W. ALI, 2020

MASTER THESIS

GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES
DEPARTMENT OF ANIMAL PRODUCTION AND TECGHNOLOGIES

T.C.
NİĞDE ÖMER HALİSDEMİR UNIVERSITY
GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES
DEPARTMENT OF ANIMAL PRODUCTION AND TECHNOLOGIES

THE EFFECT OF ENVIRONMENTAL FACTORS ON MILK YIELD OF AWASSI SHEEP IN AN INTENSIVE MANAGEMENT SYSTEM

WAJID ALI

July 2020

T.C.
NİĞDE ÖMER HALİSDEMİR UNIVERSITY
GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES
DEPARTMENT OF ANIMAL PRODUCTION AND TECHNOLOGIES

THE EFFECT OF ENVIRONMENTAL FACTORS ON MILK YIELD OF AWASSI SHEEP IN AN INTENSIVE MANAGEMENT SYSTEM

WAJID ALI

Master Thesis

Supervisor

Prof. Dr. Ayhan CEYHAN

July 2020

Wajid Ali tarafından **Prof. Dr. Ayhan CEYHAN** danışmanlığında hazırlanan **"Entansif Sisteminde Yetiştirilen İvesi Koyunların Süt Verimi Üzerine Çevre Faktörlerin Etkisi"** adlı bu çalışma jürimiz tarafından Niğde Ömer Halisdemir Üniversitesi Fen Bilimleri Enstitüsü, Hayvansal Üretim ve Teknolojileri Dalı'nda Yüksek Lisans tezi olarak kabul edilmiştir.

(The study titled **"The Effect of Environmental Factors on Milk yield of Awassi Sheep in an Intensive Management System"** and presented by **Wajid Ali** under the supervision of **Prof. Dr. Ayhan CEYHAN,** has been recognized as Master thesis by the jury at the Department of Animal Production and Technologies of Niğde Ömer Halisdemir University, Graduate School of Natural and Applied Sciences.)

Başkan : Prof. Dr. Ayhan CEYHAN, Niğde Ömer Halisdemir University

İmza (Signature)

Üye: Associate Prof. Dr. Tugay AYAŞAN, Osmaniye Korkut Ata University

İmza (Signature)

Üye: Assistant Prof. Dr. Mabrouk ELSABAGH, Niğde Ömer Halisdemir University

İmza (Signature)

ONAY (CONFIRMATION):

Bu tez, Fen Bilimleri Enstitüsü Yönetim Kurulunca belirlenmiş olan yukarıdaki jüri üyeleri tarafından …./…./20.... tarihinde uygun görülmüş ve Enstitü Yönetim Kurulu'nun …./…./20.... tarih ve …........................... sayılı kararıyla kabul edilmiştir.

(This thesis has been found appropriate at the date of …./…./20.... by the jury mentioned above who have been designated by Board of Directors of Graduate School of Natural and Applied Sciences and has been confirmed with the resolution of Board of Directors dated …./…./20.... and numbered ……………)

/ /2020

Prof. Dr. Murat BARUT

DIRECTOR

THESIS CERTIFICATION

I certify that this thesis has been duly written by me, to the best of my knowledge. All the necessary information provided in the thesis is scientific and following the academic rules. All the help received in conducting the research and all other sources used have been duly acknowledged.

Wajid ALI

SUMMARY

THE EFFECT OF ENVIRONMENTAL FACTORS ON MILK YIELD OF AWASSI SHEEP IN AN INTENSIVE MANAGEMENT SYSTEM

ALI, Wajid
Niğde Ömer Halisdemir University
Graduate School of Natural and Applied Sciences
Department of Animal Production and Technologies

Supervisor: Prof. Dr. Ayhan CEYHAN

July 2020, 53 pages

Keeping in mind the growing population and key worth of sheep milk, Sheep farming is transmuting from extensive management to an intensive management system for maximum production. This study was aimed to evaluate the effect of some environmental factors of milk yield in Awassi ewes under intensive management conditions of a dairy sheep farm at Niğde region from 2016 to 2018. The effects of lactation length, average daily milk yield, electric conductivity, lactation number, production year, season and birth type on total milk yield were estimated. The result of this study showed that the effect of lactation season, lactation number, birth type and production year of the ewes on total milk yield was significant. The spring season, twin-birth, 3rd lactation number and the 2017 production year were factors that yield maximum milk for this breed. The correlation of total milk yield between average daily milk yield and lactation length was highly significant ($P<0.01$) while non-significant ($P>0.05$) between electric conductivity and total milk yield. The average daily milk, average lactation milk yield and average lactation length for this study were 1.005±0.007 kg, 214.42± 3.43 kg and 210.07±1.51 days respectively. This study revealed that Awassi sheep are very promising for milk production under intensive conditions in the Central Anatolia region.

Keywords: Milk, Awassi, Intensive management, Lactation length, Electric conductivity

ÖZET

ENTANSIF SISTEMINDE YETIŞTIRILEN İVESI KOYUNLARININ SÜT VERİMİ ÜZERINE ÇEVRE FAKTÖRLERİN ETKİSİ

ALI, Wajid
Niğde Ömer Halisdemir Üniversitesi
Fen Bilimleri Enstitüsü
Hayvansal Üretim ve Teknolojileri Anabilim Dalı

Danışman: Prof. Dr. Ayhan CEYHAN

Temmuz 2020, 53 Sayfa

Koyun yetiştiriciliği, artan nüfus ve koyun sütünün önemi göz önünde bulundurulduğunda ekstansif üretimden entansif üretime sistemin geçmektedir. Bu çalışmanın amacı, Niğde bölgesinde 2016-2018 yılları arasında bir süt koyunu çiftliğinde entansif koşullarda yetiştirilen İvesi koyunlarının süt verimi üzerine bazı çevresel faktörlerinin etkisini değerlendirmektir. Bu çalışmada laktasyon uzunluğu, ortalama günlük süt verimi, elektrik iletkenliği, laktasyon sayısı, üretim yılı, mevsim ve doğum tipinin etkisi tahmin edilmiştir. Bu çalışmanın sonucu göstermiştir ki koyunların toplam süt verimi üzerine mevsim, laktasyon sayısı, doğum şekli ve üretim yılı etkisi önemlidir. Bu ırk için maksimum süt verimine etki eden faktörler bahar mevsimi, ikiz doğum, 3. laktasyon sayısı ve 2017 üretim yılıdır. Toplam süt verimi ile ortalama günlük süt verimi ve laktasyon uzunluğu arasındaki korelasyonu yüksek derecede anlamlı iken, elektrik iletkenliği ile toplam süt verimi arasında önemli değildir. Bu çalışma için ortalama günlük süt verimi, ortalama laktasyon süt verimi ve ortalama laktasyon uzunluğu sırasıyla 1.005 ± 0.007 kg, 214.42 ± 3.43 kg ve 210.07 ± 1.51 gündür. Bu çalışma İvesi koyunlarının İç Anadolu bölgesinde entansif koşullarda süt üretimi için çok umut verici olduğunu ortaya koymuştur.

Anahtar Sözcükler: Süt, İvesi koyunu, Entansif yönetim, Laktasyon uzunluğu, Elektrik iletkenliği

ACKNOWLEDGMENTS

I would like to appreciate the faculty of Ayhan Şahenk Agricultural Sciences and Technologies that gave me a permission and good environment for research. In particular, I thank Prof. Dr. Ayhan CEYHAN for being an excellent mentor when I needed leading. Moreover, he helped me with each step of my thesis work. I would like to thank the jury members (Associate Prof. Dr. Tugay AYASAN and Assistant Prof. Dr. Mabrouk ELSABAGH) of my thesis defense examination for their useful comments. This study has been partially supported by MeMuTa dairy sheep farm administration and staff members.

I especially would like to thank my laboratory fellows Sinan Cinar and Sadaf Qadir for supporting me during my research work. I am also thankful to my family especially my mother, who gave me moral and emotional support as well as continuous encouragement in my life.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

SYMBOLS AND ABBREVIATIONS

Symbols	Description
g	Gram
Kg	Kilogram
%	Percentage
L	Liter
lbs	pounds
ml	Milli-liter
mS.cm-1	milliSiemens per centimeter
SCC	Somatic cell count
DIM	Days in Milk
Cm	Centi-meter

Abbreviations	Description
TDM	Test Day Milk
TMY	Total Milk Yield
ADMY	Average Daily Milk Yield
S	Season
LL	Lactation Length
LN	Lactation Number
BT	Birth Type
EC	Electric Conductivity
Y	Production Year

CHAPTER I

INTRODUCTION

Milk is a vital component of balanced food for human consumption as it has a good composition of water, fat, protein, sugar, minerals, vitamins and enzymes. The main milk-producing animals in the world are cattle, buffalo, sheep, goat, yak, ass, and camel, etc. 85% of milk is accounted for by cattle and the rest 15% by other milk-producing animals (Ali et al., 2019). The sheep are also the main source of milk production in the world, especially in south-east Asia. The sheep milk has thereabouts of significant merits that the other animal's milk deficient. The dairy sheep farming gets more than 2/3 shares of income by sheep milk production and sometimes milk yielding is the only moto of sheep rearing (Banos et al., 2019). The sheep produce a small quantity of milk but very rich in the dry matter as compare to other milk-producing animals (Selvaggi et al., 2014). On this basis, sheep milk has to commence to revenue a typical point of acceptance in some parts of the world.

Globally the sheep milk production or sheep farming is considered a nascent subject for the whole world as it guaranteed a larger number of paybacks for human beings. The sheep milk possesses a superior composition as it governs a large amount of vitamins A and E, high numbers of nucleotides to stave off from cancer, and capacity to boost up immunity and regularity in hormonal concentration and function. Top 10 sheep population countries are China, India, Australia, Iran, Sudan, Nigeria, New Zealand, UK, Pakistan and South Africa respectively.

Total sheep population in the world is estimated around one billion (Skapetas and Kalaitzidou, 2017) and according to Miaschi John's (2017) statement, China is on the top number in sheep milk production with highest sheep population as it produces more than 1.5 million tons of sheep milk annually while Turkey is following it with 1.1 million tons annually sheep milk production. In Turkey, the number of milk-producing sheep has been increased with the last 10 years and feeding for domestic dairy sheep is mostly on organic feed and an extensive system of production (Kuchtík et al., 2017; Konečná et al., 2019).

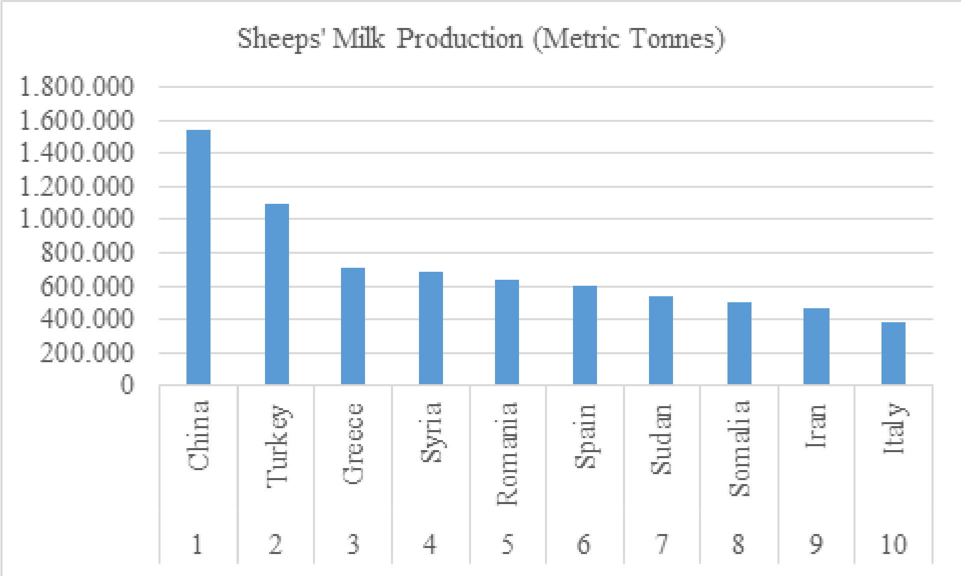

Figure 1.1. Top 10 sheep milk-producing countries (Miaschi, 2017)

In sheep farming, the Awassi sheep have a valuable name in dairy sheep as it produces a significant amount of butterfat and a reasonable amount of milk. In worldwide, Mediterranean countries have an appreciable 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; Gürsoy, 2005; Galal et al., 2008; Talafha and Ababneh, 2011; Miaschi, 2017).

