

The influence of birth type and sex on rearing of Polish Heath and Żelaźnieńska lambs

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ABSTRACT

The aim of the study was to determine the effect of birth type and sex on the rearing parameters of lambs of the Polish Heath and Żelaźnieńska breeds. The research material comprised data from breeding documentation, which was used to determine the prolificacy index, the percentage of live-born lambs, and the survival rate up to 100 days of age. The lambs were weighed at birth and at 56 days of age. Polish Heath sheep were found to have higher prolificacy ($P \leq 0,01$) and a higher percentage of reared lambs ($P \leq 0,01$) than Żelaźnieńska sheep. In the Polish Heath flock, there was a greater proportion of multiple births than singleton births. Single and twin births predominated in the Żelaźnieńska flock. The survival rate of lambs from single births was similar in both breeds. In the flock of Polish Heath sheep, however, lambs from multiple births also had better rearing parameters. In both breeds, singletons and male lambs had higher ($P \leq 0,01$) body weight at birth and at 56 days of age than lambs from twin births and female lambs. Statistically significant differences ($P \leq 0,01$) in body weight at birth and at 56 days of age were also noted between twins and triplets in Polish Heath sheep. The analysis of the distribution of lamb mortality during the rearing period showed that the first week after birth is the most critical for the offspring.

KEY WORDS: sheep, breed, lamb rearing, type of birth

INTRODUCTION

The reproductive performance of lambs largely determines the profitability of sheep production. One of the most important parameters is the prolificacy of the ewe. However, high prolificacy is not always reflected in the number of lambs ultimately obtained in the flock. This depends on rearing outcomes in lambs and their mortality. In flocks of highly prolific sheep, the survival rate can be lower than in less prolific breeds (Niżnikowski et al., 2007). Lambs from single births have higher

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survival rates than lambs from multiple births, which are less viable after birth and more vulnerable to disease (Koząńska-Małkiewicz et al., 2015). In twin pregnancies, and especially in pregnancies with three or more foetuses, survival of the foetuses can be affected by placental failure associated with lower levels of foetal oxygen and glucose, and in late pregnancy with higher lactate concentrations (Dwyer et al., 2005; Rurak and Besette, 2013). Mortality in multiple litters can reach even 30-40%, while the lamb mortality rate considered acceptable in the flock is 5%, which is not difficult to achieve in rearing of singleton lambs (Kenyon and Blair, 2014). The effectiveness of lamb rearing may also be influenced by the milk production of the ewe and her maternal instincts (Kenyon et al., 2019; Milewski and Ząbek, 2008).

The proper development of lambs during rearing is determined by their body weight at birth. Single lambs usually have a higher birth weight and faster growth rate than lambs from multiple births. Differences in body weight between lambs, depending on the size of the litter, can persist until weaning, and in the case of triplets even up to a year of age (Corner et al., 2008; Gholizadeh and Ghafouri-Kesbi, 2015; Kenyon and Blair, 2014; Niżnikowski et al., 2007). The body weight of lambs can be affected not only by the type of birth, but also by sex. Male lambs are usually born heavier and grow faster. This is particularly true of weight gains in the initial period of rearing (Niżnikowski et al., 2007).

Analysis of the factors that can influence the survival rate and development of lambs must take into account the extremely important role of staff that ensure proper supervision and care of the lambs and ewes (Koząńska-Małkiewicz et al., 2015; Sowińska et al., 2006). This is especially important in highly prolific breeds, which include both the Polish Heath and Żelaźnieńska breeds.

The aim of the study was to determine the effect of birth type and sex on the rearing parameters of lambs of the Polish Heath and Żelaźnieńska sheep breeds kept in the same environmental conditions.

MATERIAL AND METHODS

The study was carried out at the Agricultural Experimental Station in Żelazna in 2018 and 2019 in a flock of Polish Heath sheep containing 180 ewes and a flock of Żelaźnieńska numbering 140 ewes. The animals were fed on-farm feed in accordance with nutritional standards (Osikowski et al., 1998). The ewes were mated in a harem system in September and October of each year, and lambing took place in late February and early March. The housing system and environmental conditions were the same for both flocks. The Polish Heath and Żelaźnieńska sheep were looked after by the same qualified staff.

