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The Merits of Awassi sheep in terms of Milk Production and Major Factors Affecting the Reproductive Traits

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ABSTRACT

Livestock is the major contributor in the agriculture sector, besides meat and hides, and milk is the chief product obtained in terms of nutrition from livestock. 81% of the global milk production is obtained from cows followed by buffalo (15%), sheep, goat and camel (4%). In contrast to Cow, Sheep farming is famous in its worth as it does not depend on seasonality for its peak production and rich in milk fat contents. The advanced market of dairy products prefers the prebiotics and probiotics of sheep milk in comparison to other livestock. Awassi sheep is known as a very popular and proliferative breed in the non-European region due to its ability to absorb the environmental deviation and adapts the feeding fluctuation from the steppe to the highly intensive system. In general, Awassi ewe can produce an average of 60-80 liters milk with a lactation length of 150 days under different methods of production while an improved Awassi ewe can yield 504 liters milk within 214 days of lactation length under a well-managed production system. Turkish Awassi breed reported an increase from 67 kg to 152 kg in 7 years through proper selection and breeding. In the middle east, the Awassi is considered a triple purpose breed but it's a very famous type of rearing is as a dairy sheep. Several factors including lactation length and number, birth type, electrical conductivity, season, parity, milking frequency, and production year are considered important for the Awassi sheep production. This review will elaborate on the importance of Awassi sheep, its milk, and different factors affecting milk production.

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INTRODUCTION

The escalating trend in the world population with each passing day demands an obligatory survival for food. To compensate for the food requirements for the

population, every field of the food production sector should be optimized on its peak level of yield. Livestock is a very vast sector under the agriculture field and milk is a very well-known part of healthy nutrition obtained from livestock. Milk in terms of nutrition is a complete food and its history is very old starting from the Neolithic age, with the transmission of hominids from the hunting population to gathering societies. Agriculture started to become routine work after the Neolithic age because flat places had prepared for agricultural practices (Balthazar et al., 2017). For milk consumption, human beings depend on a few mammals like the cow, camel, goat, sheep, and buffalo. In the Middle East, sheep and goats were considered as the first domesticated animals because their management is very facile and suitable for humans in this area. Moreover, it was a major source of milk, meat, and clothes for native people (Barłowska et al., 2011; Balthazar et al., 2017). Cow milk has been the most popular milk consumed all over the world and is the main production engine producing up to 81% of total milk following by buffalo (15%), sheep and goat (4%), and camel (1,6%) (FAO, 2019).

Despite being unpopular, sheep milk has some of the important merits that cow's milk lacks. For this reason, sheep milk has started to gain popularity in some parts of the world. Its global production continues to increase as people keep realizing the benefits they are guaranteed from consuming sheep milk (Figure 1).

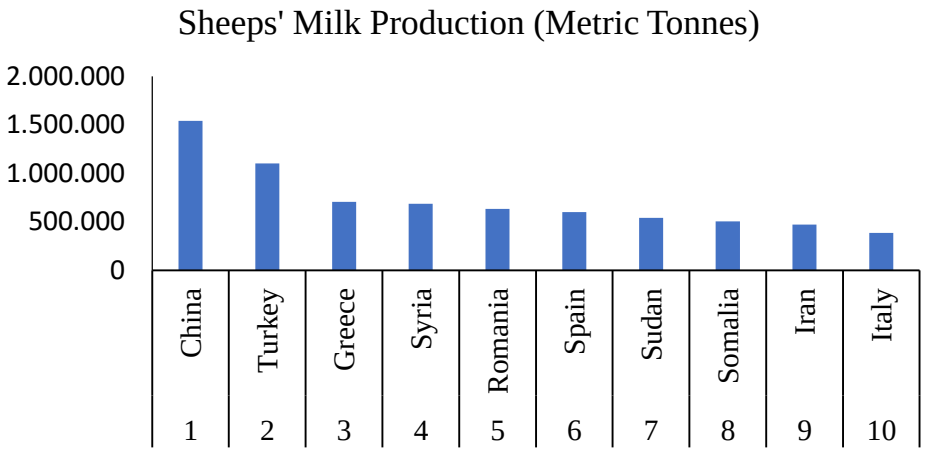

Figure 1. Top 10 sheep milk-producing countries (Misachi, 2017)

