Feeding Methods Applied in Lambs from Birth to Weaning

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Abstract

This book chapter comprehensively addresses the nutritional requirements necessary to support the growth and development of lambs from birth to the weaning period, as well as the feeding methods commonly applied during this critical phase. Particular emphasis is placed on the care and feeding strategies implemented during the neonatal period and the transition to weaning, analyzing their impacts on lambs' health, welfare, and performance. Key topics include the vital importance of colostrum, milk-feeding methods, feeding strategies, and supplementary nutrition practices. Additionally, the methods used during the weaning period and their effects on the lambs' metabolic and immune systems are thoroughly evaluated. This chapter aims to compile current knowledge from the scientific literature while offering clear and practical recommendations for researchers and those interested in this field. This approach seeks to provide a comprehensive resource on early nutrition for lambs, combining both theoretical and practical insights.

Keywords: Colostrum, Lamb nutrition, Lamb welfare, Neonatal period, Weaning

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Introduction

The number of weaned lambs is one of the key parameters indicating the overall reproductive performance of ewes, as it determines the number of surviving lambs (Koyuncu & Akgün, 2018). Both genetic and management factors influence the survival of newborn lambs. Among the management factors, the feeding program implemented during the late gestation period is one of the most critical practices (Koyuncu & Duymaz, 2017). Pregnant ewes should be fed at a maintenance level during mid-gestation and subjected to a supplementary feeding program in the last six weeks of gestation. This is because, during the late gestation period (last six weeks), approximately 70% of fetal growth occurs, necessitating additional feeding to meet the increased energy demands of both the mother and the fetus (Şen, 2016). Inadequate nutrition during late gestation leads to lambs with lower birth weights (lower viability) and insufficient and poor-quality colostrum production in ewes (İçil, 2016; Koyuncu & Duymaz, 2017).

Colostrum is a biological fluid secreted within the first 72 hours after birth, with a nutritional value significantly higher than regular milk. Colostrum differs entirely from normal milk in terms of color, consistency, odor, and composition. The most notable difference in its composition is the presence of immunoglobulins (IgG, IgM, IgE), which enhance lambs' resistance to diseases. The levels of components and immunoglobulins in colostrum are highest within a few hours after lambing and gradually decrease over time (Uysal et al., 2024).

Ruminants possess an epitheliochorial placenta, which limits the transfer of immunoglobulins (Ig) from the mother to the offspring through the placenta, resulting in newborns being born agammaglobulinemic (Agenbag et al., 2021; Sarıca, 2022). Through the process of colostrogenesis, immunoglobulins present in the mother's circulation are transferred to mammary secretions just before birth to provide maternal antibodies to the offspring. Since newborns are born sterile, they must acquire these immunoglobulins through colostrum to combat diseases after birth (Agenbag et al., 2021; Sarıca, 2022). This process, known as passive immunity, is achieved when colostrum is consumed in sufficient quantities (180–290 ml/kg^{-1}) and at the appropriate time (Sarıca, 2022). Additionally, lambs that receive adequate colostrum develop a stronger ability to recognize their mothers, enhancing the maternal-offspring bond (Banchero et al., 2015).

The number of surviving offspring is crucial for a sustainable sheep farming operation. To enhance the viability of the offspring, essential nutrients, particularly colostrum, must be provided promptly. Therefore, lambs must be properly cared for and fed until the weaning period. However, research in this area has highlighted a notable lack of existing literature on the feeding of lambs during the pre-weaning period. This chapter aims to emphasize key points regarding the feeding of suckling lambs from birth to weaning.

1. Growth and Development in Lambs

Before discussing the nutrition of suckling lambs, it is beneficial to address their growth and development. The postnatal digestive systems of ruminants encompass three stages: the preruminant stage, the transitional stage, and the ruminant stage. The preruminant stage covers the first 2 to 3 weeks of life, during which lambs have very low dry matter intake, and their digestive systems and metabolism function similarly to those of non-ruminants (Gündüz & Arslan, 2022). The rumen structure of lambs born as preruminants is smaller and

less developed in terms of microbial digestion and physiological function compared to adult sheep (Urbano et al., 2017). In newborn lambs, instead of the fore-stomachs (rumen, reticulum, omasum) found in adult sheep, there is a groove called the esophageal groove (sulcus eosephagicus) located at the terminal part of the esophagus, extending to the rumino-omasal junction. This groove allows the milk consumed by lambs to bypass the rumen and pass directly to the abomasum. The abomasum constitutes the largest portion of the stomach in newborn lambs. In ruminants, rumen development typically becomes prominent by 2-3 weeks of age. The development of the rumen depends on factors such as the weaning age, weaning method, the timing, quantity, and type of solid feed introduction. To accelerate the development of the fore-stomachs in lambs, it is recommended to provide concentrated and roughage feeds alongside liquid diets. Transitioning to solid feeds accelerates rumen development by promoting ruminal fermentation and the production of volatile fatty acids (VFAs), which in turn enhances feed intake and live weight gain in lambs post-weaning (Baldwin & Connor, 2017; Carballo, 2019; Gündüz & Arslan, 2022).

