REPRODUCTIVE
BIOLOGY

Ovulation level and prolificacy in ewes depending on their age, birth type and percentage of prolific genotype

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SUMMARY

During December mating periods of 2000-2003, wool and meat breeds crossed with East Friesian milk sheep and rams of prolific breeds (Finn or Romanov) were examined laparoscopically. Ovine ovaries were examined between 4 and 9 days after mating. The litter size was recorded and compared with the number of ovulations. The fertility of the analyzed animals was 69.6%, with 192.6% prolificacy. The difference between the average number of corpora lutea found on ovaries and the mean number of lambs born was 0.35 and ranged from 0.32 to 0.41 according to age group, from 0.22 to 0.41 according to sheep birth type, and from 0 to 0.52 lamb per ewe according to percentage of prolific breeds. *Reproductive Biology 2006* ***6*** *Suppl. 2:73–78*.

Key words: crossbred sheep, laparoscopy, ovulation, prolificacy

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INTRODUCTION

Prolificacy can be improved genetically through purebred selection or by introducing prolific breeds into a sheep flock genotype. However this method is very time consuming, so in order to achieve adequate results more quickly, it is necessary to use non-genetic methods that increase the ovulation rate [6] or accelerate the assessment of ovulation [3]. Hormonal stimulation gives immediate results only during the season in which it is used. At present, increasing prolificacy and milk yield is the primary aim of research by developing new genotypes using Finn, Romanov or East Friesian sheep [6, 7].

This study was done to determine the level of reproductive traits in crossbred ewes and in particular the relationship between the rate of ovulation and the level of prolificacy. The possible effects of age, birth type and percentage of prolific genes can provide a basis for determining selection criteria for sheep with high prolificacy.

MATERIALS AND METHODS

Laparoscopic observations were made in 2000-2003 during a single reproductive cycle of December matings at a sheep farm of the Animal Production Experimental Station in Kołuda Wielka, Poland. A total of 483 experimental crossbreds and 191 control crossbreds of wool and meat breeds crossed with East Friesian milk sheep and rams of prolific breeds (Finn or Romanov) were investigated. The crossbreds were divided into four groups according to the percentage of prolific genes (0, 25, 37.5 and 50%), in which the proportion of East Friesian milk sheep was 50, 50, 37.5 and 25%, respectively. The study included ewes of four age groups (8, 20, 32 and ≥44 months) divided into three groups according to ewe birth type (singles, twins, and triplets together with a small number of quadruplets). Ewes in estrus were detected by using teaser rams, and "hand mated" twice with a 12-hour interval. Ovaries of the experimental ewes were examined laparoscopically between 4 and 9 days after mating (fig. 1),

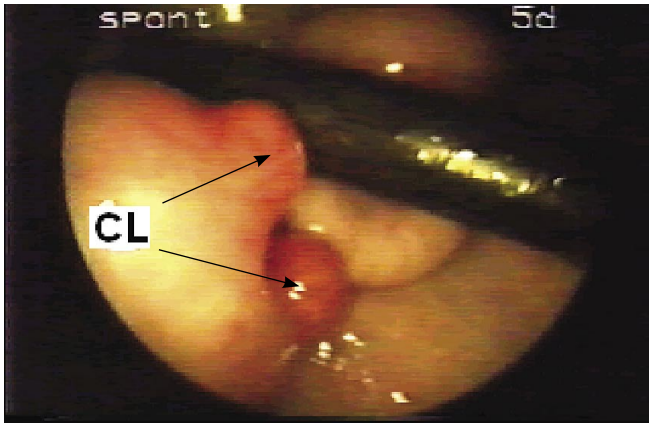

Figure 1. Sheep ovary with two 5-day-old corpora lutea.

while the control animals were not examined. Animals were submitted to general anesthesia with 2% xylazinum (Sedazin, 0.01 ml/kg body weight, Biowet, Puławy), placed on a special table and locally anesthetized with Lignocain (Polfa, Warszawa). The use of animals was in accordance with the guidelines established by the Polish Ethical Committee and under the supervision of a veterinarian. The same worker laparoscopically examined the ovaries of 30-40 ewes per day. The ovulation rate was reflected by the number of corpora lutea (CL) found on both ovaries. Litter size was recorded after lambing and compared with the number of ovulations. The data were analyzed statistically with Statistica software using analysis of variance (GLM, factorial ANOVA), Duncan's multiple range test and the CHI^2 test.