The products of sheep milk like fine cheese varieties, yogurt, and whey cheeses are highly acceptable as compared to other domesticated animals (Park et al., 2007; Wendorff and Haenlein, 2017; Milani and Wendorff, 2011) This level of fine quality cheese and other products is due to high levels of protein, fat, and calcium by the casein unit in sheep milk (Balthazar et al., 2017). Sheep milk production and sheep farming are very famous in its worth because it does not depend on seasonality for their peak production as compared to the cow (Albenzio et al., 2016). In the advanced market of dairy products, the prebiotics and probiotics of sheep milk are very creditable than other livestock animal milk and milk fat is also high as compared to cow milk (Wendorff and Haenlein, 2017).

In sheep farming, the Awassi sheep have an appreciated name in dairy sheep as it produces a significant amount of butterfat and a reasonable amount of milk. In worldwide, Mediterranean countries have a noticeable position in the field of dairy sheep farming and most probably they are interconnected to their native breeds. The Awassi sheep is the most ubiquitous and famous breed of South and West Asia as it is present mostly in Iraq, the Syrian Arab Republic, Lebanon, Israel, Jordan, and some parts of Saudi Arabia and Turkey as well (Hailat, 2005; Galal et al., 2008; Talafha and Ababneh 2011).

Based on the beneficial uses of sheep milk and the need for the increasing human population, all types of analysis and efforts are very obligatory to increase sheep milk production. For this purpose, several scientists used their effort to increase sheep milk production and upcoming are also focusing on milk affecting parameters and technique for boosting the sheep milk production.

This review will explain the work of different scientists on the milk of the Awassi sheep breed and the presence of this breed in a different region of the globe. Further, this paper also highlights the different factors of milk production in the Awassi breed of Turkey and different studies on the same breed of regions other than Turkey.

AWASSI SHEEP

Nowadays the Awassi sheep breed has been popularized in more than 30 countries of the world (Galal et al., 2008). Epstein 1985) described that the Awassi sheep name is related to a tribe in between the Tigris and Euphrates rivers known as El Awas tribe. Moreover, he also labeled its different names according to different areas as Awassi, Aouasse, El Awas, Oussi, Ussy, or Iwessi while in Turkey it is known by İvesi or Arab name and Nu'amieh in the Syrian Arab republic. Many scientists have narrated about the physical appearance of Awassi sheep as it has medium body size with the long coarse wool, long and narrow head of brown or black color with convex forehead profile and pendulous ears with medium length (Epstein 1985; Hailat, 2005; Galal et al., 2008). The neck and body length of Awassi sheep is long and fine in ewe but legs are apart wide with short length as compared to other body parts (Alkass et al., 2005; Kassem and Africa, 2005; Khazaal and Africa, 2005). It has a fatty and medium in size tail which hangs down up to hocks with two clear lobes formation (Gürsoy, 2005; Galal et al., 2008). This breed possesses the brown color on the neck, head, and legs while white for the remaining body. Sometimes head has a white blaze and the resting body has brown spotting as well but rare. Very few animals have black color in place of brown and called Karabas with a roman nose. The rams of Awassi sheep have well-developed and pointed horns whereas ewes are mostly polled or short-horned. The adult Awassi ram has an average of 80 to 90 kg bodyweight whereas adult ewe possesses an average weight of 45 to 60 kg (Degen and Benjamin, 2003; Galal et al., 2008; Talafha et al., 2011).