Growth and development are two distinct terms. Growth refers to the increase in muscles, bones, organs, and tissues due to hyperplasia (increase in cell number) and hypertrophy (increase in cell size) (Urbano et al., 2017). Development, on the other hand, is a term related to cellular changes that enable these organs and tissues to take on different functions and roles during their growth (Boğa et al., 2008; Urbano et al., 2017). In growth, it is important to distinguish between actual growth and fattening. Actual growth results from the increase in muscles and bones, while fattening is due to the increase in adipose tissue (Urbano et al., 2017). In lambs, actual growth occurs rapidly and, as in all ruminants, is described by a sigmoid curve (Urbano et al., 2017).

While the rapid growth of lambs in the first month is influenced by breed and gender, nutrition is a significant environmental factor. The foundation for the growth and development of newborn lambs must be laid in the first 7 days after birth through maternal milk (Urbano et al., 2017). It has been noted that lambs that show delayed sucking behavior exhibit slower growth and development (Ürüşan & Emsen, 2010).

2. Nutritional Needs of Lambs

The highest mortality rate in lambs occurs during the perinatal period (the first 7 days after birth). Most of the deaths during this period are caused by hypothermia and hypoglycemia. To prevent these adverse conditions, lambs must be fed colostrum, especially within the first 2-3 hours after birth (Koyuncu & Duymaz, 2017; Ermetin, 2021). Lambs that are weak and unable to stand and therefore cannot consume colostrum should be given colostrum via a stomach tube if they can hold up their head and have a swallowing reflex. If the lambs cannot hold their head up and appear lifeless, glucose injection is necessary (Ünal et al., 2018).

The neonatal period (the first 0-28 days after birth) is the most vulnerable time in the life of lambs. During this period, animals are defenseless against diseases because they transition from the warm, protected environment of the uterus to a cold, wet, and relatively unprotected environment. Additionally, during this time, the young are more susceptible to diseases due to many important metabolic changes that occur as their physiological and immune systems develop, and as they adapt to their new environment (Dwyer et al., 2016; Piccione et al., 2008). Management errors during this critical period can negatively affect the future of the operation. Therefore, especially before weaning, lambs must meet their nutritional needs with colostrum in the first 3 days of life, followed by milk or milk replacer, starter feeds, and various concentrates and roughages (Table 1) (Göncü et al., 2022).

When evaluating the nutritional needs of lambs during the neonatal period, it is important to begin with their in-utero nutrition. This is because the survival rate of lambs after birth is closely related to their nutrition in the womb. Inadequate nutrition in pregnant ewes can also affect lamb mortality rates (Rooke et al., 2015). Low birth weight in lambs is the most significant factor influencing mortality rates during the first three days of life (Ahmadzadeh et al., 2020). Lambs born to well-nourished ewes stand up earlier and have longer suckling durations (Freitas de Melo et al., 2015). Imbalanced nutrition during pregnancy in ewes affects the birth weight of lambs, having a significant impact on their survival rates (Ahmadzadeh et al., 2020).

The nutritional needs of animals and their evaluation vary depending on breed, ration, management, and environment. Generally, the consumption of solid feed in newborn lambs begins at around 3 days of age and constitutes approximately 42% of their total dry matter intake during the first 2 months of life. However, recommendations regarding the nutritional requirements of lambs during the suckling period generally focus only on milk feeding programs (Danso et al., 2016). Therefore, studies on the nutritional requirements of lambs before weaning are limited.

i. Energy and Protein Requirements

Nutrition deficiency is a primary factor limiting animal performance (Panadi et al., 2021). Some studies on the nutritional requirements of lambs before weaning have evaluated their energy and protein needs together (Danso et al., 2016; Herath et al., 2020; Herath et al., 2021). According to these studies, a lamb's requirement for crude protein (CP) relative to metabolizable energy (ME) changes as the lamb grows. In the early stages of growth, a higher CP:ME ratio is required (e.g., 14.2 g/MJ at 5 kg body weight), while later in life, a lower ratio is needed (e.g., 12.2 g/MJ at 18 kg body weight) (Danso et al., 2016). In other words, as lambs approach weaning age, their CP: ME requirement decreases. This information is important for lean growth and muscle protein accumulation. Due to the higher water content in tissues with high protein content, less energy is required for each unit increase in muscle tissue (Oddy & Sainz, 2002).

ii. Minerals and Vitamins

Animals require various inorganic elements and vitamins for normal growth, development, performance, and reproduction (Reece et al., 2015). Practically, there are 14 essential elements that can be added to the diet. These are divided into macrominerals and microminerals based on the amounts required by animals. Macrominerals include calcium, phosphorus, sodium, chloride, potassium, magnesium, and sulfur. Microminerals include cobalt, copper, iodine, iron, manganese, selenium, and zinc. Aluminum, arsenic, boron, chromium, fluoride, lead, lithium, molybdenum, nickel, rubidium, silicon, tin, and vanadium are considered essential under certain conditions for specific animal types.

Fluoride, molybdenum, lead, arsenic, aluminum, cadmium, and mercury are more commonly known for their toxic effects (NRC, 2007).

