirmek için pratikte doğrusal meme özelliklerinin kullanılması tavsiye edilmektedir. Birçok çalışmada koyunlarda meme özelliklerinin süt verimi ile ilişkisi araştırılmıştır. Meme büyüklüğü ve tipi ile süt verimi arasında genellikle pozitif ve önemli korelasyonlar bulunmuştur.

Süt verimi ve bileşimi sütçü koyunlarda başlıca seleksiyon hedefleridir. Koyun yetiştiriciliğinde süt bileşimi, süt verimi kadar önemlidir. Koyun sütünü diğer sütlerden ayıran en önemli biyokimyasal özellikler, yüksek kuru madde içeriği, süt yağında daha yüksek lesitin, yağ globullerinin daha büyük çaplı ve riboflavin bakımından zengin olmasıdır.

Sütteki somatik hücre sayısı fizyolojik ve patolojik özelliklerle ilgilidir. Somatik hücreler, meme bezinin enfeksiyonlara karşı başlıca savunma bileşenlerinden biri olduğundan, meme sağlığının bir göstergesidir.

Sütün mikrobiyal kalitesi yüksek olmalıdır. Süt mikrobiyosunun spesifik bileşimi doğrudan süt ürünlerinin gelişimini etkiler. Sütün mikrobiyal bileşimi, patojenlerle kontamine olan çiğ süt tüketiminin sağlık üzerindeki olumsuz etkileri nedeniyle de önemlidir. Toplam bakteri sayısı, süt koyunculuğunda hijyen göstergesidir ve ayrıca süt fiyat sistemi için temeldir.

Bu çalışmanın amacı, Irak-Duhok bölgesinde ticari bir koyunculuk işletmesinde yetiştirilmekte olan ve laktasyonda bulunan İvesi koyunlarında memenin çeşitli morfolojik özelliklerini, test günü süt verimini, sütte somatik hücre ve total bakteri sayısını belirlemek ve söz konusu özellikler arasındaki ilişkileri ortaya koymaktır.

MATERYAL VE YÖNTEM

Araştırmanın hayvan materyalini, Irak/Summel/Duhok bölgesinde bulunan ticari bir koyunculuk işletmesinde yetiştirilen 50 baş İvesi koyunu oluşturdu. Laktasyon döneminde bulunan koyunlarda memenin çeşitli morfolojik özellikleri ölçü mezurası ve kumpas kullanılarak sağımdan önce belirlendi. Bu amaçla dikkate alınan özellikler; meme genişliği, meme çevresi, meme başı çapı, meme başı uzunluğu, meme yüksekliği, meme başları arasındaki mesafe, memenin yerden yüksekliği ve meme başlarının yerden yüksekliğidir. Araştırma materyali koyunların meme tipleri ise Epstein'in (1985) bildirdiği şemadan yararlanılarak gözlem yoluyla belirlendi.

Irak İvesi koyunlarında sağımlar doğumdan sonraki ikinci haftadan itibaren başladı ve iki haftada bir olmak üzere toplam üç defa yapılan süt kontrolleri ile test günü süt verimleri belirlendi. Deneme günü, kuzular akşam analarından ayrıldı ve 12 saat sonra koyunlar sabah elle sağıldı. Süt miktarı ölçü silindiri kullanılarak belirlendi. Süt bileşimini belirlemek amacıyla her sütten yaklaşık 50 ml örnek alındı ve Ekomilk cihazı kullanılarak yağ, yağsız kuru madde, protein ve laktoz içeriği belirlendi. Her deneme günü alınan süt örneklerinde somatic hücre sayısı doğrudan mikroskobik sayım yöntemi ile belirlendi. Ayrıca her koyundan alınan süt örneklerinde mikrobiyolojik test yapıldı. Toplam canlı bakteri sayısını belirlemek amacıyla steril koşullar altında yayma levhası tekniği ile besin agar plakaları kullanıldı. Plakalar, 35-37 ^{o}C'de 24-48 saat inkübe edildi ve koloniler sayılarak toplam canlı bakteri sayısı kaydedildi.