Awassi ewes are generally hornless while maximum rams have sturdy spiral-shaped horns. The wool of this breed is the finest, coarsest carpet-wool among all Turkish breeds (Kaygisiz and Birol, 2017). Genetic improvement in sheep farming especially Awassi cross with different breeds of sheep is very common in sheep breeder countries. Due to genetic improvement in the Awassi sheep breed, there is enormous variation in some characteristics like teat size, shape, color, and milk production

capacity in different countries. As compared to other breeds of Turkey, the Awassi has specifically high-quality traits for growth performance. With this obvious appearance, the Awassi also has some distinguish properties to fight against parasitic diseases, extreme temperature tolerance, and accept the nutritional deviation. The Awassi sheep possess an average of 17 days of the estrous cycle and an average of 152 days of gestation period. The improved Awassi has the weightiest body shape, significant milk production ability, and excellent fertility with a twining rate as compared to the entire Awassi population (Galal et al., 2008).

Talafha and Ababneh (2011) revised a huge amount of Awassi sheep literature to create a good awareness of this breed and its origin with production correlation. He described that semi-arid areas of east countries have Awassi sheep and it is a local breed of Jordan. The ram lambs of this reach to puberty at around 8 months of age while ewe lambs achieve this status in 9 months of age. September is the last month of the breeding season for this breed which starts from April and the estrous period has almost 16–59 h in the breeding season. Ewe has an average of 17 days of the normal estrous cycle while rams are sexually active throughout the year after the puberty age. Among the whole Awassi populaces, the improved Awassi sheep is heaviest and high in productivity as compared to unimproved types. The Awassi is the best dairy sheep of the Middle East region.

Galal et al. (2008) also revised the literature and study of Epstein (1985) for a complete description of Awassi sheep and their improved forms so far. He stated that Awassi is known as a very popular and proliferative breed in the non-European region. It has a very good ability to absorb the environmental deviation and adapts the feeding fluctuation from the steppe to the highly intensive system. Performance variation completely depends on the strain, production system, and environmental variation. He noted that Israel improved Awassi sheep is on the top number to produce milk and have the heaviest weight as compared to all other local Awassi sheep. Israel improved Awassi sheep increased milk production from 297 kg to 500

kg within the period of 1940 to 1990 while the Syrian selection program also played an admirable role in increased Awassi production from 128 kg to 335 kg from 1974 to 2005. Within the last 4 to 7 years the Turkish Awassi breed increased their milk yield from 67 kg to 152 kg through the selection and outcrossing programs. In the Middle East, the Awassi is considered a triple purpose breed but it's a very famous type of rearing is as a dairy sheep.

Milk Traits of Awassi Sheep

Özyürek (2020) reported that Turkey has a total of 35 million and 194,000 heads of sheep in 2018 and 1,446, 412 tons of milk can be produced from 18,820,000 heads of milking sheep. The average lactation milk yield increased from 48 kg to 77 kg in the years 2018 to 2020 respectively. In Turkey, the Awassi is a very famous breed of the dairy sector and started to reared on big levels under specific management systems. Several factors like dam's age, weight at lambing, season, type of birth, sex of born lamb, the sheep management system, and length of the lactation period are very critical and responsible for variation in total milk production of unimproved Awassi sheep. The amount of milk of Awassi sheep is variable in different production systems for unimproved Awassi ewe and improved Awassi ewe.

Gürsoy (2005) labeled the Awassi sheep as a second-best dairy breed of the world and highest milk- producing breed of Turkey as he reported milk production range from 97.5 to 360 kg over 95 to 222 days of lactation length. The lambs suckling period of Awassi is flexible between 2-3 months depending on the availability of pasture, birth season, and growth rate of calves and calves can be separated from their dams just 10-12 hours before milking. In the past, the Awassi can be milked by hand milking but now the trend has changed due to their high milk production and advanced milking parlor.

Biçer et al. (2019) informed that brown and black headed types of Awassi sheep were compared in terms of 150-day milk yield and some fertility characteristics. At the end

of the study, 150 days milk yield of Awassi sheep with brown head and black head were determined as 111.6 and 121.5 kg, respectively. There were statistically significant differences in milk yield between two different varieties.