Vitamins are a group of complex organic compounds required for multiple metabolic and physiological processes. Unlike other organic nutrients, vitamins are typically needed in very small amounts (micrograms to milligrams per day). Vitamins are classified as either fat-soluble or water-soluble. Fat-soluble vitamins A, D, E, and K consist only of carbon, hydrogen, and oxygen, while some water-soluble vitamins also contain nitrogen, sulfur, or cobalt (NRC, 2007).

The vitamin and mineral requirements of newborn lambs are closely related to the nutritional level of the ewe during pregnancy (Rosales et al., 2016). The effectiveness of vitamins A, D, and E, as well as calcium, phosphorus, sodium, magnesium, manganese, zinc, selenium, cobalt, and iodine given to ewes during pregnancy, on newborn lamb health and performance has been evaluated (Abdelrahman, 2008; Lockwood et al., 2016; Uysal & Yörük, 2024). In general, it has been reported that vitamin and mineral supplementation, especially during the later stages of pregnancy, improves lamb health and performance (Abdelrahman, 2008; Uysal & Yörük, 2024).

Table 1: Chemical compositions of some dietary components used in pre-weaning lamb nutrition (Danso, 2016; Göncü et al., 2022)

Chemical composition	Component		
	Milk	Milk Replacer	Starter Feed[1]
Dry matter, %	17.2	96.3	88.7
Ash, %	-	5.8	7.9
Protein, %	4.9	24.4	16.9
Fat, %	6.3	26.6	1.4
Lactose, %	4.5	38	-
Casein, %	4.3	-	-
Minerals, %	-	6	-
Gross Energy, kJ/g	-	22.5	15.3
Starch, %	-	-	36.4
NDF (Neutral Detergent Fiber), %	-	-	13.8
ADF (Acid Detergent Fiber), %	-	-	4.8
Lignin, %	-	-	0.8

[1]Barley, soybean meal, canola, peas, wheat, corn, oats, molasses, vegetable oil, grass seed meal, minerals, vitamins, prebiotics, and essential oils.

3. Lamb Feeding Methods and Techniques

` Birth weight is a key factor that directly affects the survival of lambs. While the ideal birth weight varies by breed, it is reported to be between 3.5 - 6 kg, with lambs weighing 4.5 kg at birth having a higher survival rate. In inadequately nourished newborn lambs, the thermoregulation system may be disrupted, leading to death. Therefore, the feeding process and frequency for newborn lambs should be carefully monitored (Table 2) (Koyuncu & Duymaz, 2017).

Table 2: Milk feeding schedule for lambs (Koyuncu & Duymaz, 2017).

Feeding period (days)	Amount at each meal (ml)	Number of daily feedings (number)	Daily milk intake (ml)
1 (colostrum)	100	3	300
2-7	150	5	750
8-14	240	4	960
15-21	330	4	1320
22-28	440	3	1320
29- weaning	475	2	950

Different methods are used to feed newborn animals, including suckling from the mother, bottle feeding, and bucket feeding (Özer et al., 2020). In newborn animals, finding the udder is shaped by physiological and instinctive behaviors. Lambs generally begin to suckle from the mother within the first 2 hours after birth, although this may vary depending on the breed, birth weight, birth method, and gender (Nowak & Poindron, 2006). Bottle feeding is preferred for small, weak lambs, or those that cannot suckle from the mother (Tepeli, 2021). In the bottle feeding method, aspiration pneumonia can occur if milk enters the lungs due to human error. Therefore, personnel who care for the lambs should be trained in this regard and should not be frequently changed (Mahmut, 2020). In the bucket feeding method, the hand is dipped into milk, and the sucking reflex in lambs is developed through the finger (Erdem & Atasever, 2005). In all artificial feeding methods (bottle and bucket), hygiene rules must be followed to minimize the growth of pathogenic microorganisms (Mahmut, 2020). Cleaning the feeding equipment after every use prevents stomach disorders, intestinal infections, and diarrhea. Bottles should be washed with cold water and rinsed with boiled water, then left to drain. Buckets should be washed daily with soapy water prepared with warm water and then rinsed with boiled water.

i. The Importance of Colostrum in Lamb Feeding

Colostrum is defined as a biological fluid secreted by the mammary glands immediately before birth, which is completely different from normal milk in terms of its composition and color (Ermetin, 2021; Sarıca, 2022; Uysal et al., 2024). Generally, colostrum contains high levels of immunoglobulins, vitamins (A, B12, D, and E), hormones, enzymes, growth factors (IGF-1), antimicrobials, anti-inflammatory agents, and dense nutrients (Agenbag et al., 2021). However, the lactose content of colostrum is lower than that of normal milk (Uysal et al., 2024).

Colostrum approximately contains 5% lactose, 4% casein, 7% fat, and 82% water (Agenbag et al., 2021). Additionally, colostrum contains compounds like transferrin and lactoferrin, which bind iron and prevent the growth of certain pathogens and the occurrence of diarrhea in the offspring (Uysal et al., 2024).