Figure 1.2. Awassi ewes at MeMuTa dairy sheep farm

The Awassi is triple purpose sheep (milk, meat, wool) based on dynamic qualities it is considering now as a very good dairy sheep. Therefore Awassi sheep are present as a dairy animal in different countries (more than 30) of the world as imported genetics resources from Turkey, Syria, Israel and Jordan (Galal et al., 2008; FAO, 2015). Gürsoy (2005) stated that improved Awassi sheep is a second-best dairy breed of the worldwide while the highest and best milk-producing breed of Turkey. Epstein (1985) stated that Awassi ewes are milked two times per day for the first 3-4 months of lactation but only one time in the following duration until dry period (Talafha and Ababneh, 2011; Miaschi, 2017).

The Awassi sheep as a dairy animal in Turkey, the farmers are shifting animals from the grazing system to an intensive management system because nutrition is a significant aspect for milking animals. In the past sheep rearing, especially Awassi breed in Mediterranean countries depends on grazing of the mountainous pasture in the form of the flock by shepherds and came back home in the cold season. With the progress in the husbandry system and scarcity of fodder due to the disaster of environmental transformation, the rearing system also got transmutation.

In sheep farming, there are primarily 3 husbandry systems as extensive, semi-intensive and intensive (Mavrogenis and Louca, 1980; Gootwine and Pollott, 2000). Recently due to the genetic advancement of dairy animals and milking automation, sheep farming has promoted the intensive system along with indoors feeding. The breeding and milking of ewes and short period suckling of lambs are practice in different pens. Sometimes lambs can be separated just after colostrum feeding and sometimes after weaning of almost 45-60 days of age.

This study is carried out in the intensive conditions of MeMuTa dairy sheep farm near to Niğde region of Turkey. In this study, we have analyzed different factors of milk production in Awassi sheep either they affect positively or negatively. The basic parameters of this study for estimation of the milk yield are lactation length, lactation number, year of production, lactation season, average daily milk yield, birth type, and milk electric conductivity. This study aims to analyze the major environmental effect of these factors on milk production of Awassi sheep under an intensive management system of production. In this system, the animals are remained into indoors for a whole year and other practices like milking, mating, lambing and feeding within the farm. The lactation length is one of the key factors concern milk yield in dairy sheep. It is a period of milk production by a ewe that ranging from 120- 240 days in dairy sheep breeds.

The milk yield mostly directly proportional to lactation length which influenced by several environmental factors especially lambing season. The ewe lambing of winter and autumn season promotes long lactation length as compared lambing of the spring season (Basdagianni et al., 2019). The effect of season and lactation length in milk yield has been reported by different scientists on different species of sheep such as Sarda by Carta et al. (1998), Chios by Mavrogenis and Papachristoforou (2000) and Barbaresca Siciliana by Portolano et al. (2001). With the lactation length, the stage of lactation is also a considerable parameter which shows a noticeable effect on milk yield as animals produce high milk at the stage of early and mid-lactation as compared to late lactation (Pelmus et al., 2019).

In dairy sheep farming the birth type and lactation number are very considerable things to evaluate exact milk production. In this aspect Kasap et al. (2019) described that ewes with multiple lambs can produce more milk rich in fat but low in protein and lactose and he added that animals in 3rd lactation number can produce more milk as compared to young and older parity. The year of production is always a valuable point to be noted as a dam of different age produces different milk in different years of production. Electrical conductivity (EC) of milk is considered as an indicator for udder health which is directly proportional to milk yield. Norberg et al. (2004) elaborated it as a potential trait for the breeding purpose which depends on Na^+ and Cl^- concentration of milk and udder mastitis status. Considering the importance of all these parameters and production system of dairy sheep farm, this study aimed to analyze

- The impact of birth type (BT) and season (S) on total milk yield
- The consequence of electrical conductivity (EC) of milk on total milk yield
- The relation of lactation length (LL) and lactation number (LN) with total milk yield
- The effect of ewe's production year (Y) and average daily milk yield (ADMY) on total milk yield

CHAPTER II

LITERATURE REVIEW

2.1 Sheep Milk

Milk is a complete food and its history is very old which started from the age of Neolithic 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). Human beings depend on a few mammals like the cow, camel, goat, sheep and buffalo for milk. In the middle East region, the sheep and goats were considered as first domesticated animals because their managements are very facile and suitable for humans in this area. Moreover, it was a very big source of meat, milk and clothes for native people (Yildiz 2010; Barłowska et al., 2011). Cow milk has been the most popular milk consumed by humans all over the world and is the main production engine as it produced 85% of total milk following by buffalo (11%), goat (2.3%), sheep (1.4%) and camel (0.2%) (FAO 2015).

Despite being unpopular, sheep milk has some of the important merits that the cow's milk lacks. The sheep milk possesses small fat globules, the homogenous milk and high butterfat with high digestibility and prevents from cholesterol problems as compared to cow milk. 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. The products of sheep milk like fine cheese varieties, yogurt and whey cheeses are highly acceptable as compared to other domesticated animals (Haenlein and Wendorff, 2006; Park et al., 2007; Milani and Wendorff 2011). This level of fine quality cheese and other products production is due to high levels of protein, fat, and calcium by the casein unit in sheep milk (Moatsou et al., 2004). 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). Due to high healthy content, 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).

On the base of beneficial uses of sheep milk and the need for the growing 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.

2.2 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 Awasi, Aouasse, El Awas, Oussi, Ussy, or Iwessi while in Turkey it is known by Ivesi 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 (Mason, 1967; Epstein, 1985; Fahmy and Shrestha, 2001; Hailat, 2005; Galal et al., 2008; Haile et al., 2019).

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 and Juma, 2005; Khazaal, 2005; Kassem, 2005). It has fatty and medium in size tail which hangs down up to hocks with two clear lobes formation (Gürsoy, 2005; Galal et al., 2008). 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; Ozyurtlu et al., 2010; Talafha and Ababneh, 2011). White Karaman has a long and slim fatty tail as compared to Awassi.

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 Dağ, 2017). The 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 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 noticeable 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 weightiest body shape, significant milk production ability and excellent fertility with twining rate as compared to the entire Awassi population (Galal et al., 2008).

Galal et al. (2008) revised the literature and study of Epstein (1985) for a complete description of Awassi sheep and their improved forms so far. They 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 steppe to the highly intensive system. Performance variation completely depends on the strain, production system and environmental variation. They 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 as a triple purpose breed but it's a very famous type of rearing is as a dairy sheep. In improved Awassi sheep the heritability estimation for milk yield is lower but the contribution of non-additive genetic effect is high. More than 30 countries of the world imported Awassi sheep as a milk breed from their native regions because of its good ability to adapt to the environment and feeding fluctuations.

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. They 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. Hormones like progestins, PGF2α and gonadotropins can be used for estrous synchronization and estrous induction and this breed has an average of 152 days of gestation length. The Awassi is the best dairy sheep of the Middle East region.

2.3 Milk Trait of Awassi Sheep

Özyürek (2020) reported that Turkey has a total of 35 million and 194000 heads of sheep in 2018 and 1 446 412 tons of milk can be produced from 18 820000 heads of milking sheep. He also elaborated on the average lactation milk yield as it 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, 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.

Awassi ewe can produce an average of 60-80 liters milk with lactation length of 150 days under different methods of production while an improved Awassi ewe can yield 504 ltr 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 managements like 100-150 kg to 250-300 kg in a rural area to modified flocks respectively. The crossing of Awassi with 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. They used 63 ewes of Awassi breed within a range of 2-3 years of age and started milking after 30 days of parturition. Sweden method and test-day records were used for assessment of the lactation period and lactation milk yield from data. They 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.

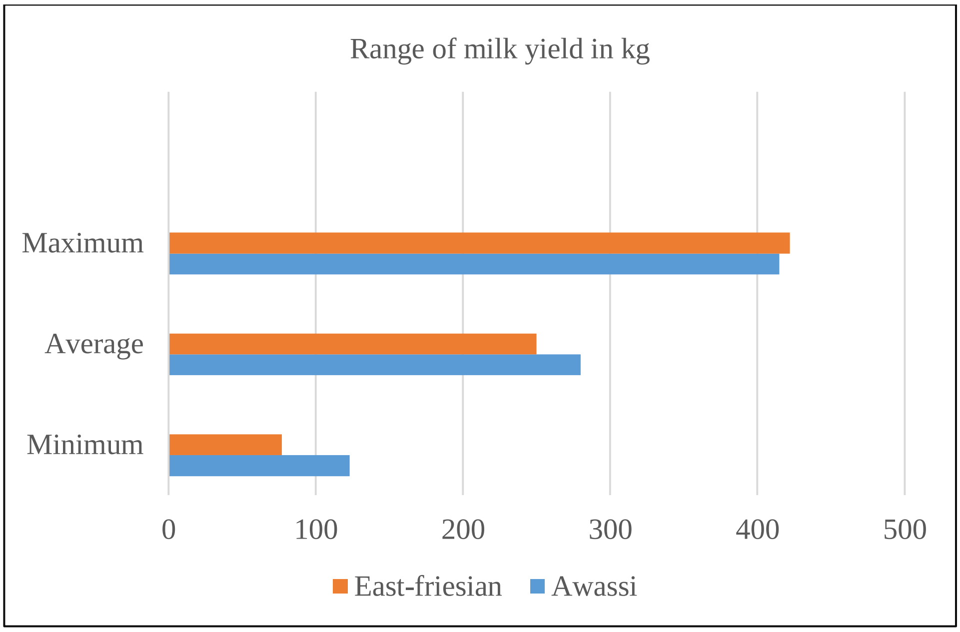

Figure 2.1. The ranges of milk yield in Awassi and East Friesian (Pacinovski et al., 2006)

2.4 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% of exotic and crossbreeds (Üstüner and Oğan, 2013). Özyürek (2020) reported that Turkey has a total of 35 million and 194000 heads of sheep in 2018 and Awassi sheep has its 3.5% portion (Galal et al., 2008). In Turkey, the ewes' milk share about 8.8% and Awassi breed have 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 high milk yield, high lamb growth and developmental properties. Awassi sheep possess specific quality like high milk yields as compared to native breeds.

Table 2.1. Turkey's native breeds with average milk yield per lactation excluding the suckling period (Aytekin and Öztürk, 2012)

Native Breeds of Turkey		
1	Awassi	100-150
2	Karayaka	30-50
3	Dağlıç	30-35
4	Morkaraman	40-50
5	Akkaraman	40-45

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. There are some experimental studies are performed on Awassi sheep under an intensive management system in the same region of this study and these published studies confirmed its suitability to this area. 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 Oğan (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 on these factors. The estimation of fertility parameters were as heat rate 100%, pregnancy rate 93.8%, Parturition rate 90.5%, single born rate 79.7%, twinning rate 20.3%, abortion rate 1.4%, lamb rate 108.8% and no. of lambs/parturition was 1.2 % respectively. The lambs' survival rates were 88.3% at the age of 60 days of age while it was 84.5% at the age of 120 days of age. The average lactation length of Awassi sheep was 184.3 ± 2.11 days and average milk production was 196.5 ± 5.60 kg. During the complete span of the experiment, the death and slaughter rate of animals was 8.2%. The environmental factors had not effected the lactation duration but the age of ewe and production year had a significant effect on lactation milk yield. The basic 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.

2.5 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 conditions. The main types of husbandry systems of Turkey are intensive, semi-intensive and extensive.

The intensive system is a specialized system of breeding and rearing of animals in which animals 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, litter size, lactation length and milk electrical conductivity etc under intensive 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 Chios (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. Cyprus fat-tail ewe was mediocre in almost all traits as compared to Chios and Awassi sheep but sophisticated in the production of protein and fat contents. The milk trait was significantly affected by lactation number and higher production result had shown in 4^{th} lactation. Production of Crossbred of Awassi and Chios was higher as compared to their pure breeds.