Awassi ewe can produce an average of 60-80 liters milk with a lactation length of 150 days under different methods of production while an improved Awassi ewe can yield 504 liters milk within 214 days of lactation length under a well-managed production system (Talafha and Ababneh, 2011). Gürsu and Aygün (2014) denoted that the rearing of Awassi sheep under conditions of dry and hot weather is a unique feature and even shows the usual growth rate. The lactation milk yield of this breed also fluctuates with conditions of management like 100-150 kg to 250-300 kg in a rural area to modified flocks respectively. The crossing of Awassi with the Akkaraman breed is very communal because of the high qualities of Awassi for milk yield, growth performances, and maximum lambing ability.

Gürsu and Aygün (2014) proposed a study at the village level of Turkey to determine some milking traits for Awassi sheep. He used 63 ewes of Awassi breed within a range of 2-3 years of age and started milking after 30 days of parturition. He denoted the means lactation length of 165.46 days and 110.05 liters total milk yield along with the significant effect of age and born lamb's gender. The findings concluded that the Awassi sheep have sufficient ability to maintain lactation length and lactation milk yield at village level management conditions.

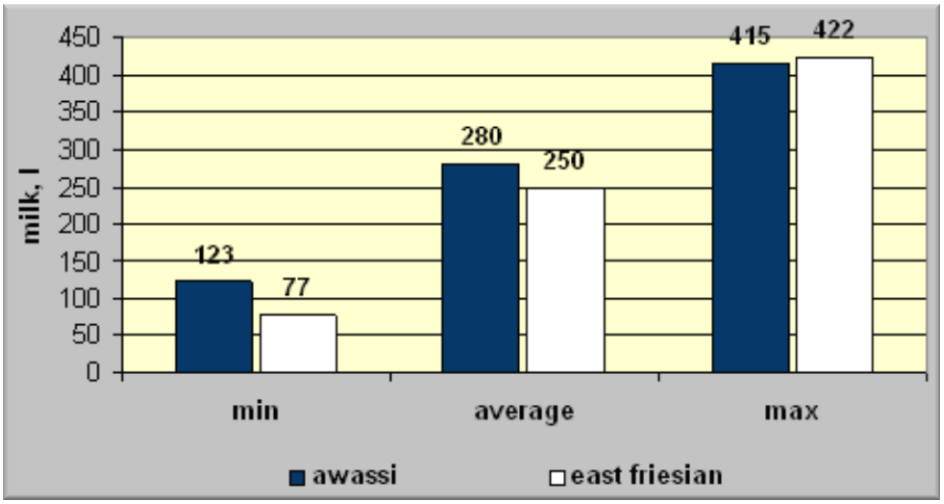

Figure 2. The ranges of milk yield in Awassi and East Friesian (Pacinovski et al., 2007)

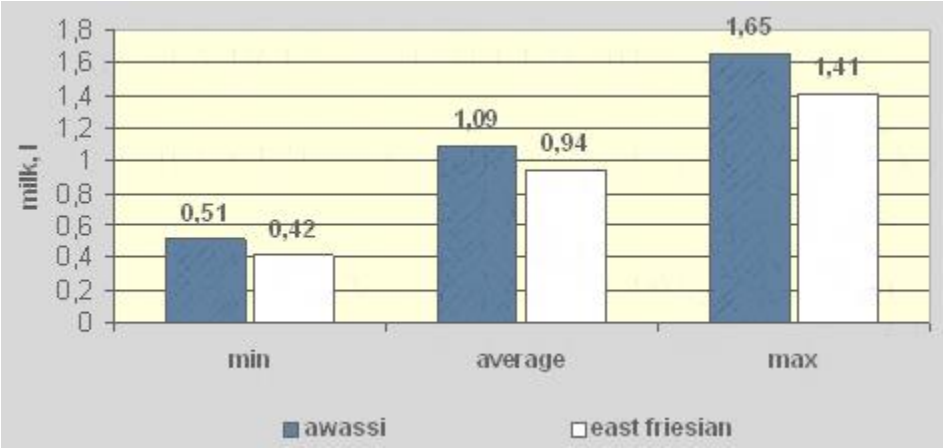

Figure 3. The ranges of daily milk yield in Awassi and East Friesian (Pacinovski et al., 2007)