BULGULAR VE SONUÇ

Çalışma materyali Irak İvesi koyunlarında test günü süt verimi 489.50 ml olarak belirlendi. Ana yaşının etkisi incelendiğinde, 3-3.5 yaşlı koyunların en yüksek (524.92 ml), 4 yaşlı koyunların ise en düşük (335.33 ml) süt verimine sahip olduğu belirlendi ($p<0.05$).

Irak İvesi koyunlarında, Epstein (1985) tarafından koyunlar için bildirilen meme tiplerinden meme başlarının yukarı ve yana doğru olduğu silindirik meme tipi ile meme başlarının aşağı doğru ve eğimli olduğu armut tipi meme yapısı gözlemlendi. Silindirik ve armut meme yapısına sahip koyunlarda test günü süt verimi sırasıyla 472.08 ml ve 505.58 ml olarak bulundu ($p>0.05$).

Süt örneklerinde ortalama somatik hücre sayısı (SHS) 39.20 hücre/ml olarak belirlendi. Koyun yaşı ve meme tipinin, SHS üzerine önemli etkisi bulunmadı.

Yoğunluk, yağ, yağsız kuru madde, protein ve laktoz içeriğine ilişkin en küçük kareler ortalamaları sırasıyla 26.65 g/l, %6.72, %9.50, %4.53 ve %4.33 olarak belirlendi. Koyun yaşının sadece protein ve laktoz içeriğine etkisi önemli bulundu ($p<0.05$). Meme tipinin ise yalnızca yoğunluk üzerinde önemli etkisi oldu ($p<0.05$).

Çalışma kapsamında alınan süt örneklerinde toplam bakteri sayısı 56.94 olarak belirlendi. İzole edilen bakterilerden *Streptococcus spp.* bulunan örnek sayısı 2 (%4) olurken, örneklerin 15 (%30)'inde *Staphylococcus aureus* belirlendi.

Irak İvesi koyunlarında memenin morfolojik özellikleri incelendi. Buna göre meme çevresi, meme genişliği, meme uzunluğu ve memenin yerden yüksekliğine ilişkin ortalama değerler sırasıyla 40.65, 20.33, 19.81 ve 42.93 cm olarak belirlendi. Diğer yandan meme başı çapı, meme başı uzunluğu, meme başları arasındaki mesafe ve meme başlarının yerden yüksekliği ölçüleri sırasıyla ortalama 16.92, 2.85, 14.81 ve 20.27 cm olarak ölçüldü. Meme uzunluğu ($p<0.01$), memenin yerden yüksekliği ($p<0.01$), meme başları arasındaki mesafe ($p<0.05$), meme başı uzunluğu ($p<0.05$) ve meme başlarının yerden yüksekliği ($p<0.05$) üzerine koyun yaşının istatistiki olarak önemli etkileri bulundu. Meme tipinin etkisi yalnızca meme çevresi ($p<0.01$), meme genişliği ($p<0.01$) ve meme başları arasındaki mesafe ($p<0.05$) üzerine önemli bulundu.

Çalışma kapsamında süt bileşimine ilişkin korelasyonlar incelendiğinde, sütün yağ içeriğinin protein, laktoz ve TGSV ile pozitif ancak zayıf korelasyonlara sahip olduğu bulundu. Yağ içeriği ile SHS arasındaki korelasyon katsayısı r= -0.26493 olarak belirlendi. Diğer yandan, yağsız kuru madde ile protein ($p<0.001$) ve laktoz ($p<0.05$) içeriği arasında önemli korelasyonlar belirlendi. Ancak, yağsız kuru madde ile TGSV ve SHS arasında oldukça zayıf ilişkiler bulundu.