To take advantage of the protective properties of colostrum against diseases, it must be consumed within the first 24 hours after birth (Alves et al., 2015). Additionally, consuming colostrum shortly after birth helps facilitate thermoregulation and the passage of meconium (Agenbag et al., 2021; Uysal et al., 2024). After 24 hours post-birth, abomasal secretions increase, and the permeability of the intestines to IgGs decreases; this permeability ends after 48 hours (Alves et al., 2015). In this case, the absorption of IgGs (which are crucial for passive immunity in lambs) from the intestines into the bloodstream decreases, and colostrum quality declines (Alves et al., 2015). The absorption of low-quality colostrum from the intestines is lower compared to high-quality colostrum, and animals become more susceptible to diseases (Figure 3) (Ermetin, 2021).

The nutritional value of high-quality colostrum is highest within the first 2 hours after birth. After the first 24 hours post-birth, the nutritional value of colostrum decreases (Table 3). For healthy lamb rearing, lambs should consume 10-20% of their body weight in colostrum within the first 2-3 hours after birth (Ermetin, 2021).

Table 3: Changes in colostrum content in the first 3 days after birth (Uysal & Yörük, 2022)

Colostrum	DM (%)	Fat free DM (%)	Oil (%)	Protein (%)	Lactose (%)	Casein (%)
1 day	28.9	17.21	11.26	11.98	3.12	8.57
2 day	26.12	16.56	9.37	11.5	3.46	8.1
3 day	25.77	16.14	9.42	10.31	3.66	7.79

DM: Dry matter

ii. Lamb Rearing Methods

a. Natural Rearing

In this method, lambs suckle from their mothers for a period of 60-120 days (Ünal et al., 2018). Additionally, lambs are fed hay, green forage, and concentrated feed (Sarıca, 1982). The lambs stay with their mothers, including on pasture, until they reach market age (Ünal et al., 2018). In natural rearing, the weaning weight can reach 30-35 kg (Yılmaz et al., 2014).

b. Artificial Rearing

Lambs are separated from their mothers at 0-2 days of age and are fed with formula or milk replacer to obtain milk and cheese from sheep (Ünal et al., 2018). This technique is called artificial rearing. This technique is also used, albeit to a lesser extent, in meat production operations and to improve the reproductive performance of sheep. In artificial rearing, lambs are weaned at 3 months of age (Boğa et al., 2008).

Artificial rearing is primarily used to feed lambs whose mothers have died or cannot produce enough milk, and to increase the survival rate of lambs in multiple births (Sarıca, 1982). The process of adapting a lamb whose mother has died or rejected it to another ewe is called fostering. However, ewes generally do not accept nursing another ewe's lamb or kid. Some procedures are necessary for the ewe to accept an orphaned or hungry lamb. For example, the ewe can be placed in a narrow enclosure with the lamb. The ewe's milk can be applied to her nose, and to the lamb's head and other body parts. The skin of the ewe's deceased lamb can be draped over the orphaned lamb's back. Through these methods, the ewe will begin to accept the orphaned lamb as her own (Ermetin, 2021).

c. Rearing with Residual Milk

In this method, lambs are fed with the milk remaining in the udder after machine or hand milking. This method can be performed in two ways: single milking + one feeding of lambs, and double milking + feeding. In the single milking + one feeding method, after lambs receive colostrum for 1-2 days, the ewe is milked in the morning or evening, and the lamb is left with the mother at other times. In the double milking + feeding method, after the lambs receive colostrum for 1-2 days, the ewes are milked both in the morning and evening, and the lambs are allowed to suckle for 20-30 minutes. This method is mostly preferred for high milk-producing breeds (Ermetin, 2021). In both methods, the ewes are first milked, and then the lambs are fed with the remaining milk in the udder. These practices continue until the lambs reach their market weight (Ünal et al., 2018).

d. Early Weaning

Lambs typically suckle from their mothers for about 30-45 days. In this method, to prevent a decrease in vitality, lambs should be weaned when they reach four times their birth weight. Otherwise, the lambs may not meet their energy requirements, and their growth may be stunted. Generally, lambs are weaned when they reach approximately 10-12 kg of live weight (Ünal et al., 2018). Early weaning is preferred for two main purposes. First, it allows for the rebreeding of the mother, increasing the reproductive efficiency; second, it aims to improve milk production. The success of the method is enhanced when the weaned lambs are fed high-quality dry hay and concentrates (Sarıca, 1982).

4. Effects of Pre-Weaning Feeding Practices on Lamb Health

The pre-weaning period, one of the most critical phases in lambs' lives, encompasses a time when adaptation to the environment, growth, and development of the immune system place. The feeding strategies during this period directly impact lamb performance and health in the later stages. Applying an appropriate feeding method before weaning not only supports rapid growth but also contributes to the development of a strong immune system (Uysal & Uysal, 2024).

The first stage of health during the pre-weaning period is colostrum intake. In lambs, the consumption of high-quality colostrum during

the first hours of life is crucial for the immune system and, consequently, for lamb survival rates. Lambs that do not receive colostrum or consume low-quality colostrum during the first hours of life have been shown to be more susceptible to diseases and mortality (Hernández-Castellano et al., 2015; McCoard et al., 2020).