Awassi Sheep in Turkey

In the present days of Turkey, the small ruminants have a significant reputation in animal breeding and milk production. The sheep population of Turkey consists of 97% indigenous breeds and 3% exotic and crossbreeds (Üstüner and Ogan, 2013). Turkey has more than 2.5 million sheep population (Skapetas and Kalaitzidou, 2013) and Awassi sheep has its 3.5% portion (Galal et al., 2008). In Turkey, the ewes' milk

shares about 8.8%, and the Awassi breed has a name on top of the table for milk production in domestic sheep (Gürsu and Aygün, 2014). Turkey is a very popular country for sheep rearing with multiple ovine habitats. So Awassi is also very renowned in Turkey due to its high milk yield, high lamb growth, and developmental properties. Awassi sheep possess specific quality like high milk yields as compared to native breeds and some exotic breeds.

The prime areas of Turkey with a good distribution of Awassi sheep are Gaziantep, Şanlıurfa, Mardin, Hatay, and Adana regions of the eastern Mediterranean. Recently the Awassi sheep have been penetrated to Aegean Region and Central Anatolia and using as best milk producers after crossing with some native and exotic breeds. Gürsu and Aygün (2014) stated that Turkey is a very appropriate country for sheep farming, sheep product market, and weather plus climate conditions for propagation.

Üstüner and Ogan (2013) performed a study in the Anatolian region's Awassi sheep for evaluation of survival rate, fertility rate, milk production, lambs growth rate, and effect of environment. The outcome of this study was that all parameters and their effects are the same in Awassi sheep raised in the central Anatolian region and their native race, even there were no extra epidemics and health issues in this region.

Sheep Management System:

Small ruminants play a noteworthy role in total milk, meat, and wool production for the religious, cultural, and economic needs of Turkey. Due to these reasons, the sheep are raised in Turkey under different management systems. Total milk yield and lactation length not only depend on the breed of sheep but also depend on the management system and environmental bravura. The main types of husbandry systems of Turkey are intensive, semi-intensive, and extensive.

The extensive system whereby animals spend all, or a substantial part, of each day outdoors and obtain most of their nutrients from pasture. In many ways, extensive systems of sheep production that we find in the mountains, moors, and rangelands across the world can be considered as natural systems of farming.

The intensive system is a specialized system of breeding and rearing of animals in which animals are kept indoors along with all health practices and feeding inside the farm. This is a very vital way to avoid the animals from different types of germs and contagious diseases etc. (Robertson et al., 2020). Many scientists had an analysis of different factors like parity number, season, and litter size. Lactation length and milk electrical conductivity etc. under different management conditions.

Mavrogenis and Louca (1980) checked the production features of some crossbred sheep and 616 purebreds under the consequence of different husbandry systems. The effects of an extensive production system, intensive production system, and semi-intensive production system were estimated on 3 different sheep-like Chois (C), Awassi (A), and Cyprus Fat-tailed. Crossbred of Awassi and Cyprus fat-tail and their performances had compared with each other under extensive production conditions. The sheep produced more milk, protein, and fat under conditions of an intensive management system and the production of Crossbred of Awassi and Chios was higher as compared to their pure breeds.

Dhaoui et al. (2019) proposed a study on the intensive oases management system of southern Tunisia with 80 lactating D-man sheep for analytical observation of milk. For the determination of milk yield, the use of oxytocin and hand milking was a condition, and samples can be collected after seven days. The estimated daily averaged milk yield was 1.64±0.02l liter and lactation showed its peak at the third and fourth weeks of lactation which decreased gradually from 10 weeks of lactation.

