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IMPACT OF VARIOUS FACTORS ON LIVE BIRTH WEIGHT LAMBS - REVIEW

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Abstract

The survival of the newborn in the first days is directly dependent on live birth weight. The indicator is related to the vitality and mortality of lambs, and also plays an important role in the later development of the young organism. Factors influencing live birth weight are genetic (breed, the effect of heterosis) and non-genetic (age, weight, body condition of the sheep, diet, year, season, month of birth, type of birth, sex, etc.). In all mammals, there is an "optimal" birth weight, as a result of which the birth process proceeds naturally and without complications. The objective of this survey is to investigate and summarize the factors that affect live birth weight of lambs.

Key words: *birth weight, factors, lambs*

INTRODUCTION

Sheep are widespread throughout the world, they are a major sub-sector of animal husbandry in different countries.

Live weight at birth is of interest because of its positive genetic correlation with the further live weight of the animals (Mellado et al., 2016), and also plays a key role in achieving better economic results on the farm. Live birth weight affects the vitality, mortality and growth of lambs (Cloete et al., 2001; Zapasnikiene, 2002; Berhan & Arendonk, 2006; Petrovic et al., 2009; Vatankhah & Talebi, 2009), which defines it as the initial factor influencing the later development of the young organism (Riggio et al., 2008).

The characteristic varies among breeds in different regions of the world because of the impact of genetic (breed, the effect of heterosis) and non-genetic factors (age, weight, body condition of the sheep, diet, year, season, month of birth, type of birth, et al.) (Kafi et al., 2004; Mandal et al., 2006; Zhang et al., 2009; Hussain et al., 2013; Karmakar et al., 2018).

Knowledge of these factors is particularly important given the association of this characteristic with the health of newborns and adults (Gardner et al., 2007; Chniter et al., 2009).

The most common method for increasing lamb production is the industrial crossbreeding (heterosis effect) with meat-producing breeds, as it directly affects the increase in live weight at birth of crossbred lambs (Petrović et al., 2011; Ivanov et al., 2015).

Alsheikh (2005) reported that the high level of inbreeding in Barki lambs had a negative effect on their birth weight.

The ewe's age had a significant effect ($P<0.01$) on the birth weight of the lamb. Younger ewes use some of the energy for their own growth and development, and the rest for the fetus, which leads to lower birth weight lambs.

While older ewes have already completed their growth and can direct all their energy to productivity and the birth of heavier lambs (Babar et al., 2004).

According to Wu et al. (2006) with increasing age of ewes, the size of the uterus, placenta and nutrient transfer from mother to fetus increases, leading to higher birth weight.

The weight of ewes during the mating season was positively associated with increased ovulation, leading to improved reproductive performance (Scaramuzzi et al., 2006).

Also, heavier ewes are usually well fed and tend to give birth to heavier lambs (Koritiaki et al., 2013).

Feeding of ewes is essential for the supply of nutrients necessary for fetus development (Robinson et al., 2002

Insufficient or excessive feeding of the mother can significantly affect prenatal and postnatal growth and development of the lamb (Barker, 2004; Caton & Hess, 2010).

The marketing year affects live birth weight through climatic characteristics for different geographical regions (Mellado et al., 2016), through farm management and disease outbreaks (Gardner et al., 2007).

The level of management depends on the abilities of the farm manager, his efficiency in the supervision of the staff, the care of the staff for the ewes and lambs, the financial resources, the availability of fodder and others.

Numerous studies have shown the strong impact of the season (rainfall rate, wind speed, humidity, temperature, day length, vegetation growth on pastures) on the birth weight of lambs in different breeds (Yilmaz et al., 2007, Rosov & Gootwine, 2013; Petrović et al., 2015).

The studied trait was also significantly influenced ($P<0.01$) by the type of birth and sex of the newborns.

Single lambs are born with a higher live weight than twins, triplets, as they have no competition for nutrients in the mother's womb (Petrović et al., 2011; Momoh et al., 2013). Male lambs are also born heavier than females due to the anabolic action of male sex hormones (Babar et al., 2004; Rashidi et al., 2008).

Saghi et al. (2006) reported that in the Iranian Baluchi breed, male lambs and females had higher birth weights than twins.

Survival of up to 48 hours is most affected by lamb birth weight (Oldham et al., 2011).

MATERIALS AND METHODS

The study was based on the analysis of current bibliographic sources with the theme in the factors that affect live birth weight of lambs.

RESULTS AND DISCUSSIONS

In this survey, the genetic and non-genetic factors influencing the live weight at the birth of lambs is observed.