Nutrition, environmental conditions, the development of the immune system, and encountered infections during the pre-weaning period can lead to an imbalance in the production of reactive oxygen species (ROS). When ROS production exceeds the antioxidant capacity, it poses a vital risk to lambs. Therefore, it is important to keep the antioxidant defense system active. Nutrition plays a key role in activating the antioxidant defense system (Gökçe et al., 2022). The reducing environment inside cells plays an important role in preventing ROS-mediated damage. This environment is protected by antioxidant enzymes such as superoxide dismutase (SOD), catalase, glutathione peroxidase, as well as antioxidant compounds like glutathione, ascorbate (vitamin C), α-tocopherol (vitamin E), and thioredoxin. These components work together to prevent cellular damage and support the cell's healthy functioning (Bayr, 2005).

5. Transition Process from Milk Consumption to Solid Feeds

There are differing views regarding the transition to solid feed consumption during the milk-drinking period in ruminant animals. The debates mostly focus on whether roughage should be provided during the milk-drinking period. When the literature is examined, sources indicate that roughage stimulates the muscular layer of the rumen, promotes rumination, maintains the integrity and health of the rumen wall, and also reduces behavioral problems. Furthermore, researchers supporting this view suggest that a lack of roughage in starter rations may reduce rumen motility, leading to hyperkeratinization and clustering of ruminal papillae. This negative outcome can, in turn, decrease nutrient absorption in the rumen mucosa (Phillips, 2004; Suárez et al., 2007; Soltani et al., 2017). On the other hand, some researchers do not recommend the addition of roughage to the rations of unweaned ruminants. According to this view, the inclusion of roughage in the diets of unweaned ruminants may reduce concentrate feed intake, leading to a decrease in rumen butyrate production and an increase in acetate production. They argue that increased acetate production may delay the development of rumen papillae. As a result, dry matter digestibility may decrease, negatively affecting live weight gain (Hill et al., 2010; Beiranvand et al., 2014). To better understand these perspectives, further research on this topic is necessary.

6. The Weaning Process and Its Effect on Welfare

Under natural conditions, for a newborn lamb to survive, the mother-offspring bond must be strong. Lambs' ability to suckle from their mothers is the critical point of this bond (Karakuş, 2014; Ermetin, 2021).

The age at which lambs are weaned is important for the morphological, functional, and bacterial development of the rumen. The effects of traditional and early weaning on rumen microorganisms have been studied, and it has been stated that both the diversity and the number of microorganisms decrease with early weaning. This situation is believed to be caused by the stress associated with early weaning. In general, it has been reported that allowing newborn lambs to suckle from their mothers and weaning them at around 45-50 days of age improves animal development and welfare (Tüfekci & Sejian, 2023).

In sheep farming enterprises, the weaning process can vary between 4 to 16 weeks depending on the structure of the operation (Napolitano et al., 2008; Karakuş, 2014). The most important strategy for weaning is when lambs reach 3-4 times their birth weight, typically around 12-13 kg of live weight (Karakuş, 2014). In many sheep farms, milking starts in the 2nd to 3rd month after birth (Altın et al., 2003; Napolitano et al., 2008). This period varies according to the overall structure of the operation. For example, in dairy sheep farms, early weaning methods are applied to increase the amount of marketable milk and cheese. In meat sheep farms, the weaning age can extend up to 3.5-4 months to present fattened lambs to the market earlier (Altın et al., 2003). Early weaned lambs tend to have more welfare concerns compared to those weaned at the proper time, so strategies that minimize this stress need to be developed (Tüfekci & Sejian, 2023).

Factors such as heat, cold, transport, shearing, treatment, etc., can also cause stress in lambs, and weaning is one of these stressors (Tüfekci & Sejian, 2023). This stress is defined as weaning stress (Napolitano et al., 2008). Stress is a reflex that occurs when an organism is unable to cope with or adapt to negative factors. When animals encounter a threatening stimulus, they develop behavioral and physiological responses to maintain homeostasis. The process of trying to maintain homeostasis is called allostasis (Smith & Dobson, 2002). From a hormonal perspective, lambs exposed to weaning stress send signals to the hypothalamus. In response, the hypothalamus releases corticotropin-releasing hormone (CRF). CRF stimulates the anterior pituitary gland, which releases adrenocorticotropic hormone (ACTH). ACTH then stimulates the adrenal glands to release cortisol. Cortisol inhibits the anterior pituitary and hypothalamus (HPA axis) (Smith & Dobson, 2002). Prolonged exposure to stress in all living organisms leads to the collapse of the body's defense system, making death inevitable (Serim Balci & Sabuncuoglu Coban, 2024). Behaviorally, lambs show stress through increased bleating and movement, as well as a decrease in feed intake (Napolitano et al., 2008; Karakuş, 2014). One of the most significant consequences of weaning stress, the reduction in feed intake, results in slower growth rates and increased susceptibility to diseases (Tüfekci & Sejian, 2023). Another stereotypical behavior is oral behavior, where lambs attempt to suck the bellies and scrotums of other lambs in the group. Additionally, lambs are reluctant to walk during open field tests (Napolitano et al., 2008). To reduce the stress of weaned lambs and thus improve their welfare, it may be necessary to provide a social environment for them, reduce human contact, and treat the lambs more gently (Tüfekci & Sejian, 2023).