EFFECT OF DIFFERENT FACTORS ON MILK YIELD OF AWASSI SHEEP:

Lactation length and number (Ln & LL)

Milk production is a natural phenomenon and the utmost purpose of dairy animals. The production of milk and its frequency can be affected by several factors on the basis of an animal's health status and management conditions. From the time of nomadic, the lactation number and its length were considered for significant results on sheep milk yield and age of sheep. The secretion of milk from the mammary glands of animals is called lactation and it's period until she can give milk in one gestation is called lactation length while lactation numbers are different times in which ewes had offsprings and gave milk. The average lactation length in dairy sheep is variable between 160 days to 240 days whereas it can be reduced from 90 days to 150 days in non-dairy sheep breeds. The lactation stage and lactation number have a prominent effect on the quality and quantity of milk.

Bencini and Pulina (1997) demonstrated about lactation, quality of sheep milk, and some kind of factors that directly or indirectly influence milk production in Australia and New Zealand region. The lactation stage is very important to obtaining high-quality milk as the beginning and end of lactation produced low-quality milk as compared to the middle of the lactation period and adult of animal status. Nutritional status and health of milking flock must excellent for high-quality milk production. These all factors have critical importance on the quality of sheep milk which directly affects the quality and quantity of their products.

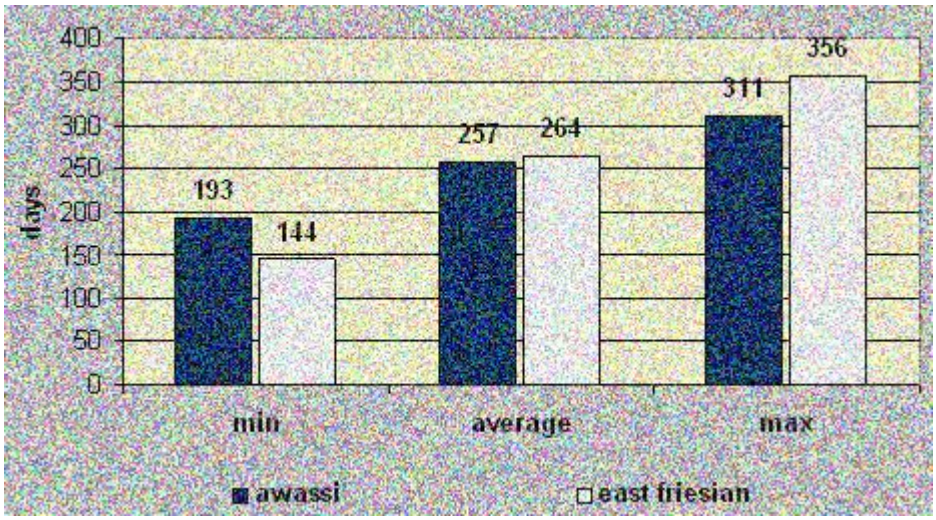

Figure 4. The ranges of lactation length in Awassi and East Friesian (Pacinovski et al., 2007)

Basdagianni et al. (2018) evaluated some reference lactation lengths and finalized an appropriate lactation length for the Chios sheep breed. He used 24474 dams of 130 flocks for a total of 260042 test day milk records in the duration of 2003 to 2014 and a defined range of 120 to 260 was evaluated for 15 different reference lactation lengths. He described that genetic evaluation and comparison of the flock and management activities can be achieved by definition and formation of reference lactation length as it is a supreme tool for breeding programs.