Dhaoui et al. (2018) proposed a study to analyze the composition of milk and total milk yield in prolific D-man sheep and the effect of some non-genetic factors on total milk yield. They had been selected as an intensive oases management system of southern Tunisia with 80 lactating D-man sheep for analytical observation. 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 lactoscan can be used for the estimation of complete chemical values or composition of milk. They used the Fleischmann method to determine the total milk production, fat, protein and other components of milk. The estimated daily averaged milk yield was 1.64±0.02 liter and lactation showed its peak at the third and fourth weeks of lactation which decreased gradually from 10 weeks of lactation.

According to his observation, the production values of protein, fat and total milk were 5.26±0.12 kg, 9.23±0.26 kg and 128.91±3.14l kg respectively. The values of other components were 16.17% of total solids, 4.32% of lactose, 7.08% of fat, 4.04% of proteins, 9.09% of solids-not-fat and 0.73% of ash. Daily milk yield and milk composition effected by lambing season as in autumn the fat and protein were estimated as high figures while in winter the total solids, lactose, ash and solids-not-fat were higher as compared to summer and autumn.

Ewes with single lamb produced less quantity of milk as compared to a ewe with multiple lambs. The milk total proteins were on the highest value in triplets or more lamb nursing ewes while the value of total solids and the fat was lowest. The young and old ewes produced less milk as compared to adult ewes and adult ewe milk contained high values of ash level, fat and total solid as compared to young ewes. The ewes with symmetrical udder produced more and less concentrated milk as compared to ewes with asymmetrical udder shape. There is a negative correlation between daily milk yield and fat, protein and total solid amount while the amounts of fat, protein and total solid were positively correlated to litter survival at weaning.

Turkyilmaz & Esenbuga (2019) defined a case study on cross-bred of Turkish indigenous Morkaraman (M) ewes with prolific Romanov (R) rams to determine the effect of semi-intensive feeding system on some reproduction and performance traits like carcass characteristics of offspring and growth rate. The difference between M and R×M for the number of ewes lambing had no significant value while the difference for the number of alive lambs born, no. of weaned lambs and the number of surviving lambs were significant. The lambs of Pure M breed had 3.71kg/average birth weight, 17.91kg/weaning weight and 23.93kg/post-grazing weight while lambs of cross R×M had 2.89kg/average birth weight, 17.14kg/weaning weight and 22.32kg/post-grazing weight.

The difference between Lambs' birth weights and at the end of the grazing period was significant for M and R x M. Differences between M and R × M in the slaughtering weight of lambs, the fat tail, organs and hot and cold carcass were significant. Moreover, the R × M had a shorter longissimus dorsi area as compared to M lambs. So it was cleared by this study the R × M cross-bred lambs had lower growth rate, low slaughter values and fewer carcass characteristics than pure M lambs. Under this climate and managemental conditions of the area, purebred M was suitable as compared to R×M crossbreds.

2.6 Effect of Lactation Number and Lactation Length on Sheep Milk Yield

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 base 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 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.

Snowder and Glimp (1991) had done a study to define the impact of lactation stage and lambing number on milk production and lamb growth in the range area. For lamb growth and milk production estimation, they used 118 multiparous ewes of Rambouillet, Columbia, Polypay, and Suffolk breeds within the age of three to seven years and they reared ewes under spring stage and mountain meadow grazing from 28-90 days after parturition. Suffolk ewes had higher daily milk yield as compared to other breeds due to lamb suckling weight difference. The total projected yield of Rambouillet, Columbia, and Polypay breeds with twins was higher as 13-17% as compared to single lamb ewes while in Suffolk breed with twins produced 61% more milk as compared to ewes with single suckling lamb. By comparing the stages of lactation, in early lactation, the twins fetched less differential in dam milk yield. Milk contents like P, Ca and protein did not affect by the number of lambs. In twins suckling ewes, there was a fat elevation of 14% and 20% in colostrum milk and 4^{th}-day milk respectively than single suckling ewes. Rambouillet, Columbia and Polypay ewes lose less body weight as compared to Suffolk breed under these range environments. There were positive and significant correlation coefficients between lamb growth and milk production and there was less association of growth rate with milk production for twins as compared for single lambs.

Sakul and Boylan (1992) proposed a lactation trail of a five-year duration in which they had evaluated the daily milk yield, total milk yield and milk contents (protein, fat, lactose, and total solids) of different standards and synthetic sheep of USA. They used 7 standards like Romanov (Ro), Suf- folk (S), Targhee (T), Dorset (D), Finnsheep (F), Lincoln (L), Rambouillet (R) and 3 synthetics breeds of sheep (Synthetic I (F × L), Synthetic II (D × R) and Synthetic III (F × L) X (DXR) for analysis. All traits for whole breeds categories shown a significant difference after thirty days of the weaning but lactose and fat percentage were not highly significant. The calculated average daily milk yield within 122 days of duration was 65.51 liters and 553 ml average daily milk yield while principle milk yielder was Suffolk with 83 liters of total average milk yield and 680 ml of average daily milk yield. Among all these, the Romanov was recorded as the lowest milk yielder with 35 liters of total milk yield and 299 ml of daily milk and second-lowest was synthetic I. Milk fat content average was 6.0 % but the most excellent performance in this field was of Suffolk with the production of 6.6 % fat and followed by Dorest with a fat value of 6.5 %. The synthetic 1 produced the lowest value of fat (5.6%) in milk. The highest rank of protein content was 6.1 % produced by multiple breeds of sheep-like Dorset, Romanov and Synthetic II while the average protein had a value of 5.8 %. The lowest milk protein and lactose were produced by Finnsheep as 5.4 % and 4.7 % respectively and ranked second lowest position according to total solid 16.8 % but Rambouillet produced the highest value of fat content (4.9 %). Dorset was excellent for total solids as it produced 18.2 % while the average value of total solids content was 17.4 % and 4.8 % of lactose. Three names of sheep-like synthetic III, Targhee, and Lincoln were in intermediate rank concerning all traits. They concluded that milk production traits in the U.S breeds shown variations and these breeds produced low quality and quantity milk as compared to the middle east and Europe dairy sheep breeds.

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. They described that for the aim of high quality and quantity of milk production, some kind of factors can be controlled like environmental, nutrition and management by the farmer but genetic factors are very difficult to manipulate. 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. In milking flock, the appropriate milking method and regularly milking is the priority to obtain high-quality milk. 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.

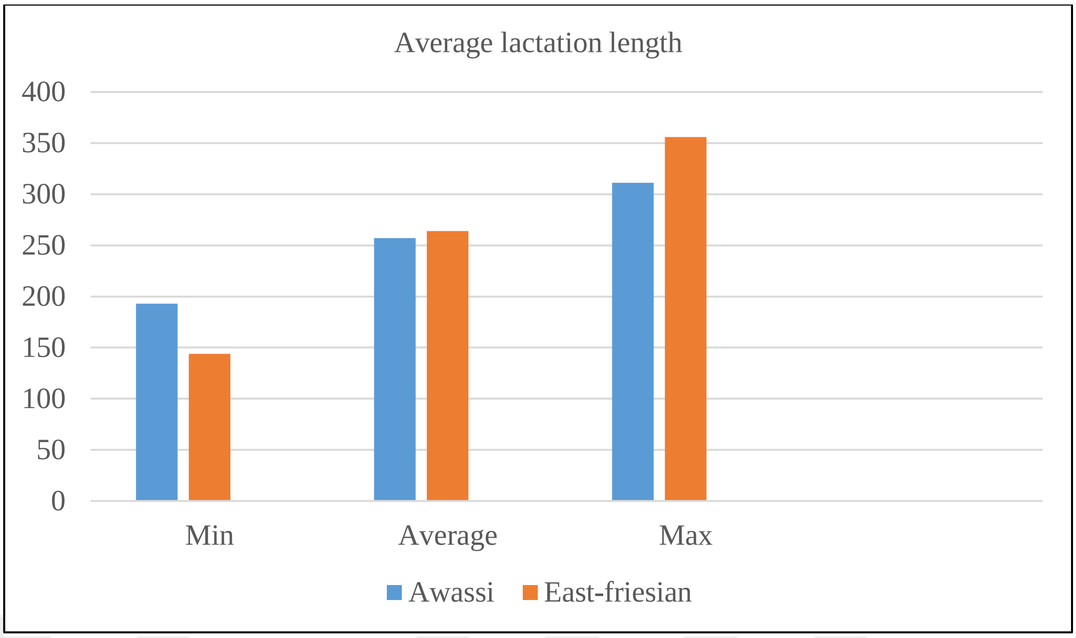

Figure 2.2. The ranges of lactation length in Awassi and East Friesian (Pacinovski et al., 2006)

Gootwine and Pollott (2000) had done a study in which they 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. 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 peak milk production value which attained on the 45th day of lactations and 3.9 liter was maximum milk yield per day. The rate of milk yield was increased by 62 g/day from lambing day to mid of lactation and deceased at 16.5 g/day from mid-lactation to end of lactations. All investigated parameters of lactations had significant effects of 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.

Basdagianni et al. (2019) evaluated some reference lactation lengths and finalized an appropriate lactation length for Chios sheep breed. They 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. In each reference lactation, the milk production's heritability and repeatability and its genetic correlation were estimated with actual lactation milk production. The milk production at 1st test day record and reference lactation milk production were correlated. For milk production, the latter emulates genetics improvements that were accomplished on the base of initial lactation selection. Long reference lactation lengths like 180-230 days got favor from repeatability and heritability. This heritability and repeatability were estimated for reference lactation milk production and genetics correlation with actual lactation production but in short lactations (120-170), there was a high correlation with 1st test day record milk production. On the evaluation results base, they recommended 220 days lactation length for overall Chios breed after lambing and 190 days lactation length for the first lactation. They described that genetic evaluation and comparison of the flock and managemental activities can be achieved by definition and formation of reference lactation length as it is a supreme tool for breeding programs.

Konečná et al. (2019) aimed a study to judge some changes in the milk of Lacaune ewes within the complete course of lactation. The evaluated experimental changes that are milk composition, milk yield, pH, acidity, curd quality and coagulation time of milk produced by ewes (n=8) under intensive management system. Daily milk yield and basic milk contents received definite effect by lactation stage while fat contents and daily milk yield were relatively high within the complete duration of lactation especially these trends are very clear in intensive nutrition conditions. Milk acidity had shown conclusively while pH showed an inconclusive effect with the stage of lactation. Except for the coagulation time, other all parameters of milk showed inconclusive correlation with the pH of the milk. Most correlations of coagulation time (CT) and curd quality (CQ) were inconclusive with SL (lactation stage) and there was also an inconclusive effect between all monitoring factors and titrable acidity. Good health and correct nutrition of intensive management were key points of balance values of coagulation time and curd quality during lactation in the whole experiment.

2.7 The Effect of Birth Type on Sheep Milk Yield

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.

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 the effect of some fixed factors of total milk yield and test-day milk yield in 938 lactations of Awassi sheep from 2001 to 2004 with the estimation of the repeatability and heritability for every trait.

The effects of ewe age, birth type and number 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. The year of lactation and ewe weaning weight affected significantly ($P< 0.0001$) to total milk yield and test-day milk. The total milk yield had 0.26 ± 0.094 value heritability and 0.27 for repeatability while TDM had shown estimation values 0.27 ± 0.96 for heritability and 0.35 for repeatability. The breeding values were measured for 681 ewes and 68 rams and it ranged between 205.1 kg and 441.2 kg for total milk yield and 1.2 kg and 2.95 kg for test-day milk. There was a huge significant spearman's rank correlation (0.51) between breeding values of milk yield traits. Total milk yield had real producing abilities range between 123.969 kg and 216.224 kg while the value of range was 0.525 kg and 1.386 kg for test-day milk. With the help of selection, 10.3 kg/year value was estimated as expected genetic gain while the genetic trend in this study was very non-significant and opposite to the phenotypic trend.

Prpić et al. (2016) proposed a study about the relationship of birth type of East Friesian ewes and milk yield with udder morphological health. They had chosen 80 sheep ewes from the 2^{nd} to 4^{th} lactation without any mastitis signs of the udder. 3 specific days per lactation were selected as sample days and measured the contents of milk. Twins and triplets lambs promised for high milk yield by their related ewes as compared to single lambed ewes. The udder size of ewes for twins and triplets had heavier size and good health status as compared to ewes with single lambs. The teats of ewes with single lambs were cranially oriented than multi-lamb ewes. The mastitis status was higher in multi-lambs ewes as compared to single lambs ewes.