Data obtained from breeding documentation were used to determine the following: prolificacy, as litter size per ewe expressed as a percentage; percentage of live-born lambs; and survival rate as the percentage of surviving lambs up to 100 days of age. The days when deaths occurred during the rearing period were recorded in order to determine the most critical time for survival of lambs. Live-born lambs were weighed at birth and at 56 days of age. The effect of birth type and sex on the survival rate and body weight of the lambs was analysed.

Analysis of variance of the results was performed by the least squares means method using SPSS 23.0 statistics software. The data pertaining to the prolificacy of ewes and the percentages of live-born and reared lambs between breeds were compared using the following model:

$$Y_{ijk} = \mu + a_i + b_j + (ab)_{ij} + e_{ijk},$$

where:

μ – mean,

a_i – breed,

b_j – lambing year;

$(ab)_{ij}$ – interaction (breed x lambing year),

e_{ijk} – error.

The effect of birth type and sex on survival rate and body weight was analysed separately for each breed using the following model:

$$Y_{ijkl} = \mu + a_i + b_j + c_k + (ac)_{ik} + e_{ijkl},$$

where:

μ – mean,

a_i – birth type,

b_j – sex,

c_k – lambing year;

$(ac)_{ik}$ – interaction (birth type x lambing year),

e_{ijkl} – error.

Where the birth type was found to have a significant influence, the differences between groups were tested using the Tukey test.

As the year of lambing and the interactions of lambing year x breed and lambing year x birth type were not shown to significantly influence the parameters analysed, they are not included in the description of the results or in the tables.

Comparison of breeds (Polish Heath and Żelaźnieńska) in terms of the distribution of litter size was performed by the chi-squared test. Differences in the distribution of lamb mortality during the rearing period within each breed were analysed using the Mann-Whitney U test.

RESULTS AND DISCUSSION

The analysis of the breeding parameters of the sheep breeds showed that, in accordance with expectations, Polish Heath sheep had statistically significantly higher ($P \leq 0,01$) prolificacy than Żelaźnieńska sheep (199,7% vs 161,8%). This breed also had a statistically significantly better ($P \leq 0,01$) survival rate (91,4% vs 83,2%), while the percentage of live-born lambs was similar for both genotypes (tab. 1).

The distribution of births registered in the flocks indicates a higher percentage of twin births ($P \leq 0,01$) and larger litters ($P \leq 0,01$) and a much lower percentage ($P \leq 0,01$) of single births in Polish Heath sheep than in Żelaźnieńska sheep. Twin births and single births predominated in Żelaźnieńska sheep, while larger litters were extremely rare (fig. 1).

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Similar results for prolificacy were previously obtained by Niżnikowski et al. (2015), who reported prolificacy of Polish Heath at a level of 1,90 lambs per ewe, while the average value for

Żelaźnieńska sheep was 1,45. Much lower mean prolificacy values for Polish Heath and Żelaźnieńska sheep (1,40 and 1,54) were reported by Milewski (2010), who analysed all flocks of these breeds covered by the Genetic Resources Conservation Programme. Prolificacy in the present study, especially for Polish Heath sheep, was much higher than the standard established by the National Research Institute of Animal Production, according to which the prolificacy of these breeds should be 1,50 and 1,70. The survival rates of the lambs of both breeds were not entirely satisfactory. Mortality among Polish Heath lambs exceeded the upper limit of 5% by 3,6 p.p. In Żelaźnieńska sheep, mortality was as high as 16,8%. Niżnikowski et al. (2007) reported similar survival rates in Polish Heath lambs from the same flock (about 91%). Another study by Niżnikowski et al. (2015) showed better rearing parameters in Polish Heath and Żelaźnieńska sheep than in crossbreds of these breeds with Berrichon du Cher. This is in conflict with the view presented by Hinch and Brien (2014), according to which lower survival rates are usually noted in purebred animals. The generally low survival rate of lambs may be linked to the level of prolificacy in the flock. Piwczyński et al. (2013) showed that in a flock of Finnish sheep with prolificacy of 235%, the survival rate was only 67%, while in Romanov sheep with prolificacy of 239% it was 80%.