Breed – The sheep breed is one of the genetic factors influencing the live weight at birth of lambs. There is a significant variation of the trait between different breeds.

Siddalingamurthy et al. (2017) received an average live birth weight of 2.07±0.01 kg for the Indian breed Mandya, while Achkakanova and Staykova (2021) reported an average of 5.193 kg for the Ile de France breed. In Nigerian breeds, the trait varies from 3.11±0.04 kg in Uda to 3.55±0.04 in Balami (Momoh et al., 2013). The birth weight of Dorper lambs reported by various authors is 3.3-3.9 kg (Hinojosa-Cuéllar et al., 2013; Mellado et al., 2016). And in Santa Inês is in the range of 3 to 4 kg, (Peruzzi et al., 2015; Torres et al., 2021). The values of the studied trait in Lacon female and male lambs were 3.90±0.7 and 4.6±0.2 kg, respectively (Barillet et al., 2002; Thomas et al., 2014). The average live birth weight of the Rambouillet breed was 3.17±0.04 kg (Mika et al., 2018), and the average live weight of Thalli was 4.11±0.82 kg (Hussain et al., 2013). The lowest average values of live weight were measured in lambs of Karakachan breed (3.40 kg), while in Teteven and Srednostaroplaninska offspring they were 4.50 kg and 4.10, respectively (Genkovski, 2006). In Tsigai, bred in Romania, the trait varies from 4.1 to 4.3 kg (Ilişiu et al., 2013).

Another genetic factor influencing birth weight in lambs is the effect of heterosis.

Heterosis effect (from genotype) – Heterosis (heterosis effect) occurs when crossing two or more breeds of sheep and leads to a much larger number of combinations of genes and thus is more likely to express important and favorable economic traits (Petrovic et al., 2013).

In the resulting crossings (F1) heterosis is expressed in increased live weight at birth, viability, higher growth capacity, higher productivity, better resilience and adaptability to environmental conditions, better utilization of feed compared to parental forms (Leymaster, 2002; Petrović et al., 2011, 2019). The most widely heterosis effect is used through the so-called industrial (user) crossbreeding. The purpose of this method is to obtain animals for commodity production with higher growth capacity, better quality meat, lower fodder consumption per 1 kg of growth, which leads to early reaching the desired market weight and brings faster farmer income (Hussain et al., 2013). A number of authors have found that the growth rates of crossbred lambs are better than

those of local lambs, as well as the growth rates before and after weaning (Dawson & Carson, 2002; Momani et al., 2010). Lakew et al. (2014) reported an average birth weight of lambs of local Ethiopian breeds and crossings between local with Dorper, 2.36±0.05 and 3.24±0.04 kg, respectively. The indicator varies from 3.56 kg in Pirot x Württemberg crosses to 3.69 kg in Sjenica x Württemberg (Petrović et al., 2015). Crossbred lambs obtained between 'Bulgarian Dairy Synthetic Population' (BDSP) and Mouton Charollais have the highest average live weight at birth with 4.18 kg, while BDSP weigh an average of 2.83 kg, and crossings between BDSP x Ile de France with 3.978 kg (Ivanov et al., 2015).

Age of ewes – The weight of the ewes and the order of birth have an effect on the birth weight of the lambs. Older ewes give birth to heavier lambs than two-year-old lambs, but this effect decreases when ewes reach the age of 8 (Amores et al., 1998; Babar et al., 2004; Pettigrew et al., 2019). These results are in line with the findings of Gama et al. (1991) in several sheep breeds Finnsheep, Dorset, Rambouillet, Suffolk and Targhee. Depending on the age of the ewe, the variation in birth weight is from 3.38 to 3.82 kg in crossbred lambs from Pirot x Württemberg, while in Sjenica x Württemberg is from 3.43 to 3.95 kg (Petrović et al., 2015). In local breeds of sheep, such as Pirot and Svrljig, Petrovic et al. (2011) found that young and old ewes gave birth to lighter lambs, while middle-aged sheep gave birth to heavier lambs, with statistically significant differences ($P<0.01$). Aljubouri et al. (2021) reported that Avasi and Karakul sheep over 4 years of age gave birth to lambs with a higher live weight (4.45±0.08 kg). In a study by Mellado et al. (2016) young Dorper ewes (aged <20 months, 3.6 kg) gave birth to lambs that were 300 g lighter ($P<0.05$) at birth than ewes aged > 20 months (3.9 kg). Koritiaki et al. (2013) reported a higher birth weight of Santa Inês lambs born to older ewes (4.23±0.19 kg) than those born to younger ewes (2.93±0.27 kg). Eight-year-old ewes of the Ascanian fine fleece breed gave birth to lambs with a live weight higher than the average for the population (101 g), while the youngest ewes had lambs with significantly lower than the average for the population (155 g) (Ktamarenko et al., 2020).