Kasap et al. (2019) defined a study on Istrian dams to predict the effect of litter size and parity on dairy traits. They analyzed multi-number of dairy traits as daily milk yield, fat yield, fat content, protein yield, lactose yield, lactation milk yield and lactose contents. They 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 effected significantly by parity as ($P<0.001$). 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. Fat content had shown a non-significant effect by birth type while other all investigated traits had a significant effect by litter size ($P<0.01$, $P<0.001$). They described that multiple litters always yield high milk quantity and dry matter components and they added that such types of studies are helpful for proper farming and understanding the contribution of different dairy traits.

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 year age for the study and evaluated their lambs for 12 weeks. The ewes were grouped on the base of 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 or low weight produced a high amount of milk with twins number of lambs.

2.8 The Effect of Milk Electrical Conductivity (EC) on Sheep Milk Yield

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 condition and electrical conductivity is the very best tool to measure the 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 base on different factors like lactation number, lactation stage, time of milking and season. The range of milk EC was variable in different studies on the base of 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 a decrease in 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, they studied the relation of EC with milk macro composition and somatic cell count (SCC) of milk. EC and SCC were significantly effected 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.

Uhrinčat et al. (2019) proposed a study to detect the mastitis status in sheep milk of the Slovakia region on the base of the relation between somatic cell count (SCC), electric conductivity (EC) and bacteriological examination of the udder. The samples were collected from 295 sheep on the base of 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. They 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 EC measuring meter on the Robotic milking parlor.

2.9 The Effect of Season and Production Year on Sheep Milk Yield

The effect of season on milk yield has been studied very briefly from previous some decades especially on sheep, goat 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 on the base of 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. They designed predicted lactation curves per age at lambing and season by fitting a mixed model on 10866 records of 1740 lactations. The model was consist of year-month-flock interaction of test day through a fixed effect. 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.

Papaloukas et al. (2016) investigated the effect of season on fatty acid production in the milk of ewe from the dairy farm of Greece region. They took 760 samples from the different seasons as winter (147 samples), spring (314 samples) and summer (299 samples). The sample from the summer group had low saturated fatty acids and a high concentration of linolenic acid. In conclusion, the availability of fodder according to the nature of season can significantly affect the daily milk yield in ewes. The pasture of extensive management systems in the season highly contributed to the high quality and quality of milk.

Abecia et al. (2017) proposed a study to evaluate the effect of production year after dividing it into 5 different phases on the base of weather. They took 609 dairy sheep from a Spanish farm and divided them into five groups on the base of lambing time like FEB (n=124); APR (n=141); JUL (n=114); SEP (n=102), and NOV (n=128). They also divided the lactation into three-stages as early, mid and late lactation. They 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.

2.10 Related Studies on Animals Other Than Sheep

It is very obvious the other dairy animals are reared for milk production and they are affected by the same factors. Some studies described the same environmental factors in animals other than sheep as estimated in this study. The dairy animal's main purpose is milk production and uplifts the economy of the country and farm. The dairy industry provides livelihood to many humans as equally as the need for food and comfort for high production. The environment and feeding system always play a significant role in the understandable milk production of dairy animals. So other animals have the same system of milk production and variation in milk production as sheep shown in this study.

Kumar et al. (2017) designed a study to estimate the milk yield in cattle affected by some seasonal factors. They used Hariana and Sahiwal cows reared under sub-tropical conditions of Indian regions. All parameters and factors were observed in 6 cows and the result was significant for milk yield. The milk yield and all other physiological parameters were increased in summer seasons which directly depend on the ambient temperature.

Zamuner et al. (2020) proposed a study on the lactations of Australian dairy goats to identify the effect of some crucial environmental factors on milk yield. These environmental factors were the month of kidding, parity and litter size. They divided the lactation into three groups as early lactation (kidding to 90 days in milk; DIM), mid-lactation (91–180 DIM) and late lactation (181–270 DIM). There were 4 seasons in a row from June 2016 to March 2017 and data was collected from 940 lactations of Saanen goats of the commercial farm. The effects of the month of kidding, parity number, and litter size were observed on total milk yield, lactation groups, average lactation length, and percentage of fat and protein in milk. The estimated mean result was TMY = 519 L /goat; lactation length = 233 d, milk fat = 4.2%; milk protein = 2.9%. Every phase of lactation was effected by litter size, parity and the month of kidding in respect of milk production and there was high milk yield in February with an adverse decrease in June. There was high milk production in November kidding does as compared to March kidding while June kidding dam showed a long lactation period. There was high milk production shown in the 3^{rd} parity and there was a short lactation period in doe of more than 3^{rd} parity. There was high milk yield in twins kidder and low fat and protein percentage as compared to single kidder doe. The result indicated that the milk yield in goat significantly affected by the parity, month of kidding and season.

CHAPTER III

MATERIALS AND METHODS

3.1 Farm Location

The data used for analysis was taken from a dairy sheep farm named MeMuTa located in the Niğde region near Konya province. Niğde is ecologically located at the very best portion of Turkey with 37.97 latitudes, 34.68 longitudes and the altitude of 1243 meters above sea level. The location of the farm is a place of Turkey with a diversity of climate, agriculture and plenty of forages availability. This farm had most of the animals of Awassi breed but some crossbred animals also were present on-farm.

3.2 Analysis Material and Feeding Management

In this study, the milk data of Awassi sheep were taken with the permission of farm authority under the rules and regulations. The animals were kept in intensive management conditions along with indoor feeding of animals. The feed of animals was consist of alfalfa, wheat straw, concentrate and corn silage in the form of a mixture and ad-libitum access to water. The lactation data of 3 years from 2016 to 2018 was taken from an automatic Fullwood milking parlor for sheep 2x48 and EC data from a computerized flock management software system. The milking of the animals was regulated by a two-time method per day in the evening and morning. The average calculated weight of Awassi ewes on that farm was 65 kg and their lambs had different weights according to their ages while the ewes and lambs were kept in different pens or shed. The records of 2042 lactation from Awassi ewes were used in descriptive and inferential statistical analysis.

Figure 3.1. Fullwood milking parlor 2x48 for sheep of MeMuTa Dairy Sheep Farm at Niğde

3.3 Flow Chart of The Study

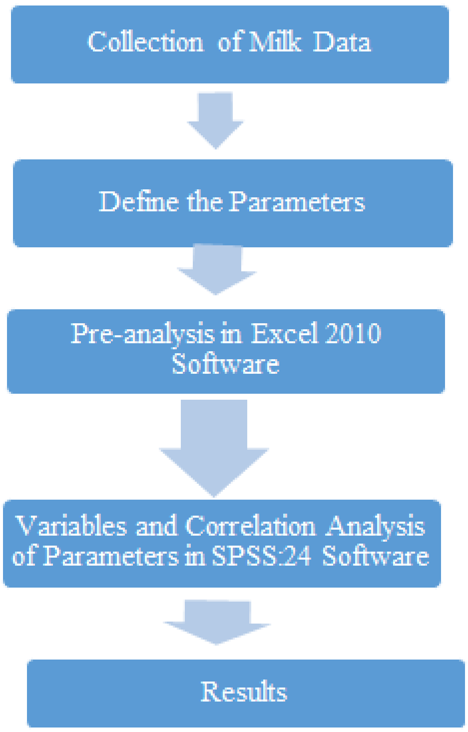

Figure 3.2. Flow chart of study

3.4 Pre-Analysis Design

To avoid a variation of the results due to the unconditional errors and improper parameters, the data was first pre-analyzed and arranged according to software demands and required evaluation. In pre-analysis, the data was arranged on Microsoft Excel 2010 software and all parameters for each factor had reformed. In pre-analysis, the animals of up to 5th lactation had selected with single or twins birth type. The animals were arranged in three years of 2016, 2017 and 2018 along with four seasons of spring (March, April, May), autumn (September, October, November), winter (December, January, and February) and summer (June, July, and August). The Lactation length is an elementary parameter which can be calculated by dry off date – lambing date and the animals with less than 80 days of lactation length were excluded from this study. The average electrical conductivity (EC) of both time milking was taken for 2042 Awassi ewe's lactations to evaluate the udder health status of animals and its effect on total milk yield. The total milk yield of animals was calculated by the sum of total lactating milk by milk machine and milk-fed by lambs during the weaning period.

The average daily milk yield was calculated as

$$\text{Avg daily Milk Yield (kg/day)} = \frac{Total\ milk\ Yield\ in\ kg}{Lactation\ length\ in\ days} \tag{3.1}$$

3.5 Analysis Method

In this study, the SPSS: 24 statistical software (SPSS, 2016 package program) was used to evaluate the effect of the season (S), lactation length (LL), average daily milk yield (ADMY), lactation number (LN), birth type (BT), electrical conductivity (EC) and production year of the ewe (Y) on total milk yield (TMY) of MeMuTa dairy sheep farm. The statistical variance analysis of these traits was done by Duncan model and general linear model through SPSS: 24 software. The lactation length (LL), average daily milk yield (ADMY), total milk yield (TMY) and average electrical conductivity (EC) were dependant variables of the evaluating-factors like season (S), lactation number (LN), birth type (BT) and production year of the ewe (Y) in the first approach of analysis. First of all, these parameters have analyzed separately to check the effect of the season (S), lactation number (LN), Birth type (BT) and production year of the ewe (Y) by analysis of variance. Then correlations between lactation length (LL), average daily milk yield (ADMY), total milk yield (TMY) and average electrical conductivity (EC) were analyzed in the second approach of analysis to obtain final results of these factors on total milk yield per lactation in ewes of this farm.

CHAPTER IV

RESULTS

4.1 Total Milk Yield (TMY)

Under the intensive management conditions of Mamuta dairy sheep farm, the total milk yield was a pivotal consideration of this study. The analysis of variance for factors affecting the milk yield was given in Table 4.1. and the effects of factors were significant (P<0.05) for total milk yield.

Table 4.1. The general linear model for milk yield according to evaluating-factors.

Source	Sum of Squares	Df	Mean Square	F-value	P-value
Corrected Model	2082745.219	30	69424.841	11.928	0.000
Intercept	22786632.412	1	22786632.412	3914.924	0.000
Lactation Number (LN)	474413.792	4	118603.448	20.377	0.000
Years (Y)	120761.390	2	60380.695	10.374	0.000
Season (S)	213207.083	3	71069.028	12.210	0.000
Birth Type (BT)	27335.737	1	27335.737	4.696	0.030
LN × Y	274123.516	8	34265.440	5.887	0.000
LN × S	295331.912	12	24610.993	4.228	0.000
Error	11704932.885	2011	5820.454		
Total	94515701.329	2042			

Table 4.2. The least-square means and standard errors of milk yield by season, production year, type of birth and number of lactations

Investigated Factors	n	Mean	Std. Error	Min	Max
Lactation number**					
1	219	227.65	9.01 c	69.70	543.44
2	315	228.59	6.68 b	79.79	574.74
3	141	232.99	10.98 a	87.21	501.11
4	522	206.22	4.43 c	67.46	522.93
5	845	176.67	3.51 d	69.53	509.81
Years**					
2016	703	205.22	4.50 c	67.46	543.44
2017	715	232.98	5.78 a	75.74	574.74
2018	624	205.07	5.05 b	69.53	520.10
Season**					
Spring	623	226.10	4.07 a	67.46	531.18
Summer	247	216.65	9.59 b	72.61	440.14
Autumn	588	192.14	4.94 c	69.53	497.58
Winter	584	222.80	4.07 a	71.24	574.74
Birth type*					
Single	1275	210.33	3.43 a	69.53	574.74
Twin	767	218.52	4.34 b	67.46	522.93
Average	2042	214.42	3.43	67.46	574.74

**: highly significant (P<0.01), *: significant (P<0.05), NS: non-significant

Briefly described in Table 4.2 as in this study, we took 2042 lactations of Awassi ewes from 1st to 5th LN and we found maximum lactation milk yield in 3rd LN with the mean value of 232.99±10.98 kg/L and minimum yield was in 5th LN with the mean value of 176.67± 3.51 kg/L milk (Figure 4.1). The minimum (67.46 kg) and maximum (574.74 kg) milk yield per lactation were observed in 4th LN and 2nd LN respectively. The result has revealed that the average lactation milk yield of this farm was 214.42± 3.43 that was very appropriate for intensive management of this area.