Conclusion

Proper and balanced nutrition of lambs during the period from birth to weaning plays a critical role in ensuring healthy growth, immune system development, supporting rumen function, and overall welfare. During this process, correct feeding strategies applied during sensitive periods such as colostrum intake, the transition from milk to solid feeds, and weaning determine the long-term health, growth performance, and productivity of lambs. These strategies also provide significant contributions to flock productivity and farm profitability. Scientifically, the development of lamb feeding methods and planning that meet nutritional needs is not only a fundamental necessity for individual animal health but also for supporting sustainable farming practices. Therefore, further improvements in lamb feeding practices are of great importance for the future of the industry.

References

Abdelrahman, M. M. (2008). The effect of high calcium intake by pregnant Awassi ewes at late gestation on minerals status and performance of ewes and newborn lambs. *Livestock Science*, *117*(1), 15-23.

Agenbag, B., Swinbourne, A. M., Petrovski, K., & van Wettere, W. H. (2021). Lambs need colostrum: A review. *Livestock Science*, *251*, 104624.

Ahmadzadeh, L., Hosseinkhani, A., Taghizadeh, A., Ghasemi-Panahi, B., & Hamidian, G. (2020). Effect of late gestational feed restriction and glucogenic precursor on behaviour and performance of Ghezel ewes and their offspring. *Applied Animal Behaviour Science*, *231*, 105030.

Altın, T., Karaca, O., & Cemal, İ. (2003). Sütten kesim yaşının koyunlarda süt verimi ve kuzularda büyüme üzerine etkisi. *Yuzuncu Yıl University Journal of Agricultural Sciences*, *13*(2), 103-111.

Alves, A. C., Alves, N. G., Ascari, I. J., Junqueira, F. B., Coutinho, A. S., Lima, R. R., & Abreu, L. R. (2015). Colostrum composition of Santa Inês sheep and passive transfer of immunity to lambs. *Journal of Dairy Science*, *98*(6), 3706-3716.

Baldwin, R. L., & Connor, E. E. (2017). Rumen function and development. *Veterinary Clinics: Food Animal Practice*, *33*(3), 427-439.

Banchero, G. E., Milton, J. T. B., Lindsay, D. R., Martin, G. B., & Quintans, G. (2015). Colostrum production in ewes: a review of regulation mechanisms and of energy supply. *Animal*, *9*(5), 831-837.

Bayr, H. (2005). Reactive oxygen species. *Critical Care Medicine*, *33*(12), S498-S501.

Beiranvand, H., Ghorbani, G. R., Khorvash, M., Nabipour, A., Dehghan-Banadaky, M., Homayouni, A., & Kargar, S. (2014). Interactions of alfalfa hay and sodium propionate on dairy calf performance and rumen development. *Journal of Dairy Science*, *97*(4), 2270-2280.

Boğa, M., Görgülü, M., & Yurtseven, S. (2008). Ruminant hayvanlarda telafi edici büyüme ve etkileri. *Hayvansal Üretim*, *49*(2).

Carballo, O. C., Khan, M. A., Knol, F. W., Lewis, S. J., Stevens, D. R., Laven, R. A., & McCoard, S. A. (2019). Impact of weaning age on rumen development in artificially reared lambs. *Journal of Animal Science*, *97*(8), 3498-3510.

Danso, A. S. (2016). Nutrient utilisation, growth and chemical body composition of pre-weaned lambs reared artificially: effects of feeding milk replacer and pellets: a thesis presented in partial fulfilment of the requirements for the degree of Doctor of Philosophy in Animal Science at Massey University, Palmerston North, Manawatū, New Zealand (Doctoral dissertation, Massey University).

Danso, A. S., Morel, P. C. H., Kenyon, P. R., & Blair, H. T. (2016). Effect of different feeding regimens on energy and protein utilization and partitioning for maintenance and growth in pre-weaned lambs reared artificially. *Journal of Animal Science*, *94*(12), 5359-5371.

Dwyer, C. M., Conington, J., Corbiere, F., Holmøy, I. H., Muri, K., Nowak, R., Gautier, J. M. (2016). Invited review: improving neonatal survival in small ruminants: science into practice. *Animal*, *10*(3), 449-459.

Erdem, H., & Atasever, S. (2005). Yeni doğan buzağilarda kolostrumun önemi. *Anadolu Tarım Bilimleri Dergisi*, *20*(2), 79-84.

Ermetin, Ö.U.O. (2021). kuzu-oğlak bakım-besleme ve yönetimi. Koyun Keçi Sağlığı Ve Yetiştiriciliği, *119*.

Freitas-de-Melo, A., Ungerfeld, R., Hötzel, M. J., Abud, M. J., Alvarez-Oxiley, A., Orihuela, A., & Pérez-Clariget, R. (2015). Mother–young behaviours at lambing in grazing ewes: Effects of lamb sex and food restriction in pregnancy. *Applied Animal Behaviour Science*, *168*, 31-36.

Gökçe, E., Cihan, P., Atakişi, O., Kirmizigül, A. H., & Erdoğan, H. M. (2022). Oxidative stress in neonatal lambs and its relation to health status and passive colostral immunity. *Veterinary Immunology and Immunopathology*, *251*, 110470.