Weight and body condition of ewes – The body weight of ewes at the end of pregnancy is important because a sheep with a higher body weight gives birth to heavier lambs with better survival (Koritiaki et al., 2013). Lambs with higher live weight at birth have more intensive growth and they produce heavier carcasses (Cemal et al., 2005).

Petrovic et al. (2015) report that lambs are heavier in both genotypes if their mother is heavier. The differences were 0.14 kg for Pirot x Württemberg lambs ($P<0.05$) and 0.26 kg for Sjenica x Württemberg lambs ($P<0.05$). Identical results were obtained by Mahala et al. (2019) in lambs of the Avikalin breed. In two local Serbian sheep breeds, Pirot and Svrljig, the effect of maternal weight on live weight at birth was found to be statistically significant ($P<0.05$). Heavier lambs (3.41 kg for Pirot and 3.50 kg for Svrljig) were born from sheep with higher live weight, and lighter lambs were obtained from mothers with lower live weight (3.33 kg for Pirot and 3.37 kg for Svrljig) (Petrović et al., 2011). The birth weight of the lambs was not affected by the body condition score (BCS) of the ewes in mid-pregnancy, but was affected by BCS at the end of pregnancy ($P<0.0001$). Pesántez-Pacheco et al. (2019) reported that Lacon lambs born to sheep with high BCS (BCS≥ 3) were heavier and larger than those born to sheep with low BCS (BCS ≤ 2). Sheep of the Norduz breed with BCS 2.5 gave birth to lambs with a live weight of 4.77±0.11 kg, those with BCS 3-4.92±0.14 33 kg, and with BCS 3.5-5.18±0.29 kg (Karakus & Atmaca, 2016). Live weight and body condition score of ewes are related to nutrition.

Ewes' feeding – The ewes' feeding during pregnancy is a major factor in fetus growth (Caton & Hess, 2010). It must be adapted to the physiological condition of the animals in order to prevent the use of their own body reserves (Robinson et al., 2002). The combination of higher nutrient requirements and low intake, during the beginning of lactation and at the end of pregnancy, in high-yielding animals, can lead to a negative energy balance. This significantly increases the risk of metabolic diseases, especially ketosis, which contributes to significant production losses (Chilliard et al., 2000). According to Reed et al. (2007) and Swanson et al. (2008) decreased nutrient intake

by the ewes during the last two thirds of pregnancy leads to weight loss at birth. The level of maternal feeding between the 30th and 80th day affects birth weight (P<0.01), placental weight, placental activity and the average surface area of cotyledon (P<0.01) (Aysondu & Ozyurek, 2020).

Placental growth in sheep begins approximately on the 30th day of pregnancy (Symonds et al., 2007) and ends by the 100th day (Redmer et al., 2004). Poor feeding from the 28th to the 78th-80th day of pregnancy, when maximum placental growth occurs, reduces placental mass (Symonds et al., 2007) and placental size (Clarke et al., 1998). Changes in placental growth can lead to low birth weight due to the high correlation between placental weight and fetal weight (Mellor & Murray, 1982). It has been found that overfeeding of young ewes during pregnancy leads to rapid growth of the ewe and especially maternal adipose tissue, but at the expense of the nutritional needs of the pregnant uterus. As a result, the rapid growth of the mother leads to limited placental growth, premature birth of low-weight lambs (Wallace et al., 1996, 1999, 2001). In merino sheep Oldham et al. (2011) reported that the effect of poor feeding up to the 100th day of pregnancy can be completely overcome by improving it at the end of pregnancy.Which will lead to weight gain at birth and increase the survival of offspring.