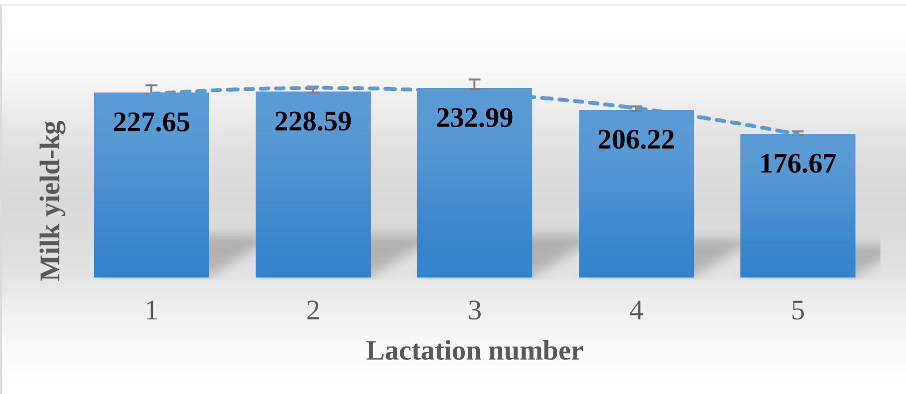

Figure 4.1. The effect of lactation number on milk yield in kg along with standard errors

Among the lactations from three production years (2016, 2017 and 2018), the lactations from 2017 produced the highest average milk yield (232.98±5.78) as compared to other production years. The maximal milk yield per lactation was denoted in the production year 2017 while minimal value was part of the production year 2016. In the LN, the level of significance was not much different in the 4th and 1st lactations and this trend was also the same for spring and winter seasons.

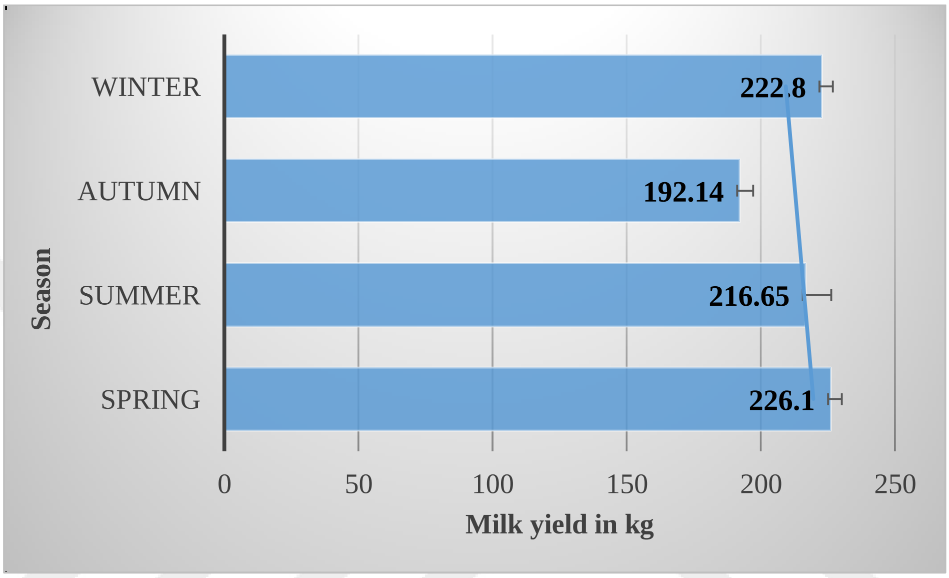

Figure 4.2. The effect of season on milk yield in kg along with standard errors

As shown in Figure 4.2 the lactations belong to the spring season produced peak milk yield per lactation (226.10±4.07) and lactations from the autumn season produced the least milk yield per lactation (192.14±4.94). Among the 2042 lactations, the milk yield per lactation of twining birthed lactations was higher as compared to lactations of single birth-giving animals. Single-birthed lactations produced an average of 210.33±3.43 kg milk per lactation while twin-birthed lactations produced an average of 218.52±4.34 kg milk per lactation. Apart from these fundamental factors, the correlation of total milk yield (TMY) was also analyzed with lactation length (LL), average daily milk yield (ADMY) and an average electrical conductivity. Moreover, the effects of these evaluating-factors on lactation length (LL), average daily milk yield (ADMY) and an average electrical conductivity (EC) were also analyzed to strengthen the correlation and attain the appropriate result for total milk yield.

4.2 Lactation Length (LL)

In this study, the lactation length is a prominent supporting factor to evaluate the total milk yield of animals. The lactation length is directly proportional to total milk yield and this study concluded the analysis of the interaction of evaluating-factors like the season, lactation number, birth type and production year on the lactation length. Under the conditions of intensive management dairy sheep farm and analysis of variance, the lactation length is significantly (P<0.05) effected by the season (S), lactation number (LN), Birth type (BT) and production year of the ewe (Table 4.3).

Table 4.3. The general linear model for lactation length according to evaluating-factors

Source	Sum of Squares	df	Mean Square	F-value	P-value
Corrected Model	815927.174	10	81592.717	34.101	0.000
Intercept	46101966.518	1	46101966.518	19268.073	0.000
Lactation number (LN)	615949.061	4	153987.265	64.358	0.000
Years (Y)	23422.756	2	11711.378	4.895	0.008
Season (S)	81153.193	3	27051.064	11.306	0.000
Birth type (BT)	11443.825	1	11443.825	4.783	0.029
Error	4859494.517	2031	2392.661		
Total	87123187.000	2042			
Corrected Total	5675421.691	2041			

Table 4.4. The least-square means and standard errors of lactation length by season, production year, type of birth and number of lactations

Investigated factors	n	Mean	Std. Error	Min	Max
Lactation number**					
1	219	237.63	3.65[a]	82	432
2	315	212.25	3.03[b]	85	401
3	141	223.51	4.30[a]	103	452
4	522	195.29	2.32[c]	95	409
5	845	181.68	1.83[e]	69	439
Years**					
2016	703	212.03	2.23[b]	69	452
2017	715	213.40	2.31[a]	95	452
2018	624	204.80	2.37[a]	69	436
Season**					
Spring	623	212.29	2.10[a]	69	452
Summer	247	201.91	3.38[b]	102	399
Autumn	588	205.89	2.35[c]	82	409
Winter	584	220.20	2.22[a]	87	436
Birth type*					
Single	1275	207.44	1.57[a]	82	452
Twin	767	212.70	2.24[b]	69	439
Average	2042	210.07	1.51	69	452

**: highly significant (P<0.01), *: significant (P<0.05), [NS]: non-significant

The results of this study revealed that the average lactation length in this analysis was 210.07±1.51days which was one of the optimum average lactation lengths for Awassi ewes. The longest average lactation length (237.63±3.65 days) was observed in the animals of 1st LN while the shortest lactation length (181.68±1.83 days) was calculated in the 5th LN. The longest lactation period by a single animal (452 days) was observed in 3rd LN while short lactation length by single animals (69 days) was observed in the 5th LN.

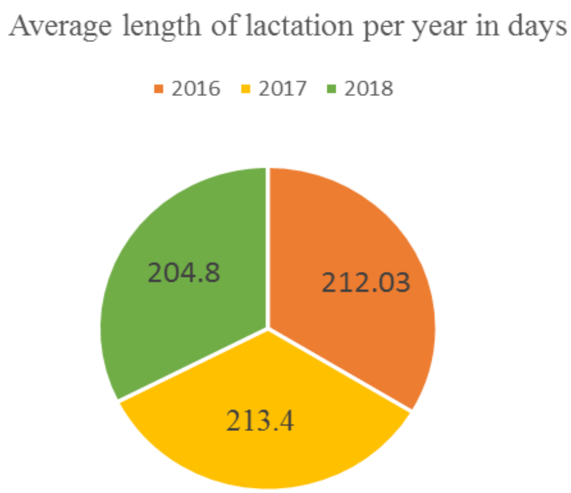

Figure 4.3. The effect of production years on lactation length in days along with standard errors

Among the 2042 lactations, the lengths of lactation were long for 2016 and 2017 production years as compared to the 2018 production year (Figure 4.3). The minimum lactation length by a single animal was also observed in 2018 while maximum lactation length per single animal was observed in 2016 and 2017 as well. In this study, the shortest average lactation length (201.91±3.38 days) was evaluated in the summer season while the longest average lactation length (220.20±2.22 days) was observed in the winter season. Besides the other factors, the season effect was different than others because minimum lactation length per animal and maximum lactation length per animal were observed in the same season as in Spring and average lactation length of the spring season was 212.29±2.1 days.

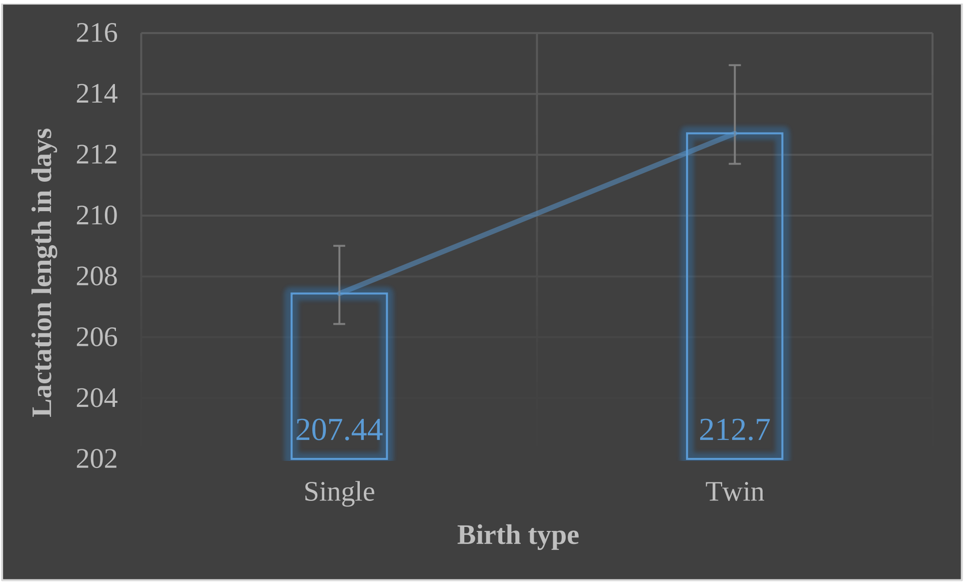

Figure 4.4. The effect of birth type on lactation length in days along with standard errors

The Average lactation length for animals with twin-birthed (212.702.24 days) was higher than animals with single-birthed (207.44±1.51) as shown in Figure 4.4.

4.3 Average Daily Milk Yield (ADMY)

The average daily milk yield is a key factor to calculate total milk yield per lactation and it supports expressively to evaluation the rudimentary effect of evaluating-factors on total milk yield. The average daily milk yield is directly proportional to the total milk yield of animals. Under the conditions of our study and analysis of variance, the effect of LN and S was significant ($P \leq 0.05$) on ADMY while ADMY was not affected significantly ($P \geq 0.05$) by BT and production years (Table 4.5).