Göncü, S., Gökçe, G., & Yeşil, M. I. (2022). Akdeniz İklim Koşullarında Mevsimin İnek, Koyun ve Keçi Süt Kompozisyonu Üzerine Etkisi. *Kadirli Uygulamalı Bilimler Fakültesi Dergisi*, *2*(2), 230-243.

Gündüz, A., & Arslan, C. (2022). Buzağıların Preruminant Dönemde Beslenmesinin Ön Midelerin Gelişimine Etkisi. *Bahri Dağdaş Hayvancılık Araştırma Dergisi*, *11*(1), 37-50.

Herath, H. M. G. P., Pain, S. J., Kenyon, P. R., Blair, H. T., & Morel, P. C. H. (2020). Effect of dietary protein to energy ratio of milk replacer on growth and body composition of pre-weaned lambs reared artificially. *Animal Feed Science and Technology*, *264*, 114478.

Herath, H. M. G. P., Pain, S. J., Kenyon, P. R., Blair, H. T., & Morel, P. C. H. (2021). Effect of dietary protein to energy ratio on growth performance of pre-and post-weaned lambs. *Animal Feed Science and Technology*, *272*, 114787.

Hernández-Castellano, L. E., Moreno-Indias, I., Morales-delaNuez, A., Sánchez-Macías, D., Torres, A., Capote, J., & Castro, N. (2015). The effect of milk source on body weight and immune status of lambs. *Livestock Science*, *175*, 70-76.

Hill, T. M., Bateman II, H. G., Aldrich, J. M., & Schlotterbeck, R. L. (2010). Roughage amount, source, and processing for diets fed to weaned dairy calves. *The Professional Animal Scientist*, *26*(2), 181-187.

İçil, N. İ. (2016). Koyunculuk işletmelerinde metabolik profil testinin uygulanabilirliğinin araştırılması. Selçuk Üniversitesi, Yayımlanmış doktora tezi, Konya.

Karakus, F. (2014). Weaning stress in lambs. Journal of International Scientific Publications: *Agriculture & Food*, *2*, 165-170.

Koyuncu, M., & Akgün, H. (2018). Ekstansif yetiştirme koşullarındaki Kıvırcık koyunlarında bazı döl verimi özellikleri. *Hayvansal Üretim*, *59*(1), 33-40.

Koyuncu, M., & Duymaz, Y. (2017). Kuzularda yaşama gücünün iyileştirilmesi. *Hayvansal üretim*, *58*(1), 46-56.

Lewis, N. A., Holm, B. A., Rossman, J., Swartz, D., & Glick, P. L. (2011). Late administration of antenatal vitamin A promotes pulmonary structural maturation and improves ventilation in the lamb model of congenital diaphragmatic hernia. *Pediatric Surgery International*, *27*, 119-124.

Lockwood, A., Currie, A., Hancock, S., Broomfield, S., Liu, S., Scanlan, V., & Thompson, A. N. (2016). Supplementation of Merino ewes with cholecalciferol in late pregnancy improves the vitamin D status of ewes and lambs at birth but is not correlated with an improvement in immune function in lambs. *Animal Production Science*, *56*(4), 757-766.

Mahmut, O. K. (2020). Buzağıları Hastalıklardan Koruma Yöntemleri. Buzağı Sağlığı Ve Yetiştiriciliği, *61*.

McCoard, S. A., Cristobal-Carballo, O., Knol, F. W., Heiser, A., Khan, M. A., Hennes, N., & Stevens, D. R. (2020). Impact of early weaning on small intestine, metabolic, immune and endocrine system development, growth and body composition in artificially reared lambs. *Journal*