RESULTS AND DISCUSSION

A total of 1077 CL were found on the examined ovaries, averaging 2.23 CL/ewe. There were 766 CL in 336 lambing ewes. Of the examined 336 ewes, 12.6% had 1 CL, 56.9% had 2 CL, 25.7% had 3 CL, 4.4% had 4 CL and 0.4% carried 5 CL. Fertility of ewes ranged from 63 to 78% (tab. 1) and averaged 69.6% with 192.6% of prolificacy. The lambing ewes averaged 2.28

Table 1. Parameters of fertility and potential and actual prolificacy of the analyzed ewes

Groups of factors analyzed		No. of lambing ewes	Fertility	CL/ewe	Lambs/ewe	Difference between CL and lambs	
			%	$\bar{x}$	$\bar{x}$	head	%
Age of ewes during mating (months)	8	83	65.9	1.867 ^{C}	1.458 ^{B}	0.41	21.9
	20	73	62.9	2.247 ^{Bb}	1.931 ^{A}	0.32	14.0
	32	60	71.4	2.533 ^{A}	2.150 ^{A}	0.38	15.1
	≥ 44	120	76.4	2.458 ^{Aab}	2.133 ^{A}	0.33	13.2
Birth type of ewes	single	65	77.7	2.108	1.892	0.22	10.2
	twin	230	69.7	2.343	1.930	0.41	17.6
	triplet + quadruplet	41	63.1	2.195	1.951	0.24	11.1
% of prolific breed in genotype	0	39	62.9	1.974 ^{Bb}	1.974 ^{ac}	0	0
	25	162	66.9	2.203 ^{Ba}	1.883 ^{bc}	0.32	14.6
	37.5	63	77.8	2.222 ^{Ba}	1.698 ^{Bb}	0.52	23.6
	50	72	73.5	2.667 ^{A}	2.194 ^{Aa}	0.47	17.7

$^{A, B}$ $p \leq 0.01$; $^{a, b, c}$ $p \leq 0.05$, within each group of analyzed factors

CL/sheep and 1.93 lambs. The difference between the potential prolificacy evaluated based on the number of CL found and the actual number of lambs born was 0.35 lamb per ewe. It was 0.41, 0.32, 0.38 and 0.33 according to age group, 0.22, 0.41 and 0.25 according to ewe birth type, and 0, 0.32, 0.52 and 0.47 lamb per ewe according to the percentage of prolific genotype. The differences are given in absolute terms and as a percentage in Table 1.

In the analyzed population, as much as 87% of animals had the most favorable number of 2-4 CL (fig. 1). Two sheep with 5 CL belonged to the oldest age groups, while the least desirable number of 1 CL was carried by 61 animals, primarily from the youngest age group. The potential prolificacy of the crossbred group was very high and proved to be higher or comparable to the results of other authors [6, 7]. Further improvement in litter size has been curtailed by the limited possibility of lamb rearing.

From 336 lambing ewes a total of 647 lambs were born, averaging 1.93 lambs per ewe. Both a prolificacy of 192.6% and a fertility of 69.6% in one cycle can be considered to be good. However, animals of the experimental group had 14 and 20 percentage points lower fertility compared with a group of sheep not undergoing laparoscopy [2]. Such a large drop surprised us since no previous research using laparoscopy indicated such a possibility. Probably the drop in fertility is due to the negative effects of laparoscopy on the nesting of the embryo. This is reflected in the fertility results but it did not lower prolificacy. The experimental group had a mean of 1.81 lambs while the control group with no laparoscopic observations – 1.74 lambs per ewe [2].

As expected, the number of lambs born proved an average of 0.35 points lower than the CL number estimated laparoscopically. The age of ewes during mating and the percentage of breed in the genotype had a greater effect on the number of CL and lambs born than birth type of animals.

Evaluation of the ovulation rate proved the most promising of the known intermediate criteria for prolificacy selection. Observations made on young ewes in a replication with further cycles provide a reliable evaluation of an animal's breeding value, as indicated by Martyniuk [4]. Ślósarz and Stanisz [7] considered measurements at eight months of age to be a good basis for evaluating an ewe's ovulation rate during her first four years. Considering the estimated relationships based on two repeated studies, these authors believe that the lifetime prolificacy of ewes can be shown with a high degree of reliability. Our laparoscopic observations of ovaries of crossbred ewes conform to the findings of Patkowski and Pięta [6], who obtained better results in the older age groups of ewes. In terms of reproductive value, ewes mated at eight months of age are inferior to

the other groups. Despite this tendency, such young animals are mated in an attempt to accelerate the evaluation of breeding. High accuracy laparoscopy was also used with success by Murawski [5] in work concerning high prolificacy in native Olkuska sheep. The identification of animals carrying this gene would allow it to be introduced into a population of sheep of any breed [4]. This would accelerate the effects of selection and increase the extent to which prolificacy is improved.

Of the two methods used to evaluate the rate of ovulation in small animals, the ultrasonic method is of greater practical use, since it is less invasive as well as easier and cheaper to use, although less accurate with respect to corpora lutea evaluation. Laparoscopy, which we have also used for intrauterine insemination, enables a better visual control of the ovary status and above all facilitates manipulations in the abdominal cavity. The latter method is also used to control oocyte collection and gamete transplantation techniques [1, 3].

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