Table 4.5. The general linear model for average daily milk yield according to evaluating-factor

Source	Sum of Squares	Df	Mean Square	F-value	P-value
Corrected Model	20.889	24	0.870	8.082	0.000
Intercept	709.295	1	709.295	6586.260	0.000
Lactation Number (LN)	1.806	4	0.452	4.193	0.002
Years (Y)	0.617	2	0.308	2.863	0.057
Season (S)	0.943	3	0.314	2.920	0.033
Birth Type (BT)	0.018	1	0.018	0.168	0.682
LN × Y	4.432	8	0.554	5.145	0.000
Y × S	2.321	6	0.387	3.591	0.002
Error	217.217	2017	0.108		
Total	2301.825	2042			

Table 4.6. The least-square means and standard errors of average daily milk yield by season, production year, type of birth and number of lactations

Investigated Factors	n	mean	Std. Error	Min	Max
Lactation number**					
1	219	0.826	0.0202[b]	0.3192	1.7531
2	315	1.048	0.0188[a]	0.3467	2.7569
3	141	1.057	0.0278[a]	0.4320	2.4100
4	522	1.015	0.0159[a]	0.3189	2.9268
5	845	1.021	0.0113[a]	0.2341	2.6121
Years [NS]					
2016	703	0.977	0.0124[b]	0.3189	2.9268
2017	715	1.072	0.0127[a]	0.3467	2.5909
2018	624	0.961	0.0138[b]	0.2341	2.6121
Season*					
Spring	623	1.038	0.0137[a]	0.3189	2.1636
Summer	247	1.038	0.0231[a]	0.3946	2.9268
Autumn	588	0.928	0.0133[b]	0.2341	2.5909
Winter	584	1.035	0.0141[a]	0.3189	2.1636
Birth type [NS]					
Single	1275	0.990	0.0096[a]	0.2341	2.9268
Twin	767	1.031	0.0123[b]	0.3189	2.3197
Average	2042	1.005	0.0076	0.2341	2.9268

**: highly significant (P<0.01), *: significant (P<0.05), [NS]: non-significant

Briefly described in Table 4.3.2 as the minimum value (0.928±0.01 kg) of ADMY was observed in Autumn while the other spring and summer showed almost constant value (1.038±0.03 kg) of ADMY. The ADMY of this study under intensive management conditions was 1.005±0.007 kg that was a very considerable result of production per day.

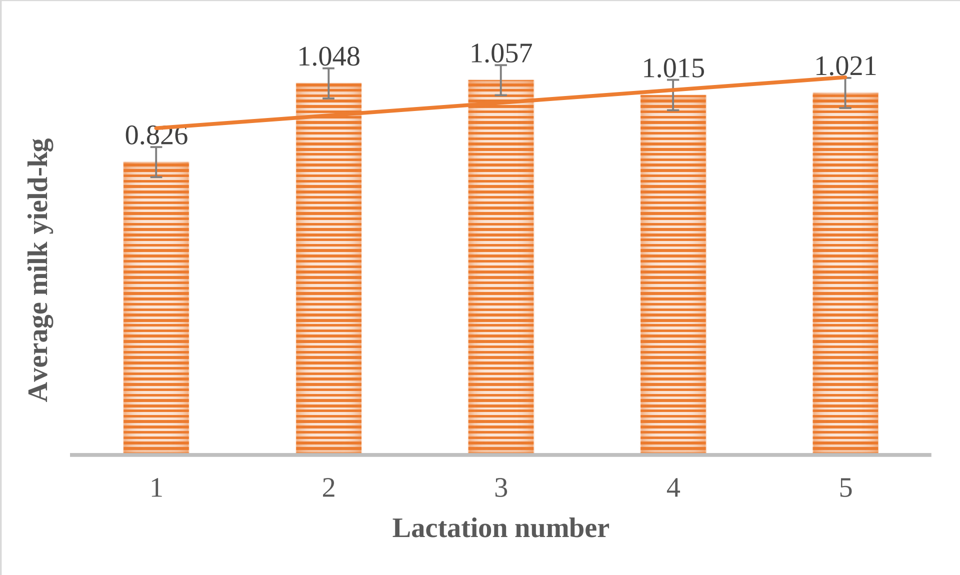

Figure 4.5. The effect of lactation number on ADMY in kg along with standard errors

Among the 2042 lactations, the animals from 3rd LN showed maximum production of average daily milk (1.057±0.02 kg) and in contrast to it, the minimum average daily milk yield (0.826±0.02 kg) was observed in animals of the first LN (Figure 4.5).

4.4 Average Electric Conductivity (EC)

Under the conditions of this study and analysis of variance, the EC significantly (P≤0.05) affected by season, birth type and production year but not affected by lactation number (Table 4.7).

Table 4.7. The general linear model for average electric conductivity according to evaluating-factors

Source	Sum of Squares	Df	Mean Square	F-value	P-value
Corrected Model	287.241	18	15.958	24.108	0.000
Intercept	70568.877	1	70568.877	106609.197	0.000
Lactation Number (LN)	4.178	4	1.044	1.578	0.178
Years (Y)	104.133	2	52.067	78.658	0.000
Season (S)	50.353	3	16.784	25.356	0.000
Birth Type (BT)	6.620	1	6.620	10.001	0.002
Y × S	39.826	6	6.638	10.027	0.000
Y × BT	4.488	2	2.244	3.390	0.034
Error	1339.104	2023	0.662		
Total	153493.992	2042			

Table 4.8. The least-square means and standard errors of average electric conductivity by season, production year, type of birth and number of lactations

Investigated factors	n	Mean	Std. Error	Min	Max
Lactation number NS					
1	219	8.54	0.042[bc]	3.16	10.18
2	315	8.41	0.054[c]	3.86	11.45
3	141	8.56	0.047[bc]	7.16	11.10
4	522	8.55	0.039[bc]	5.12	11.74
5	845	8.78	0.033[a]	3.16	11.77
Years**					
2016	703	8.27	0.032[c]	3.16	11.59
2017	715	8.73	0.032[b]	3.16	11.77
2018	624	8.90	0.035[a]	7.11	11.58
Season**					
Spring	623	8.73	0.038[a]	3.16	11.77
Summer	247	8.52	0.056[b]	5.12	11.55
Autumn	588	8.34	0.031[b]	6.18	11.59
Winter	584	8.84	0.036[a]	3.86	11.61
Birth type**					
Single	1275	8.57	0.023[a]	3.16	11.77
Twin	767	8.72	0.035[a]	3.16	11.57
Average	2042	8.62	0.020	3.16	11.77

**: highly significant (P<0.01), *: significant (P<0.05), NS: non-significant

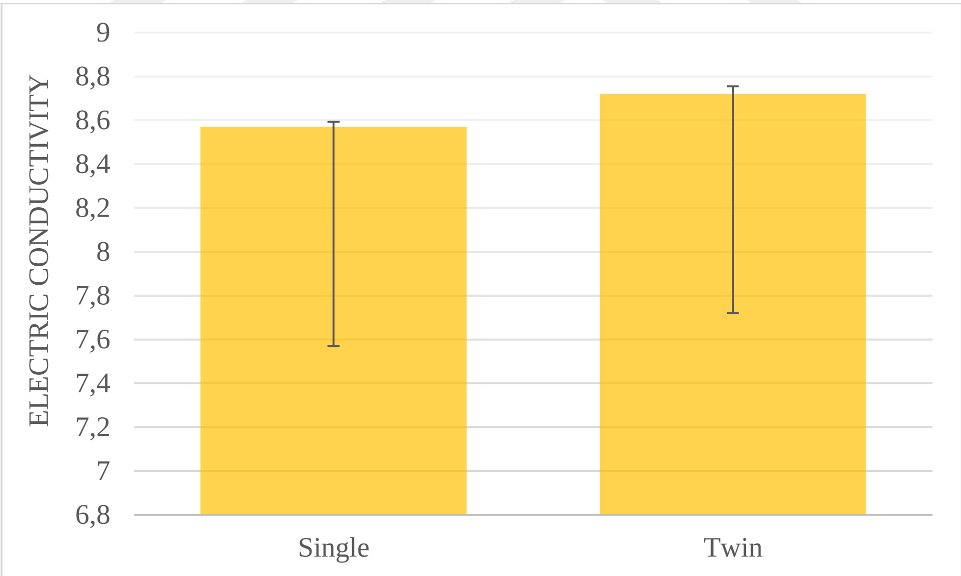

Figure 4.6. The effect of birth type on EC in milliSiemens (mS) along with standard errors

Briefly, the average mean EC of this farm was higher (8.62±0.02 mS/cm) as compared to many other studies and the highest average EC was observed in lactations of the winter season (8.84±0.3 mS/cm) while lowest was present in lactations of the autumn season (Table 4.4.2). The average EC of twin-birthed animals was higher as compared to single-birthed animals (Figure 4.6). Moreover, the lactations of 2018 had higher average EC and the lowerest of average EC was observed in the year 2016.

4.5 Correlation

After estimation of the effect of S, LN, BT and Y on different dependent factors like on LL, average EC, ADMY and TMY by analysis of variance through SPSS: 24 software. The point of worth was to an estimation of correlation between lactation length (LL), total milk yield (TMY), average daily milk yield (ADMY) and electric conductivity (EC) for assessment of the basic effect of these evaluating-factors on milk yield of this farm's animals.

Table 4.9. Pearson correlation between total milk yield, lactation length, average daily milk yield and electric conductivity

	LL	**TMY**	**ADMY**	**EC**
LL	1	0.536**	-0.108**	-0.086**
TMY		1	0.752**	-0.006 NS
ADMY			1	0.052*
EC				1

****: highly significant (P<0.01), *: significant (P<0.05, NS : non-significant (P>0.05), LL**: Lactation length, **TMY**: Total Milk Yield, **ADMY**: Average daily milk yield, **EC**: Electric conductivity

Finally, the effect of the season (S), lactation number (LN), birth type (BT) and production year of the ewe (Y) on TMY was significant separately and the correlation of each parameter's 2042 observations for total milk yield (TMY) between average daily milk yield (ADMY), lactation length (LL) was highly significant and positive while non-significant for average electric conductivity (EC) (Table no. 4.5.1). The correlation between other traits like ADMY, LL and EC was negotiable but our ultimate goal was to predict the effect of evaluating-factors on TMY.

So at the end of the analysis of this data, we estimated that major evaluating-factors like spring season, twin-birth, 3rd lactation number and the 2017 production year gave the highest total milk yield. The effect of BT and Y for ADMY and LN for EC was non-significant but most of the factors were significant and most important the correlation result of these dependent factors was positive with total milk yield expect electric conductivity which proved that the effect of these all was considerable for milk yield.

CHAPTER V

DISCUSSION

Many studies had been performed on these environmental parameters for assessment of milk in Awassi ewes even other sheep breeds. The average lactation milk yield from previous studies was considered for almost 90-170 kg with 190-210 days period of lactation length. This study was performed under the intensive management conditions of feeding and rearing at MeMuTa dairy sheep farm near to Niğde region. In which we found that the average lactation milk yield of ewes was 214.42± 3.43 kg which was a good production status of Awassi ewes. The production status of improved Awassi ewes can be higher to this on the base of a production unit, management conditions and breed improvement criteria. The average daily milk and average lactation length for this study were 1.005±0.007 kg and 210.07±1.51 days respectively that are also shown an appropriate mark of the production unit. The correlation between parameters like ADMY, LL, TMY and EC were highly significant and positive but the correlation of TMY and EC was negative which is obligatory because there is a negative relationship between TMY and EC as electric conductivity (EC) badly affect the udder health in the form of somatic cells count (SCC).

The results of this study were higher to studies of Özyürek (2020) in which he found average lactation milk yield 47.99±9.5 kg, average LL 130.0±8.02 days and ADMY 348.92±52.5 g respectively. He claimed that the reason for the low production values of Awassi ewes was single milking of animals and an extensive production system because his result was very close to the study of Talafha and Ababneh (2011). The result of Talafha and Ababneh (2011) was also lower to this study as they found 40 to 60 kg milk per lactation of 159 days period under extensive management conditions. The correlation between average daily milk yield and lactation length for Özyürek (2020) study was similarly positive as for this study.

Kaygisiz and Dağ (2017) performed a familiar study to this study on Elite Awassi sheep flock raised in Ceylanpınar State Farm and found prominent results in milk yield and length of lactation period 244.39±73.04 kg and 173.81±16.92 days, respectively. They also revealed the effect of lactation number and birth types on total milk yield and lactation length as that was significantly similar to the study of Awassi ewes reared at MeMuTa dairy sheep farm.

Gürsu and Aygün (2014) performed a study to analysis the Awassi ewe's production under some rural area of Turkey and they found that the length of lactation period 165.46 days and average TMY 110.05 kg respectively which were less in total lactation milk production from this study according to its length of milking period. The results of their study were less due to the reason of extensive management of production. The results of the current study were high to study performed by Özbey and Akcan (2000) at Firat University, Turkey, on Awassi ewes to predict milk yield, lactation period and average daily milk yield that were 109.90 kg, 169.44 days and 640.09 g respectively.

The effect of season and production year in our study was significant on TMY and LL as similar to a study of Yıldız and Yıldız (2002) in which he concluded the similar significance level and found the 176.61±0.93 kg and 204.12±1.73 days of lactation milk yield and average LL respectively.