Sütün protein içeriğinin, laktoz içeriği ile arasında pozitif ve önemli (r= 0.35088, $p<0.01$); TGSV ve SHS ile zayıf korelasyonları belirlendi. Bununla birlikte, süt laktozu SHS ile negatif önemli korelasyon gösterdi (r= -0.29025, $p<0.05$).

Memenin morfolojik özellikleri arasındaki korelasyonlar incelendiğinde, meme çevresi, meme genişliği ve meme başları arasındaki mesafe özelliklerinin birbirleriyle korelasyonu önemli bulundu ($p<0.01$, $p<0.001$). Meme uzunluğunun da memenin ve meme başlarının yerden yüksekliği ile olan korelasyonları istatistiki olarak önemli oldu ($p<0.01$, $p<0.05$). Beklenildiği gibi, memenin yerden yüksekliği, meme başlarının yerden yüksekliği ile önemli ölçüde ilişkili bulundu ($p<0.001$).

Meme özellikleri ile süt bileşimi özellikleri arasında zayıf ilişkiler belirlendi. En yüksek korelasyon meme başı uzunluğu ile yağsız kuru madde arasında bulundu (r= 0.27761) ($p<0.05$).

Meme uzunluğu, meme başı uzunluğu, memenin ve meme başlarının yerden yüksekliği gibi memenin uzunluk ve yükseklik özellikleri, TGSV ile negatif ve son derece zayıf korelasyonlar gösterdi. Meme özelliklerinden yalnızca memenin uzunluğu ile SHS arasında önemli bir korelasyon belirlendi (r= -0.32876, $p<0.05$).

Kontrol zamanlarına göre test günü süt verimleri arasındaki korelasyonlar yüksek ve istatistiki olarak önemli bulundu ($p<0.001$). En yüksek korelasyon katsayısı, ikinci ve üçüncü control zamanlarındaki test günü süt verimleri arasında belirlendi (r= 0.99287, $p<0.001$). Test günü süt veriminin, tüm kontrol zamanlarında SHS ile negatif korelasyon gösterdiği tespit edildi. Çalışma materyali Irak İvesi koyunlarında ortalama test günü süt verimi ile somatik hücre sayısı arasındaki korelasyon katsayısı r= -0.34427 olarak belirlendi ($p<0.05$).

Sonuç olarak, Irak İvesi koyunlarında meme tipinin, test günü süt verimi, somatik hücre sayısı ve süt bileşimi üzerine önemli etkisi bulunmadığı belirlendi. Meme özellikleri ve süt kompozisyonu özellikleri arasında pozitif ve negatif ancak oldukça zayıf korelasyonlar belirlendi. Yalnızca meme uzunluğu ölçüsünün, SHS ile korelasyonu istatistik olarak önemli ancak negatif bulundu ($r= -0.32876$, $p<0.05$). Irak İvesi koyunlarının, sütlerindeki düşük SHS (39.20 $x10^3$ hücre/ml) ve bakteri içeriği nedeniyle sağlıklı bir meme bezi ve tüketilebilir süte sahip olduğu tespit edildi. Meme başlarının zemine temasından dolayı enfeksiyon riski arttığı için, meme başları yukarı ve yana doğru olan silindirik meme yapısına sahip koyunlar, meme başları aşağıya doğru ve eğimli olan armut biçimli meme yapısına sahip koyunlar yerine tercih edilebilir.

CURRICULUM VITAE

Nazik Mahmood Elias was born on 15 July, 1982 in Duhok, Iraq. She accomplished the degree of bachelor in Agricultural Sciences at University of Duhok, 2006. Directly after graduation, she worked as an office clerk in University of Duhok at the International Office for three years. She also acquired a great experience in higher studies field through working for more than five years in the Directorate of Higher Studies. In 2014, she moved to the College of of Basic Education, as one of the student registration process team. As she has not found her previous jobs satisfying her ambition, she decided to apply for a master study in Turkey. In 2017, she has been accepted at the Van Yuzuncu Yil University for the Master degree in Animal Sciences.

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