Despite other studies, Gootwine and Pollott (2000) had done a study in which he analyzed Awassi sheep's lactations for estimation of milk production factors and lactation curve parameters. The experimental flock was milked two times a day after lambing and reared under intensive management conditions. The lams were reared under artificial feeding as they got separated from ewes after birth. The mean litter size of 1.28 lambs per ewe lambing was found by the analysis of 3740 lactations and the results of this study also showed 506-liter average total milk yield in 214 days of lactation with 330 days of average lambing interval. The first conception took place in the average 6 month age of ewe and ewe showed 3.71 average mean lactation numbers. 3.44 liter is the peak milk production value attained on the 45th day of

lactations and 3.9 liter was the maximum milk yield per day. The rate of milk yield was increased by 62 gr/day from lambing day to mid-lactation and deceased at 16.5 g/day from mid-lactation to end of lactations. All investigated parameters of lactations had significant effects on the first lambing age, the number of lactations, the size of litter, the month of conception, and the month of lambing. The lactation started in January and March showed a relatively high rate of production as compared to other months. The reproduction performances showed adverse significant effect by high milk production and short term variation in milk production also followed by conception rate.

Birth type (BT)

The profitable sheep farming always depends on a substantial contribution of lambing. The high lambing rate is always a desire of farmers to increase the number of the farm population. The birth type/litter size is the total number of lambs birthed by a single ewe in one lambing. It had a significant effect on total sheep milk yield as described by different researchers. Kasap et al. (2019) defined a study on Istrian dams to predict the effect of litter size and parity on dairy traits. He analyzed multi-number of dairy traits as daily milk yield, fat yield, fat content, protein yield, lactose yield, lactation milk yield, and lactose contents. He took 2786 ewes with their 6482 lactation records for analysis through the use of a statistical model applied for an unbalanced data structure for all phenotypic variable sources. All the investigated traits were affected significantly by parity ($P<0.001$). In the third party, the lactose production, daily milk production, protein production, and lactation milk yield was on peak value while lactose content was on peaked at second lactation, and protein and fat contents were very high in the fourth lactation. He described that multiple litters always yield high milk quantity and dry matter components and he added that such types of studies are helpful for proper farming and understanding the contribution of different dairy traits.

Jawasreh and Khasawneh (2007) defined a study for the evaluation of genetic traits of milk yield in Awassi sheep at an agriculture research center in Amman, Jordon. They had analyzed effects of ewe age, birth type, and no. of parturition were significant ($P< 0.05$) on total milk yield and test day milk whereas test day milk (TDM) and total milk yield (TMY) effected non-significantly by lamb birth weight and ewe type of birth

Sultan (2019) had performed a study on Awassi sheep to evaluate the effect of birth type and ewe age on milk yield, milk composition, and lambs' weight gain performances. He used 28 Awassi sheep of 2-3 years of age for the study and evaluated their lambs for 12 weeks. The ewes were grouped based on their weight and birth type. High body weight ewes were denoted with 1 and 2 groups with their single (HS) and twins (HT) lambing while the low body weighted ewes were also symbolized by 3 and 4 groups along with their birth types (LS) and (LT) respectively. The High-single (HS) group had shown a prominent for the body weight gain of lambs as compared to the low-twins (LT) group. The milk yield was also high in heavy animals with twins lambs as compared to single lamb and lower weight ewes. Heavy ewes with single lambs gave high body gain of lambs while ewes of both heavy and low weight produced a high amount of milk with twins number of lambs.

Electrical Conductivity (EC)

The amount of milk production and udder health of animals always very closed concerning the electrical conductivity of milk. Milk production always decreased in mastitis conditions and electrical conductivity is the very best tool to measure mastitis status and udder health. Fat, sodium, and chloride content are very responsible for EC variation in sheep milk (Roca et al., 2019). By the information of different studies, the milk EC can vary based on different factors like lactation number, lactation stage, time of milking, and season. The range of milk EC was variable in different studies based on factors analyzed and species of animal but the

average value of sheep milk EC was varied between 3-7 mS.cm-1 for most of the studies. There is more information between the correlation of udder health and milk EC but very little data available about the analysis of direct relation in milk EC and total milk yield. Several writers described milk EC and milk yield and denoted it as an inverse relation of them. The EC always increases with the higher number of somatic cell account (SCC) in milk and SCC leads to decease daily milk yield.