The LL and TMY result from the study of Ustuner and Ogan (2013) on Awassi ewe was very close to our study as they determined that average LL of 184.3 ± 2.11 days and average lactation milk yield of 196.5 ± 5.60 kg. They also claimed that the Central Anatolian Region had similar effects of lactation length and milk yield as Awassi ewes had in their native races. This last thing is very favorable to our study as its also completed in the region of Niğde province which is a part of the Central Anatolian Region.

TMY recorded herein by Awassi ewes is higher to some previous studies of Alkass et al. (2009) and Alkass and Akreyi (2016) as that were 85.64 liters and 126.22±5.03 liters respectively and their length of lactation period were 132.36 days and 169.66±2.31 respectively. The reasons behind their studies were hand milking and semi-intensive management conditions. However, this study findings concluded that the Awassi sheep of Niğde region produce less milk under intensive management conditions as compared to improved Awassi ewes of Israel (Gootwine and Pollott, 2000). Their study revealed that improved Awassi ewes of Israel region had produced 506 liters of average TMY from lactation of 214 days and they claimed for 3.44 liters of daily milk yield at peak day of production.

Many studies have proven that electric conductivity (EC) causes an indirect impression on milk production because an increase in electric conductivity always increases somatic cell count (SSC) and somatic cells count always harms milk yield (Uhrinčať et al., 2019). So the effect of electric conductivity can not be ignored for the estimation of total milk yield as a supporting factor in correlation. In this study, the average EC was analyzed to evaluate the effect of season, lactation number, birth type and production year on it and then its correlation with total milk yield per lactation was estimated.

The average electric conductivity (EC) of this study was a bit higher (8.62±0.02 mS/cm) to previous studies on sheep milk. There are very fewer studies for sheep milk EC measurements and especially its correlation between other traits of lactation affecting and milk production. Many authors have been denoted about the EC of milk with udder health of animals without correlation studies of it with different lactation affecting traits/ parameters. So this study is very unique in itself and its result is higher to the study of Caria et al. (2016) which ranged from 4.21 to 5.86 mS/cm as they performed their study on Sarda breed sheep. Romero et al. (2017) experimented with a study to evaluate the electric EC of manchega ewes to detect mammary gland health and their result was also less in value (5.73±1.31 mS/cm) than our study. The result of the Uhrinčať et al. (2019) study was also lower 5.3389±1.2836 mS.cm-1 as compared to the current study and they did this study on different breeds of sheep with hand milking sample collection.

The measurement of EC on Awassi sheep of Niğde is a novel work as there is no previous study similar to it in this specific part of Turkey and its range a bit higher to other sheep breeds. The range of EC (5.30- 6.23 mS.cm-1) is also lower in the study of Roca et al. 2019 performed in the region of Spain. The udder health status means subclinical mastitis is directly related to electric conductivity of ewe milk which needs specific attention to maintain in favorable range (4–7 mS.cm-1) for small ruminant (Martí-De Olives et al., 2015).

Most of the studies have been done on cow milk for EC measurement and denoting the status of udder health but this study has been concluded results of EC measurement on Awssi sheep breed which opens the mind for the management team of a sheep farm. This study results show that the EC of this breed is a little higher as compared to many other sheep breeds and its maintenance at a low level can enhance milk production and improve the udder health of animals.

Apart from the result of the above parameters, the effect of evaluating factors on total milk yield, lactation length, average daily milk yield and electric conductivity were also fabricated in this study and clinched that the spring season, twin-birth, 3rd lactation number and the 2017 production year have a highly significant consequence on total milk yield and their supporting parameters. We found the highest milk yield in the spring season, animals with twin birthed lambs and 3rd lactation number which is similar to the study of (Gootwine and Pollott, 2000).

Sultan (2019) proposed a study on an Awassi sheep and found twins birthed ewes produced maximum milk as compared to single birthed ewes. Alkass and Akreyi (2016) opposed to our study as they obtained maximum daily milk yield in the 5th LN but we found optimum milk yield in the 3rd LN. Alkass et al. (2009) denoted in a study the effects of season and birth type were significant on total milk as similar in this study but they opposed by mentioning the non-significant effect of these parameters on LL. The difference between these can be on the base of the production system and the region of study for Awassi breed but they supported to study of Niğde region. Awassi sheep by the conclusion of Alkass et al. (2008) study as they described that total milk yield and daily milk yield of Awassi ewe significantly affected by the type of birth, stage of lactation and lambing season.

Dhaoui et al. (2019) also support this study by measuring the same results for prolific D’man ewes in Tunisian oases. The effect of season on total milk production resembles the study of Abecia et al. (2017) on a dairy sheep farm of Spain. Carta et al. (1995) performed a study on Sarda dairy sheep and they denoted a similar effect of the season as we described in the current study. Prpić et al. (2016) detailed the BT effect on TMY of different sheep breeds of the Croatian region and concluded that the multiple birthed animals had more milk as compared to single as described in this study.

Romero et al. (2017) were named to performed a study to denote the effect of birth type on EC and found high (4.37 mS/cm) EC of twin ewes as compared single birthed ewes (4.07 mS/cm). This study is exactly similar to study performed on the MeMuTa dairy sheep farm in the Niğde region. There are very few studies available for describing the action of EC in sheep farming. So the correlation between EC and other parameters was negative but this was positive between LL, ADMY and TMY. To support this study, Gootwine and Pollott (2000) had shown some correlation patterns between ADMY, TMY and LL as we mentioned in this study. The uniqueness of this study was combinations of some milking traits and their results of production by some other parameters or factors were analyzed along with correlation. The results of this study are notable with studies of the different researchers on the base of breed type, production conditions and milking styles. That is the basic reason to generate the variations in results of milk yield for different studies and create a curriculum to understand the original production status of animals on the farm.

CHAPTER VI

CONCLUSION

The rearing conditions of Awassi sheep on the farm were intensive management along with indoor feeding, ad-libitum access to water, free movement and two time milking by milking machine with automatically electric conductivity calculation. For denoting the total milk yield of the farm, we have to analyze the milk data and effect of some factors on milk-producing traits in Awassi ewes. The effects of season, birth type, electric conductivity, daily milk yield, lactation number, lactation length and production year were measured to predict total milk yield per lactation.

Ultimately this study concluded a result for milk yield of Awassi sheep reared at MeMuTa dairy sheep farm of Niğde region and posted a reasonable figure of daily milk yield and total milk yield with a considerable length of the lactation period. This study has an appropriate average daily milk yield of 1.005±0.007 kg, an average total milk yield of 214.42±3.43 kg within a length of 210.07±1.51 days of the lactation period. These figures of results are suitable for this region and system of production according to the status of the breed but there is little need to decrease average electric conductivity which can improve udder health and production of milk as well. For this farm, the milk yield of animals was higher in the spring season and the third number of lactation that is very familiar to many studies perform on Awassi sheep of this region and out of this region as well. Some researchers oppose to results of this study which can be evaluated on the basic production system and other local criteria. The effect of birth types in this study is very similar to all other studies performed on Awassi sheep and different breeds as it shows maximum milk yield in ewes with twin-birthed lambs than single-birthed ewes.

In this study, the analysis of variance for these parameters to electric conductivity, average daily milk yield, lactation length and total milk yield was highly significant. Some parameters (lamb weight, lamb sex, ewe age and suckling period) which had been decided for pre-evaluation in this study are excluded based on the uncertainty of data and the issue of fit in for this analysis.

This study also concluded the result of the correlation between electrical conductivity and other lactating traits which is very rare in other studies of Awassi sheep. Results denoted that there was a positive correlation between lactation length, average daily milk yield and total milk yield. The negative correlation of electric conductivity and total milk yield was present in this study which is a sign of good udder health in animals.

The results of this study are excellent in respect of native Awassi breed but less than improved Awassi breed of Israel region and this thing generates a reason for the improvement in management and breeding policy of the country and local farms as well. This study provides opportunities to the new researchers to evaluate the effects of these parameters on milk yield along with the composition of milk and promote the best breed with a healthy milk composition and genetic make-up. This approach will elaborate on the genetic improvement of animals, human health by using good milk and upsurge the economy of the country to increase milk production.

REFERENCES

Abecia, J.A., Garcia, A., Castillo, L. and Palacios, C., “The effects of weather on milk production in dairy sheep vary by month of the lambing and lactation phase”, ***Journal of Animal Behaviour and Biometeorology*** 5(2), 56-63, 2017.

Albenzio, M., Santillo, A., Avondo, M., Nudda, A., Chessa, S., Pirisi, A. and Banni, S., “Nutritional properties of small ruminant food products and their role on human health”, ***Small Ruminant Research*** 135, 3-12, 2016.

Ali, W., Akyol, E., Ceyhan, A., Dilawar, S., Firdous, A., ul Qasim, M.Z. and Ahmad, M.M., “Milk Production and Composition in Camel and Its Beneficial Uses; A Review”, ***Turkish Journal of Agriculture-Food Science and Technology*** 7(12), 2142-2147, 2019.

Alkass, J.E. and Juma, K.H., “Small Ruminant breeds of Iraq: Characterization of Small Ruminant Breeds in West Asia, North Africa”, ***International Center for Agricultural Research in the Dry Areas (ICARDA)*, Aleppo, Syria** 1, 63–65, 2005.

Aytekin, İ. and Öztürk, A., “Turkey's sheep and sheep management”, ***Archiva Zootechnica*** *15*(3), 39, 2012.

Balthazar, C.F., Pimentel, T.C., Ferrão, L.L., Almada, C.N., Santillo, A., Albenzio, M., Mollakhalili, N., Mortazavian, A.M., Nascimento, J.S., Silva, M.C. and Freitas, M.Q., “Sheep milk: Physicochemical characteristics and relevance for functional food development”, ***Comprehensive Reviews in Food Science and Food Safety*** 16(2), 247-262, 2017.

Banos, G., Clark, E.L., Bush, S.J., Dutta, P., Bramis, G., Arsenos, G., Hume, D.A. and Psifidi, A., “Genomic analyses underpin the feasibility of concomitant genetic improvement of milk yield and mastitis resistance in dairy sheep”, ***PLoS ONE*** 14 (11), 214346, 2019.

Barłowska, J., Szwajkowska, M., Litwińczuk, Z. and Król, J., “Nutritional value and technological suitability of milk from various animal species used for dairy production”, ***Comprehensive Reviews in Food Science and Food Safety*** 10(6), 291-302, 2011.

Basdagianni, Z., Sinapis, E. and Banos, G., “Evaluation of reference lactation length in Chios dairy sheep”, ***Animal*** 13(1), 1-7, 2019.

Bencini, R. and Pulina, G., “The quality of sheep milk: a review”, ***Australian Journal of Experimental Agriculture*** 37(4), 485-504, 1997.

Caria, M., Chessa, G., Murgia, L., Todde, G. and Pazzona, A., “Development and test of a portable device to monitor the health status of Sarda breed sheep by the measurement of the milk electrical conductivity”, ***Italian Journal of Animal Science*** *15*(2), 275-282, 2016.

Carta, A., Sanna, S.R. and Casu, S., “Estimating lactation curves and seasonal effects for milk, fat, and protein in Sarda dairy sheep with a test day model”, ***Livestock Production Science*** 44(1), 37-44, 1995.

Carta, A., Sanna, S.R., Rosati, A. and Casu, S., “Milk yield adjustments for milking length and age-parity-lambing month interaction in Sarda dairy sheep”, ***Annales de Zootechnics, INRA/EDP Sciences*** 47(1), 59-66, 1998.

Cimen, M. and Karaalp, M., “Effect of restricted suckling time on milk components and sucking behavior of lambs”, ***Archives Animal Breeding*** *52*(3), 299-308, 2009.

Degen, A.A. and Benjamin, R.W., “Milk intake and growth rate of Awassi lambs sucking ewes grazing on natural pasture in the semi-arid Negev”, ***Animal Science*** 76, 455–460, 2003.

Dhaoui, A., Chniter, M., Atigui, M., Dbara, M., Seddik, M.M. and Hammadi, M., “Factors affecting the milk yield and composition over lactation of prolific D’man ewes in Tunisian Oases”, ***Tropical animal health and production*** 51(3), 507-518, 2019.