Table 1

Effect of analysed factors and interactions on breeding parameters of sheep

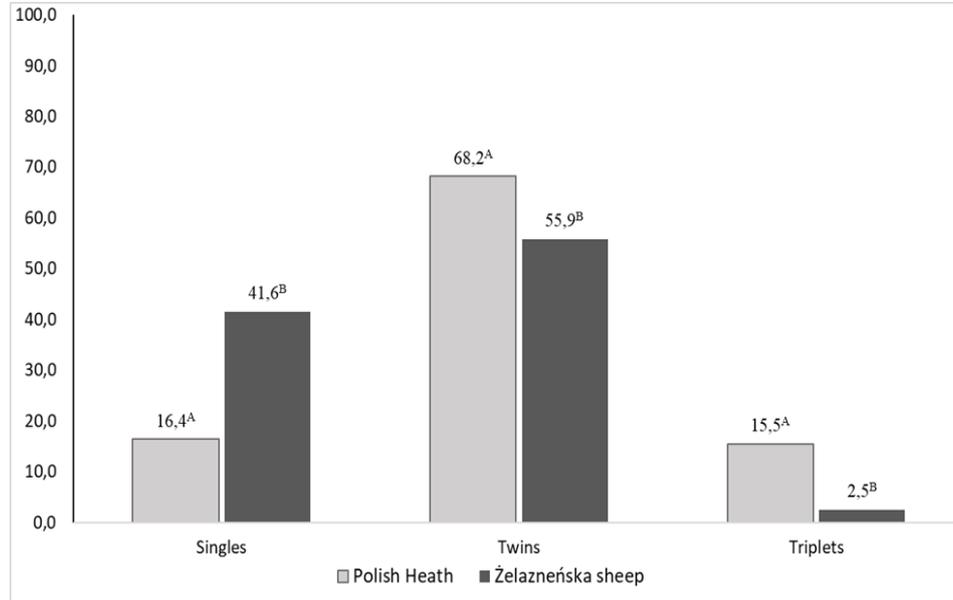
	Grand mean	Degrees of freedom	Mean square	F-value	P value
Prolificacy					
breed		1	36,200	109,606	0,000
lambing year	180,0	1	1,053	2,898	0,089
breed x lambing year		1	0,907	2,742	0,098
Live-born lambs					
breed		1	0,044	1,565	0,211
lambing year	97,0	1	0,000	0,008	0,931
breed x lambing year		1	0,031	1,086	0,298
Lamb survival rate					
breed		1	1,607	16,456	0,000
lambing year	87,3	1	0,156	1,505	0,220
breed x lambing year		1	0,007	0,074	0,786

Survival rates and rates of live births among lambs largely depend on litter size. Analysis of the percentage of live births and the survival rate in the two breeds reveals the best results in the group of singletons. In Żelaźnieńska sheep, the survival rate of lambs from single births reached 91,3% - 14,1% higher ($P \leq 0,01$) than in the case of twin births and 24,6% higher than in triplet births. It should be noted that triplet births in that breed accounted for only 2,5% of all births (fig. 2).

In Polish Heath sheep the survival rate of lambs from single births was similar to that of Żelaźnieńska lambs. In this flock, however, rearing was also much more successful in lambs from multiple births. There were practically no differences in the survival rates of singletons and twins,

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while that of triplets was slightly lower, although the differences were not confirmed statistically. Differences between singletons and triplets ($P \leq 0,01$) in Polish Heath sheep were noted for the percentage of live-born lambs. In the group of single births, all lambs were born alive; stillbirths accounted for only 2,2% among twins and 6,1% in triplets (fig. 3).