Roca et al. (2019) aimed a study to analyze the effect of milking fraction, milk yield, and mammary gland health on ewe's milk electrical conductivity (EC) with lactation number. Further, he studied the relation of EC with milk macro composition and somatic cell count (SCC) of milk. EC and SCC were significantly affected by mammary gland health status, milking fraction, and lactation number. So milking fraction was prominently affected by EC as compared to the health status of the glands or the number of lactation. The gland health status was higher according to SCC evaluation and followed by milking fraction and lactation number. The EC of milk greatly affected milk composition, milk fraction, and milk contents like fat and lactose. Thus milking fraction, individual differences, lactation stage, or lactation number caused a significant effect in EC variation and this effect to milk production.

Uhrinčať et al. (2019) proposed a study to detect the mastitis status in sheep milk of the Slovakia region based on the relation between somatic cell count (SCC), electric conductivity (EC), and bacteriological examination of the udder. The samples were collected from 295 sheep based on SCC and udder health status. There were 3 classes of samples on the base of pathogens like major pathogens" (n=14), "minor pathogens" (n=161), and "without pathogens" (n=415). The depletion of lactose, an increase of SCC, EC, and protein contents was significantly affected by the presence of pathogens. There was a minute correlation between EC and log SCC as compared to lactose and protein content. He decided that the measuring of EC is the best option to detect udder health, SCC, and daily milk production and an easy way to measure EC was the use of an EC measuring meter on the Robotic milking parlor.

Season and Production Year (S & PY)

The effect of season on milk yield has been studied very briefly from previous decades especially on sheep, goats, and cattle. The production year can be divided into four seasons into most of the studies and they put a different number of results for production values. These seasons are comprised of multiple weather conditions like cold, temperature, humidity, etc. that create a significant impact on animal production. Some intensive management units are trying to demolish these seasonal effects on the total milk yield but they are not completely successful. Different researchers have different opinions about the effect of seasons on the sheep milk yield but mostly cast their vote for the spring season as best for high milk production. So every year has different values of milk yield based on the season and environmental conditions.

Carta et al. (1995) described the effect of season and per age lambing for milk, protein, and fat yield in Sarda sheep. He designed predicted lactation curves per age at lambing and season by fitting a mixed model on 10866 records of 1740 lactations. Seasonal effects were very irregular for protein and fat yield throughout the study and it needs more investigation. So that was the reason for further studies were suggested but the conclusion about season effect on milk yield was significant for spring season and depressive for winter and summer seasons. Efficient use of hormones in female awassi individuals for prosperous breeding and parity has been documented. The hormonal influence reported causing a direct positive effect on the overall production of lambs in a shorter duration. However, it should be kept in mind that the use of hormones is not an efficient alternative in contrast to positive management practices. PGF2α, gonads, and progestins have been used for estrous synchronization along with its onset. Prostaglandins reported starting the new cycle within 3 days by regressing the corpus electrum and declining the progesterone level in the blood.

Abecia et al. (2017) proposed a study to evaluate the effect of production year after dividing it into 5 different phases based on weather. He took 609 dairy sheep from a Spanish farm and divided them into five groups based on lambing time like FEB (n=124); APR (n=141); JUL (n=114); SEP (n=102), and NOV (n=128). He also divided the lactation into three-stages as early, mid and late lactation. He concluded that the highest milk production was observed for September and April as compared to other groups. Milk yield in five lambing periods was significantly affected by season and meteorological variables. Within the year the phases of lactation and seasonal groups are major factors for assessing milk yield.

CONCLUSION

Conclusively, the dynamic chattels of Awassi sheep of adjusting itself in ecological eccentricity and wavering feeding regimen from basic to the intensive system made it an eminent and proliferative breed in the Non-European region. On average, during the lactation, an Awassi sheep produces 60-80 liters of milk to 504 liters in an advanced farming system. This wide range in the production is obtained via considering several major factors for awassi sheep production like selective breeding, lactation length, birth type, electrical conductivity, season, parity, milking frequency, and production year.

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