Epstein, H., “The Awassi Sheep with Special References to the Improved Dairy Type”, ***FAO Animal Production and Health Paper*** 57, 282, 1985.

FAO., FAOSTAT: Statistics division. Food and agriculture organization of the United Nations, http://faostat.fao.org/, 2015.

Galal, S., Gürsoy, O. and Shaat, I., “Awassi sheep as a genetic resource and efforts for their genetic improvement—A review”, ***Small Ruminant Research*** 79(2-3), 99-108, 2008.

Gootwine, E. and Pollott, G.E., “Factors affecting milk production in improved Awassi dairy ewes”, ***Animal Science*** 71(3), 607-615, 2000.

Gürsoy, O., “Small ruminant breeds of Turkey: Characterization of Small Ruminant Breeds in West Asia, North Africa”, ***International Center for Agricultural Research in the Dry Areas (ICARDA)***, ***Aleppo, Syria*** 1, 239–416, 2005.

Gürsu, G. and Aygün, T., “Some characteristics of milk yield in Awassi ewes maintained at village conditions”, ***Journal of Advanced Agricultural Technologies*** 1, 1, 2014.

Hailat, N., “Small ruminant breeds of Jordan: Characterization of Small Ruminant Breeds in West Asia, North Africa”, ***International Center for Agricultural Research in the Dry Areas (ICARDA), Aleppo, Syria*** 1, 30–61, 2005.

Haile, A., Hilali, M., Hassen, H., Lobo, R.N.B. and Rischkowsky, B., “Estimates of genetic parameters and genetic trends for growth, reproduction, milk production and milk composition traits of Awassi sheep”, ***Animals*** 13(2), 240-247, 2019.

Jawasreh, K.I.Z. and Khasawneh, A.Z., “Genetic evaluation of milk production traits in Awassi sheep in Jordan”, ***Egyptian J Sheep Goat Sci*** 2(2), 83-100, 2007.

Kasap, A., Špehar, M., Držaić, V., Mulc, D., Barać, Z., Antunović, Z. and Mioč, B., "Impact of parity and litter size on dairy traits in Istrian ewes", ***Journal of Central European Agriculture*** 20(2), 556, 2019.

Kassem, R., "Small ruminant breeds of Syria: Characterization of Small Ruminant Breeds in West Asia, North Africa", ***International Center for Agricultural Research in the Dry Areas (ICARDA), Aleppo, Syria*** 1, 183–237, 2005.

Kaygisiz, A. and Birol, Dağ., "The effect of breast type and some environmental factors on milk yield in Elit İvesi sheep", ***Journal of Agriculture and Nature*** *20* (4), 344, 2017.

Khazaal, K., "Small ruminant breeds of Lebanon: Characterization of Small Ruminant Breeds in West Asia, North Africa", ***International Center for Agricultural Research in the Dry Areas (ICARDA), Aleppo, Syria*** 1, 155–181, 2005.

Konečná, L., Kuchtík, J., Sedláková, M., Šustová, K. and Filipčík, R., "The Effect of the Lactation Stage on Milk Yield, Composition and Renneting Parameters of Milk in Sheep Reared Under Intensive Nutrition", ***Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis*** 67(1), 85-89, 2019.

Kuchtík, J., Konečná, L., Sýkora, V., Šustová, K., Fajman, M. and Kos, I., "Changes of Physico-chemical characteristics, somatic cell count and curd quality during lactation and their relationships in Lacaune ewes", ***Mljekarstvo: časopis za Unaprjeđenje Proizvodnje i Prerade Mlijeka*** 67(2), 138-145, 2017.

Kumar, Jitender., Kumar, Muneeder., Madan, A.K., Singh, Yajuvender., Yadav, Brijesh. and Anand, Muul., "Effect of season on physiological parameters and production profile of Haryana and Sahiwal cattle", ***The Haryana Vet*** 56(1), 69-71, 2017.

Martí-De Olives, A., Navarro-Ríos, M.J., Rubert-Alemán, J., Fernández, N. and Molina, M.P., "Composition, proteolysis indices and coagulating properties of ewe milk as affected by bulk tank somatic cell count", ***Journal of Dairy Research*** *82*(3), 344-349, 2015.

Mavrogenis, A.P. and Louca, A., "Effects of different husbandry systems on milk production of purebred and crossbred sheep", ***Animal Science*** 31(2), 171-176, 1980.

Mavrogenis, A.P. and Papachristoforou, C., "Genetic and phenotypic relationships between milk production and body weight in Chios sheep and Damascus goats", ***Livestock Production Science*** 67(1-2), 81-87, 2000.

Miaschi, John., "The Top Sheep Milk Producing Countries in the World", WorldAtla***s***, https://www.worldatlas.com/articles/the-top-sheep-milk-producing-countries-in-the-world.html, 2017.

Milani, F.X. and Wendorff, W.L., "Goat and sheep production in the United States (USA) ", ***Small Ruminant Res*** 101, 134-9, 2011.

Norberg, E., Hogeveen, H., Korsgaard, I.R., Friggens, N.C., Sloth, K.H.M.N. and Løvendahl, P., "The electrical conductivity of milk: the ability to predict mastitis status", ***Journal of Dairy Science*** 87(4), 1099-1107, 2004.

Özbey, O. and Akcan, A., "Akkaraman, Morkaraman ve İvesi koyunlarının yarı-entansif şartlardaki verim performansı I. döl ve süt verim özellikleri", ***Vet. Bil. Derg*** *16*, 109-120, 2000.

Özyürek, S., "Morkaraman ve İvesi Koyunlarında Meme Morfolojisi, Laktasyon Özellikleri ve Süt Bileşenleri Arasındaki İlişkinin Araştırılması", ***Gümüşhane Üniversitesi Fen Bilimleri Enstitüsü Dergisi*** 10(1), 268-274, 2020.

Ozyurtlu, N., Kucukaslan, I. and Cetin, Y., “Characterization of estrous induction response, estrous duration, fecundity and fertility in awassi ewes during the non-breeding season utilizing both CIDR and intravaginal sponge treatments”, ***Reproduction in Domestic Animals*** 45, 464–467, 2010.

Pacinovski, N., Gilevski, M. and Eftimova, E., “Comparison of milk production ability between Awassi and East-Friesian sheep in Macedonia”, ***Macedonian Journal of Animal Sciences*** *3*, 65-72, 2006.

Papaloukas, L., Sinapis, E., Arsenos, G., Kyriakou, G. and Basdagianni, Z., “Effect of season on fatty acid and terpene profiles of milk from Greek sheep raised under a semi-extensive production system”, ***Journal of Dairy Research*** 83(3), 375-382, 2016.

Park, Y.W., Juarez, M., Ramos, M. and Haenlein, G.F.W., “Physico-chemical characteristics of goat and sheep milk”, ***Small ruminants Res*** 68, 88-113, 2007.

Pelmus, R.S., Grosu, H., Rotar, M.C., Gras, M.A., Lazar, C., Popa, F. and Ghita, E., “Estimation of the Genetic Parameters for Test-Day Milk, in Teleorman Black Head Sheep”, ***Animal Science & Biotechnologies*** 52(1), 56-60, 2019.

Portolano, B., Montalbano, L. and Militi, W., “Genetic and environmental sources of variation for milk yield traits in Barbarescasiciliana breed”, ***Small Ruminant Research*** 41(3), 195-202, 2001.

Prpić, Z., Vnučec, I., Benić, M. and Mioč, B., “Relationship of litter size with milk yield, udder morphology and udder health of East Friesian sheep”, ***Journal of Central European Agriculture*** 17(4), 1331-1345, 2016.

Robertson, S.M., Broster, J.C. and Friend, M.A., “Performance of sheep systems grazing perennial pastures. 1. Pasture persistence and enterprise productivity”, ***Animal Production Science*** 60(3), 388-405, 2020.

Roca, A., Romero, G., Alejandro, M., Muelas, R. and Díaz, J.R., “Milk electrical conductivity in Manchega ewes: Variation throughout milking and relation with mammary gland health status”, ***Czech Journal of Animal Science*** 64(7), 300-308, 2019.

Romero, G., Roca, A., Alejandro, M., Muelas, R. and Díaz, J.R., “Relationship of mammary gland health status and other noninfectious factors with electrical conductivity of milk in Manchega ewes”, ***Journal of Dairy Science*** *100*(2), 1555-1567, 2017.

Sakul, H. and Boylan, W.J., “Evaluation of US sheep breeds for milk production and milk composition”, ***Small Ruminant Research*** 7(3), 195-201, 1992.

Selvaggi, M., Laudadio, V., Dario, C. and Tufarelli, V., “Investigating the genetic polymorphism of sheep milk proteins: a useful tool for dairy production”, ***Journal of the Science of Food and Agriculture*** 94(15), 3090-3099, 2014.

Skapetas, B. and Kalaitzidou, M., “Current status and perspectives of the sheep sector in the world”, ***Livestock Research for Rural Development*** 29, 2017.

Snowder, G.D. and Glimp, H.A., “Influence of breed, number of suckling lambs, and stage of lactation on ewe milk production and lamb growth under range conditions”, ***Journal of Animal Science*** 69(3), 923-930, 1991.

Sultan, K.H., “The effect of body weight and litter size on some productive parameters and milk components of sheep under semi-intensive breeding”, ***Mesopotamia Journal of Agriculture*** 47(3), 15-24, 2019.

Talafha, A.Q. and Ababneh, M.M., “Awassi sheep reproduction and milk production”, ***Tropical Animal Health and Production*** 43(7), 1319-1326, 2011.

Turkyilmaz, D. and Esenbuga, N., “Increasing the productivity of Morkaraman sheep through crossbreeding with prolific Romanov sheep under semi-intensive production systems”, ***South African Journal of Animal Science*** 49(1), 185-191, 2019.

Uhrinčať, M., Tančin, V., Tvarožková, K., Mačuhová, L., Vršková, M., Ptáček, M. and Holko, I., "The electrical conductivity of sheep's milk and the possibility of mastitis detection", ***Potravinarstvo Slovak Journal of Food Sciences*** 13(1), 562-565, 2019.

Üstüner, H. and Oğan, M.M., "Main productive performance of Awassi sheep in the Central Anatolian Region of Turkey", ***Turkish Journal of Veterinary and Animal Sciences*** 37(3), 271-276, 2013.

Wendorff, W.L. and Haenlein, G.F., "Sheep Milk Composition and Nutrition", ***Handbook of Milk of Non-Bovine Mammals*** 210-221, 2017.

Yıldız, A. and Yıldız, N., "Milk yield and lactation period of İvesi sheep raised in Ceylanpınar Agricultural Enterprise", ***Yüzüncü Yıl University Journal of Veterinary Faculty*** *13* (1-2), 117-121, 2002.

Zamuner, F., DiGiacomo, K., Cameron, A.W.N. and Leury, B.J., "Effects of the month of kidding, parity number, and litter size on milk yield of commercial dairy goats in Australia", ***Journal of Dairy Science*** 103(1), 954-964, 2020.

CURRICULUM VITAE

WAJID ALI was born on June 06, 1994, in Sheikhupura, Punjab, Pakistan. He completed his secondary education from Government High School Butter, Sheikhupura in 2009. He completed his higher secondary education from Government Post-graduate College, Sheikhupura in 2011. Afterward, he was enrolled in the Faculty of Veterinary Sciences at Bahauddin Zakariya University, Multan, Pakistan for his undergraduate studies. He completed his DVM (Doctor of Veterinary Medicine) from the Faculty of Veterinary Sciences at Bahauddin Zakariya University, Multan, Pakistan in 2016. He did a job as a farm manager on the different dairy farms of Pakistan from 2016 to 2018 and learned practical work experience to manage animals and their health practices. In September 2018, he was enrolled in the Graduate School of Natural and Applied Sciences, Department of Animal and Production at Niğde Ömer Halisdemir University, Niğde, Turkey to pursue his Master,s education under the supervision of Professor Dr. Ayhan CEYHAN. During his master's thesis research, he worked on the Evaluation of Environmental Factors of Milk Yield in Awassi Sheep under an Intensive Management System. He knows English, Urdu, Punjabi. Saraiki and little Turkish languages. He has published some studies in different journals and some are accepted and under the status of submitted until now.