A, B – values with different letters within litter size differ significantly at $P \leq 0,01$

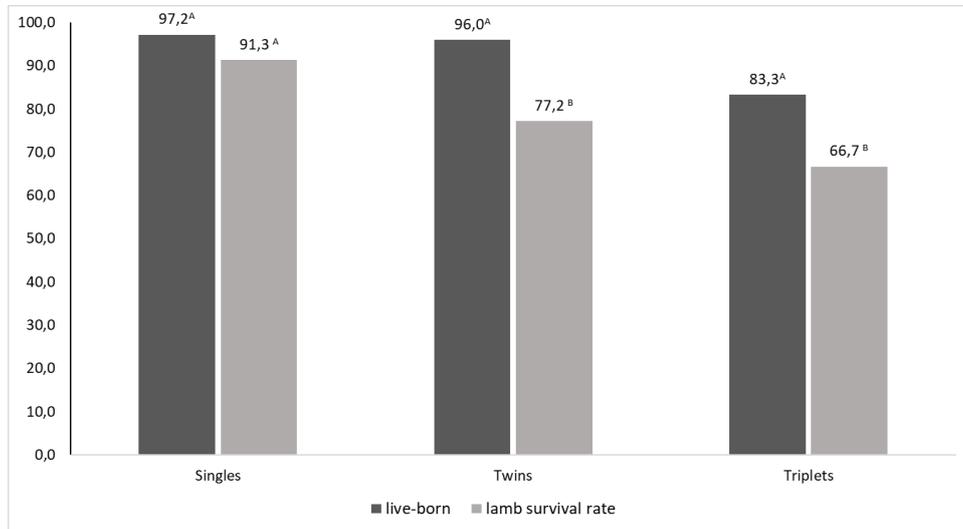
Fig. 1. Distribution of litter size (%) in the two breeds

Problems obtaining live births and with rearing of larger litters have been discussed by Hinch and Brien (2014), who emphasized that rearing losses among twins can be even 2,5 times the level in single births. Niżnikowski et al. (2007), in an earlier study on the Polish Heath flock, also noted a higher survival rate among singletons – 96%, compared to 94% in twins and only 86% in triplets. Good rearing parameters can sometimes be attained in very large litters of lambs, even in quadruplets, which may be the effect of extra care by the breeders in the case of this type of birth (Kenyon et al., 2019). This was confirmed by Niżnikowski et al. (2012) in a study on the meat breeds Charollais and Suffolk, in which the survival rate of triplets was 100%.

Litter size and sex are factors that can influence the birth weight of lambs and thus their further growth and development. This also affects their survival rate and rearing. The Żelaznieńska lambs from single births had a higher birth weight ($P \leq 0,01$) than twins and triplets (Fig. 4). The birth weight was reflected in the weight at 56 days, which was highest among the singletons. The body weight of triplets at that time was higher than that of twins, but the differences were not confirmed statistically between any of the birth types (fig. 4).

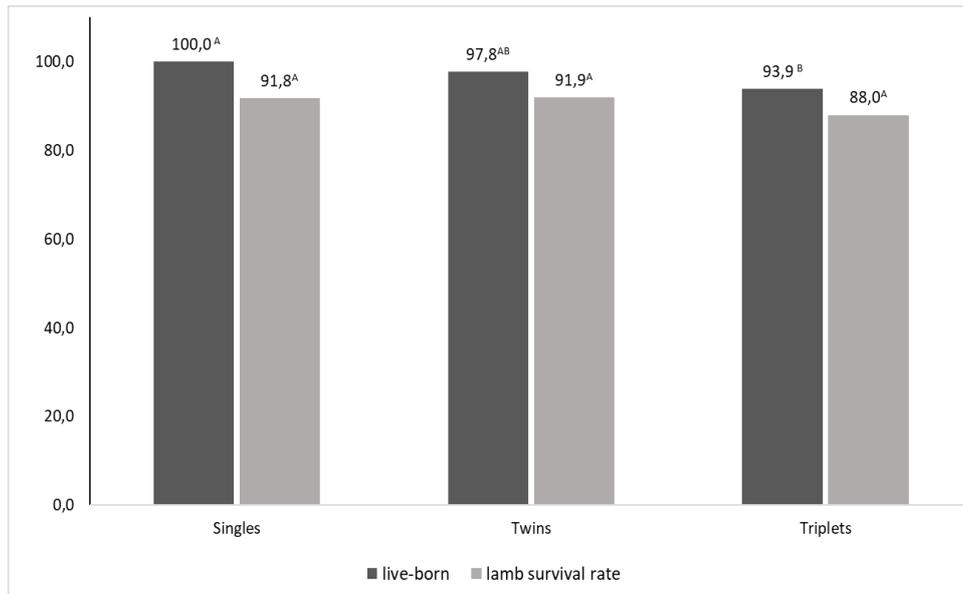
The results obtained for Polish Heath lambs confirm the rule that the larger the litter size, the lower the body weight and growth potential in subsequent stages of growth. Singletons of this breed