of Animal Science, *98*(1), skz356.
Napolitano, F., De Rosa, G., & Sevi, A. (2008). Welfare implications of artificial rearing and early weaning in sheep. *Applied Animal Behaviour Science*, *110*(1-2), 58-72.
National Research Council (2007). Nutrient requirements of small ruminants: sheep, goats, cervids, and new world camelids. National Academy Press.
Nowak, R., & Poindron, P. (2006). From birth to colostrum: early steps leading to lamb survival. *Reproduction Nutrition Development*, *46*(4), 431-446.
Oddy, V. H., & Sainz, R. D. (2002). Nutrition for sheep-meat production. Sheep Nutrition, 237-262.
Özer, K., Şahin, O., & Çoban, Ö. B. (2020). Muş ili merkez ilçesi sığırcılık işletmelerinde ineklerin ve buzağıların beslenmesi açısından mevcut durum ve çözüm önerileri. *Akademik Ziraat Dergisi*, *9*(2), 337-344.
Panadi, M., Mat, K., Rahman, M. M., Khan, M. A. K. G., Balakrishnan, M., & Rusli, N. D. (2021). Nutrient intake, growth performance and nutrient digestibility of pre-and post-weaning Dorper lambs fed varying crude protein level. *Tropical Animal Health and Production*, *53*(5), 515.
Phillips, C. J. C. (2004). The effects of forage provision and group size on the behavior of calves. *Journal of Dairy Science*, *87*(5), 1380-1388.
Piccione G, Bertolucci C, Giannetto C, Giudice E. (2008). Clotting profiles in newborn Maltese kids during the first week of life. *Journal of Veterinary Diagnostic Investigation*, *20*(1), 114-118.
Reece, W. O., Erickson, H. H., Goff, J. P., & Uemura, E. E. (2015). *Dukes' Physiology of Domestic Animals*. John Wiley & Sons.
Rooke, J. A., Arnott, G., Dwyer, C. M., & Rutherford, K. M. D. (2015). The importance of the gestation period for welfare of lambs: maternal stressors and lamb vigour and wellbeing. *The Journal of Agricultural Science*, *153*(3), 497-519.
Rosales Nieto, C. A., Meza-Herrera, C. A., Moron Cedillo, F. D. J., Flores Najera, M. D. J., Gámez Vázquez, H. G., Ventura Pérez, F. D. J., & Liu, S. (2016). Vitamin E supplementation of undernourished ewes pre-and post-lambing reduces weight loss of ewes and increases weight of lambs. *Tropical Animal Health and Production*, *48*, 613-618.
Sarıca, M. (2022). Koyunlarda kolostrum kalitesinin brix refraktometre kullanılarak belirlenmesi (Master's thesis, Balıkesir Üniversitesi Sağlık Bilimleri Enstitüsü).
Yilmaz, O., Sezenler, T., Alarslan, E., Ata, N., Karaca, O., & Cemal, İ. (2014). Karacabey Merinosu, Karya ve Kıvırcık kuzularda sütten kesim döneminde kabuk yağı kalınlığı ve Musculus longissmus dorsi thoracis et lumborum (MLD) derinliğinin ultrason ölçümleri. Kafkas Üniversitesi Veteriner Fakültesi Dergisi, *20*(6), 829-834.
Şen, U. (2016). Koyunlarda gebelik dönemi besleme ve fötal kas lifi gelişimi. *Gaziosmanpaşa Bilimsel Araştırma Dergisi*, (12), 44-51.
Serim Balci, E., & Sabuncuoğlu Çoban, N. (2024). Measuring Stress in Animals by Noninvasive Methods. *Veterinary Sciences & Practices*, *19*(1). 52-58.
Smith, R. F., & Dobson, H. (2002). Hormonal interactions within the hypothalamus and pituitary with respect to stress and reproduction in sheep. *Domestic Animal Endocrinology*, *23*(1-2), 75-85.
Soltani, M., Kazemi-Bonchenari, M., Khaltabadi-Farahani, A. H., & Afsarian, O. (2017). Interaction of forage provision (alfalfa hay) and sodium butyrate supplementation on performance, structural growth, blood metabolites and rumen fermentation characteristics of lambs during pre-weaning period. *Animal Feed Science and Technology*, *230*, 77-86.
Suárez, B. J., Van Reenen, C. G., Stockhofe, N., Dijkstra, J., & Gerrits, W. J. J. (2007). Effect of roughage source and roughage to concentrate ratio on animal performance and rumen development in veal calves. *Journal of Dairy Science*, *90*(5), 2390-2403.
Tepeli, C. (2021). Koyun-Keçi işletmelerinde kuzu-oğlak büyütme döneminde olması gereken yapısal ve teknik uygulamalar. *koyun keçi sağlığı ve yetiştiriciliği*, *99*.
Tüfekci, H., & Sejian, V. (2023). Stress factors and their effects on productivity in sheep. *Animals*, *13*(17), 2769.
Ünal, H. B., Taşkın, T., & Kandemir, Ç. (2018). Küçükbaş hayvancılıkta yavru ölümlerinin azaltılmasına yönelik barındırma ve yetiştirme uygulamaları. *Hayvansal Üretim, 59*(2), 55-63.
Ürüşan, H., & Emsen, H. (2010). Kuzulama mevsimi, kuzu genotipi, anne ve doğumla ilgili faktörlerin kuzuların büyüme ve yaşama gücü üzerine etkileri. *Tekirdağ ziraat fakültesi dergisi*, *7*(3), 163-172.
Urbano, S. A., Ferreira, M. A., Rangel, A. H. N., Júnior, D. L., Andrade, R. P. X., & Novaes, L. P. (2017). Lamb feeding strategies during the pre-weaning period in intensive meat production systems. *Tropical and Subtropical Agroecosystems*, *20*(1), 49-63.
Uysal, S., & Uysal, A. (2024). The relationship between nutrition and intestinal health in newborn lambs. *CABI Reviews*, *19*(1).
Uysal, S., & Yörük, M. A. (2022). Yeni Doğan Kuzuların Beslenmesinde Kolostrum Kalitesinin Önemi. *Bahri Dağdaş Hayvancılık Araştırma Dergisi*, *11*(2), 113-120.
Uysal, S., & Yoruk, M. A. (2024). Boric Acid in Milk Replacer as a Health Enhancer and Growth Promoter for Lambs in the Suckling Period. *Biological Trace Element Research*, 1-11.
Uysal, S., Uysal, A., Öz, C., Yörük, M. A., & Ölmez, M. (2024). Evaluation of sheep colostrums according to time after lambing by brix refractometer method and color scoring. *Research and Practice in Veterinary and Animal Science (REPVAS)*, *1*(1), 27-35.