Year, season and month of lambing – Differences in feeding (especially during pregnancy), farm management, availability of fodder, diseases and others in different years are the reasons for the effect of the marketing year on the birth weight of lambs (Hassan & Seyed, 2009). In lambs of Staroplaninski Tsigai and Karakachan breeds, Ivanova et al. (2021) found a highly reliable effect of the economic year on live weight at birth in both sexes (P<0.001). The results obtained for live weight at birth in female lambs of Staroplaninski Tsigai vary between 2.916 kg and 3.706 kg, and of males – between 3.109 kg and 4.271 kg. In both sexes, the highest live weight was at birth in 2019 (P<0.001), and the lowest in 2021. The female Karakachan lambs born in 2019 has the lowest weight (2.822 kg) (P<0.001), and the heaviest are those born in 2020 (3.110 kg). The results are identical for male lambs of the same breed in 2019 (3.211 kg) and in 2020 (3.718 kg). Mean birth weights showed wide variations over the years, ranging from 3.13±0.07 kg (1984) to 4.77±0.07 kg (1995) for the Thalli breed (Hussain et al., 2013). Assan & Makuza (2005) reported that the marketing year had a significant effect (P<0.05) on birth weight in Sabi, Mutton Merino and Dorper sheep. The birth weight observed over three years ranged from 3.35 to 3.87 kg in Pirot x Württemberg lambs and from 3.40 to 3.93 kg in Sjenica x Württemberg lambs (Petrović et al., 2015). Lambs born during the rainy season were heavier at birth than those born during the dry season (Momoh et al., 2013). Higher birth weights were reported in Avikalin lambs born in the spring, probably due to the presence of pastures for ewes before the lambing season (Mahala et al., 2019). Avasi and Karakul lambs born in January showed significantly higher birth weight values (4.65±0.04 kg) than those born in November (3.95±0.08 kg) and December (4.34±0.11 kg) (Aljubouri et al., 2021). The highest (P<0.05) average birth weight was recorded in summer and the lowest in winter and spring in Dorper lambs reared in the intensive care system in Mexico. The lower body weight of lambs born in winter and spring underscores the need to provide additional food to ewes in late autumn to increase fetus growth rates (Mellado et al., 2016).

Type of birth – The type of birth (singles or twins, triplets, etc.) has a significant effect on birth weight and can be explained by the limited uterine space and feeding of lambs during pregnancy (Gamasaee et al., 2010; Momoh et al., 2013). Baneh & Hafezian (2009) report that the live weight of single lambs of all ages and their average daily gain is higher than that of twins due to competition between twins for breast milk, which leads to breastfeeding less milk. The reduction in birth weight compared to the type of birth is greater in females. The most important factor influencing the birth weight of lambs is the number of offspring. The uterine space of the ewe has a limited capacity and with increasing number of offspring the weight at birth of the individual decreases. Lambs born as singles were 0.6 kg heavier (P<0.05) than twins, 1.6 kg heavier than triplets and 1.9 kg heavier than quadruplets (Gluckman & Hanson, 2004; Mellado et al., 2016). The type of birth affects the body weight of Pirot and Svrljig lambs. Changes in birth weight ranged from 3.27

(twins) to 3.48 kg (singles) in the Pirot breed and from 3.36 (twins) to 3.53 kg (singles) in the Svrljig breed (Petrović et al., 2011). Identical results were obtained by Mirderikvandi et al. (2016) in lambs of the Iranian breed Lori Bakhtiari.

In the Ile de France breed, the average live weight at birth of single male lambs (5.1 kg) was 4.36 kg for twins and 3.7 kg for triplets. In female singles the indicator is 4.65 kg, in twins it is 4.23 kg and in triplets – 3.32 kg (Ivanova, 2021).

Lamb's sex – The effect of sex on live weight at birth can be explained by differences in the number of cotyledons (higher in ewes carrying male lambs) and the weight of the placenta (heavier in ewes carrying male lambs) (Jawasreh et al., 2009). The anabolic effect of male sex hormones may also be the reason for the higher birth weight of male lambs (Hafex, 1962). Male lambs are likely to start releasing androgens earlier, growing and developing faster than females (Ebangi et al., 1996). Estrogen hormone has a limited effect on the growth of long bones in females. This may be one of the reasons why female lambs have less body and less weight than males (Rashidi et al., 2008). In the Thalli breed, male lambs showed a higher birth weight (4.21±0.10) than females (3.85±0.08) (Hussain et al., 2013). Similar results were obtained by Babar et al. (2004) in the Indian breed Lohi, in male lambs the average live weight at birth was 3.69±0.02 kg, and in females 3.48±0.02 kg. Mellado et al. (2016) found that male Dorper lambs were on average 200 g heavier at birth than females ($P<0.01$). The average birth weight of both sexes of lambs is almost the same (3.39 and 3.36 kg in Pirot and 3.48 and 3.43 kg in Svrljig) (Petrovic et al., 2011).

CONCLUSIONS

Establishing the links between all these factors in different sheep breeds raised in different climatic zones is necessary to obtain high live weight lambs at birth, alive and healthy, and hence to achieve better economic results on the farm.

It has been found that older and heavier ewes give birth to heavier lambs, and male lambs compared to female, and singles compared to twins have higher birth weight.

Genetic factors, nutrition and farm management have a major impact on live birth weight.

There is an "optimal" birth weight, as a result of which the birth process proceeds naturally and without complications.

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