had a higher average birth weight ($P \leq 0,01$) than twins and triplets. Differences in birth weight ($P \leq 0,01$) were also noted between twins and triplets. Similarly, differences were observed ($P \leq 0,01$) in body weight at 56 days between all birth types (fig. 5).



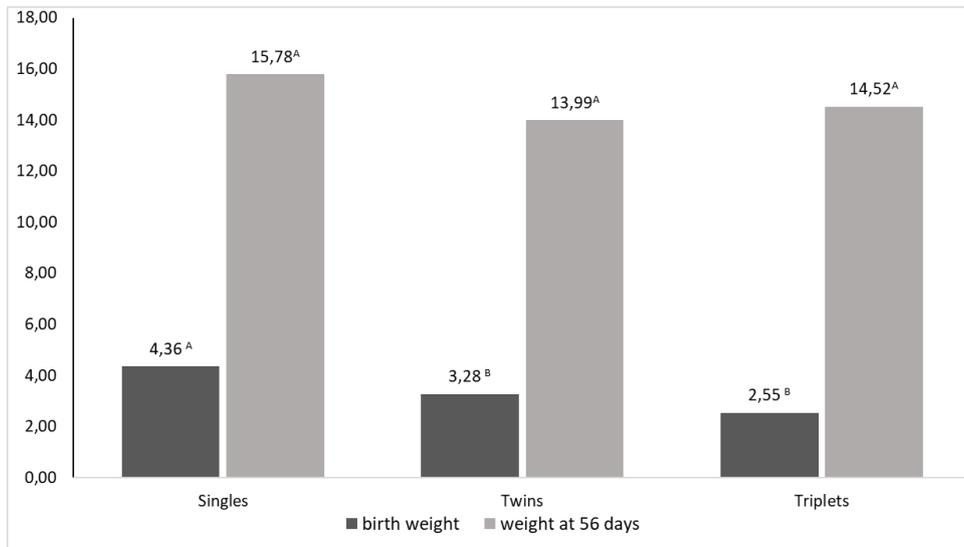
A, B – values for survival rates of lambs with different letters differ significantly at $P \leq 0,01$

Fig. 2. Live births (%) and survival rate of Żelaźnińska lambs (%) depending on litter size



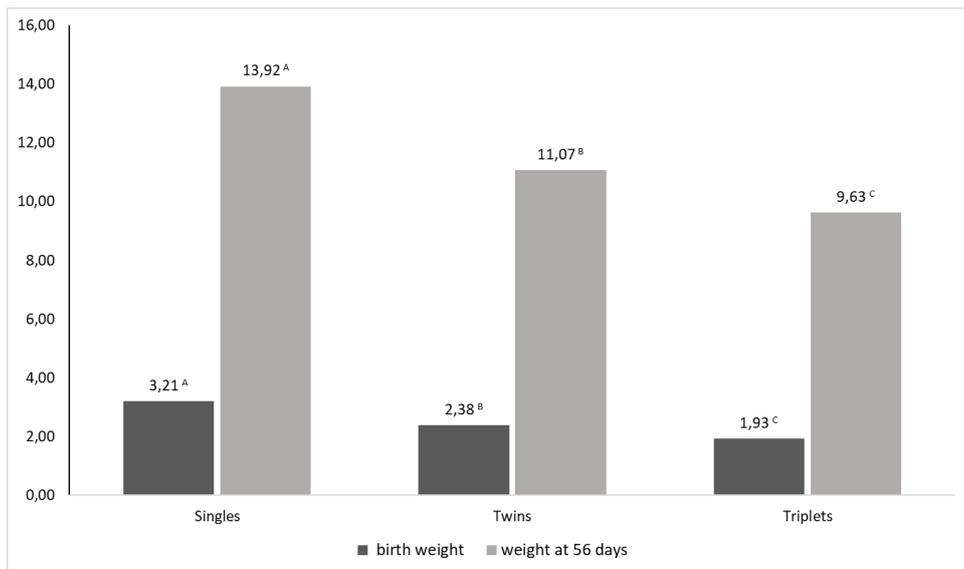
A, B – values for live-born lambs with different letters differ significantly at $P \leq 001$

Fig. 3. Live births (%) and survival rates of (%) Polish Heath lambs depending on litter size



A, B – values for birth weight with different letters differ significantly at $P \leq 0,01$

Fig. 4. Body weight (kg) at birth and at 56 days in Żelaźnińska lambs depending on birth type



A, B, C – values for body weight at birth and at 56 days with different letters differ significantly at $P \leq 0,01$

Fig. 5. Body weight at birth and at 56 days in Polish Heath lambs depending on birth type

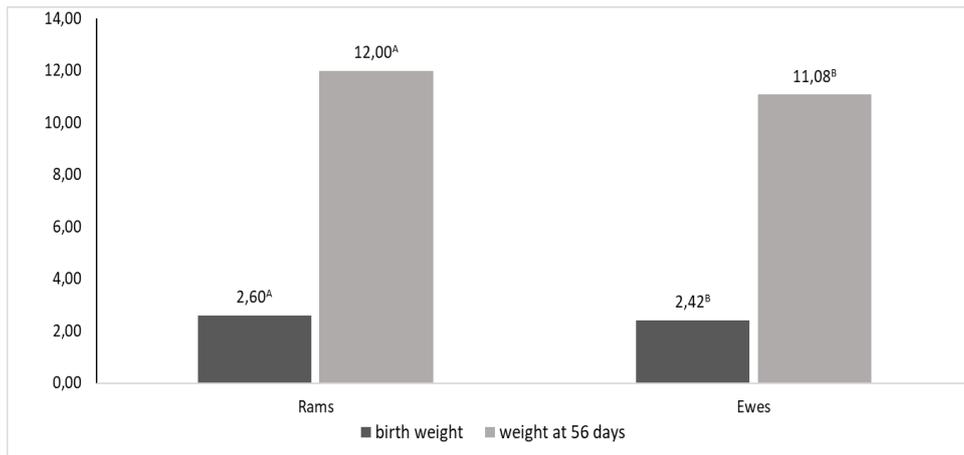
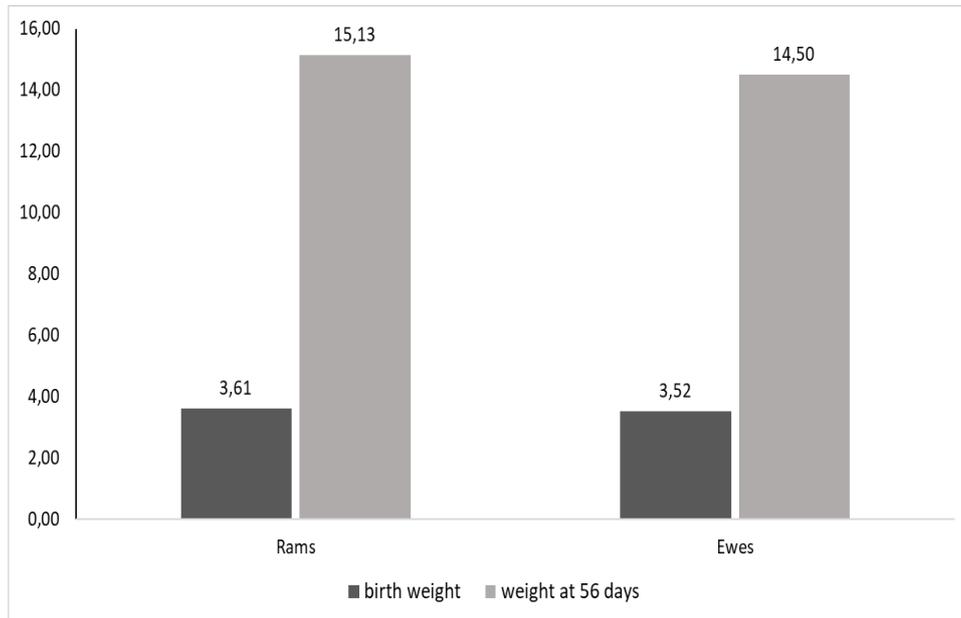


Fig. 6. Body weight at birth and at 56 days in Żelaźnieńska lambs depending on sex



A, B – values for body weight at birth and at 56 days with different letters differ significantly at $P \leq 0,01$

Fig. 7. Body weight at birth and at 56 days in Polish Heath lambs depending on sex

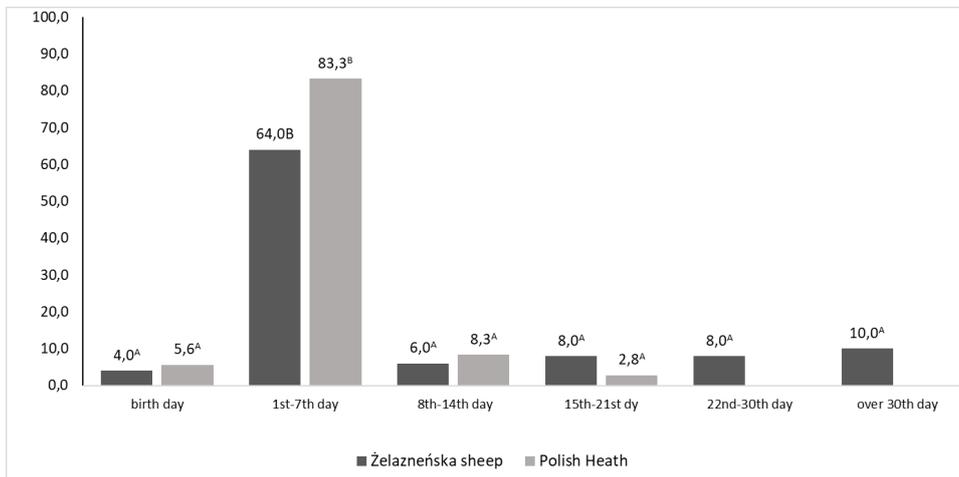
Analysis of the effect of sex on body weight at birth and at 56 days in Żelaźnieńska lambs revealed greater weight in males than in females, but the differences were not statistically significant (fig. 6). Among Polish Heath lambs, males had significantly higher ($P \leq 0,01$) body weight than females, both at birth and at 56 days. Polish Heath sheep have a slight build, so they attain lower

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body weights than Żelaźnieńska sheep. The male Polish Heath lambs in the present study had an average birth weight of 2,6 kg, while that of females was on average 0,18 kg lower. The differences between the body weights of males and females increased during their development. Males at 56 days weighed on average 12 kg, while females weighed nearly 1 kg less (fig. 7).

Junkuszew et al. (2015), in a study on synthetic prolific meat lines, also reported differences in body weight at birth and at 56 days depending on birth type and sex. The authors showed that singleton lambs had higher body weight than twins and triplets, and that males weighed more than females. Niżnikowski et al. (2007), in a study on Polish Heath lambs, also noted higher birth weight in singletons and males. Results obtained by Milewski (2010) regarding weight gains in lambs of this breed confirmed that males showed greater potential in body weight development.

The present study also included an analysis of the distribution of deaths of lambs during the rearing period in the two breeds. The first week of life proved to be the most critical period for the offspring. In the Żelaźnieńska breed, 64% of all recorded deaths occurred during this period ($P \leq 0,01$), and in Polish Heath as many as 83,3% ($P \leq 0,01$; fig. 8). The mortality rate showed a marked decrease after this period and was more uniform. In Polish Heath sheep no deaths were noted after 22 days of age, while in the Żelaźnieńska breed deaths were also noted after 30 days. Thus the survival rate of Polish Heath lambs at 7 days of age was 92,8%, while that of Żelaźnieńska lambs was 89,3%. In an earlier study by Niżnikowski et al. (2007), the survival rate of Polish Heath lambs at 7 days of age was 95%.



A, B – values within breeds with different letters differ significantly at $P \leq 0,01$

Fig. 8. Distribution of mortality (%) of lambs of the Żelaźnieńska and Polish Heath breeds depending on the stage of the rearing period

Like the present study, another study by Niżnikowski et al. (2015) conducted on both Polish Heath and Żelaźnieńska sheep also showed that the former breed had a better survival rate at 7 days of age.

Bangar et al. (2016) studied the timing of deaths of Deccani lambs in India. Mortality in the flock was 2,2% in lambs up to one month of age, 4,7% up to weaning, and 10,1% up to one year of age. The authors stressed that birth weight was a factor determining the survival rate of lambs in the first few days of life. In addition, higher mortality was noted during the rainy season.

CONCLUSIONS

Polish Heath sheep had a higher level of prolificacy and a higher lamb survival rate than Żelaźnieńska sheep. The percentage of twin births and larger litters was also higher in Polish Heath sheep, and the proportion of single births was lower than in Żelaźnieńska sheep.

Birth type influenced both the percentage of live births and the survival rate of Żelaźnieńska lambs, with more favourable parameters noted for single births. In Polish Heath sheep the survival rate of lambs was similar for all birth types.

Body weight at birth and at 56 days of age was shown to depend on both litter size and sex. Lambs from single births and male lambs had higher body weight in both periods than lambs from multiple litters and female lambs, irrespective of genotype. Analysis of deaths in the flock showed that the first seven days of life are the most critical period in rearing of lambs.

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Wpływ typu urodzenia i płci jagniąt na parametry ich odchowu u owiec rasy wrzosówka i żelaźnińska

Streszczenie

Celem badań było określenie wpływu typu urodzenia oraz płci na parametry odchowu jagniąt w stadzie owiec rasy wrzosówka i żelaźnińska. Materiał do badań stanowiły dane zawarte w dokumentacji hodowlanej, które wykorzystano do określenia wskaźnika plenności, procentowego udziału żywo urodzonych jagniąt i wskaźnika odchowu jagniąt do 100 dnia życia. Kontrolę masy ciała jagniąt przeprowadzono po urodzeniu oraz w 56 dniu życia. Większy wskaźnik plenności ($P \leq 0,01$) oraz większy procent ($P \leq 0,01$) odchowanych jagniąt określono w stadzie owiec wrzosówkowych w porównaniu do owiec żelaźnińskich. W stadzie owiec wrzosówkowych odnotowano większy udział miotów bliźniaczych i bardziej licznych. U owiec żelaźnińskich dominowały mioty pojedyncze i bliźniacze. Wskaźnik odchowu jagniąt pochodzących z miotów pojedynczych kształtował się na podobnym poziomie u obydwu badanych ras. Natomiast w stadzie owiec wrzosówkowych znacznie lepiej odchowowały się także jagnięta z miotów mnogich. Jagnięta tryczki urodzone pojedynczo charakteryzowały się większą ($P \leq 0,01$) masą ciała przy urodzeniu oraz w 56 dniu życia w porównaniu do jagniąt pochodzących z miotów bliźniaczych i jagniąt maciorek zarówno u owiec wrzosówkowych jak i żelaźnińskich. Statystycznie istotne różnice ($P \leq 0,01$) w masie ciała przy urodzeniu i w 56 dniu zarejestrowano także pomiędzy bliźniętami i trójczkami u wrzosówki. Analiza rozkładu upadków jagniąt w okresie odchowu wykazała, iż najbardziej newralgicznym okresem jest pierwszy tydzień życia narodzonego potomstwa.

SŁOWA KLUCZOWE: owce, rasa, odchów jagniąt, typ urodzenia