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Performance and slaughter value of Polish Merino, Booroola and Suffolk crossbred lambs*

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ABSTRACT

Polish Merino lambs (ewes and rams, n=322) and crossbred Polish Merino, Booroola and Suffolk lambs were raised for 8 weeks, then intensively fattened (rams, n=66) to a body weight of 35 kg. Lambs with a genotype of 75% Merino and 25% Booroola (MBM) had lower daily weight gains (181 g; P≤0.01) during raising than Merino lambs (MM, 212 g). This relationship was not found in lambs with a genotype of 25% Merino, 25% Booroola and 50% Suffolk (MBS, daily gain 215 g). Body weight gains (372 g) of MBS rams were larger (P≤0.01) during fattening than those of MBM (301 g) and MM (309 g) rams. MBS rams utilized less (P≤0.01) concentrate dry matter, crude protein and metabolizable energy (2.9 kg, 608 g and 35.29 MJ) per kg body weight gain than MBM (3.5 kg, 735 g and 42.63 MJ) and MM (3.5 kg, 721 g and 41.86 MJ) rams, respectively. The slaughter value of MBS and MM rams was similar, while that of MBM rams was inferior due to the higher fat content of the carcasses.

KEY WORDS: crossbred lambs, fattening performance, slaughter value

INTRODUCTION

The lifting of export quotas on meat-type lambs in trade with the European Union has stimulated interest in developing this area of production in Poland. However, the size of these herds in Poland is insufficient to provide an appropriate number of high commercial quality lambs for export. One of the conditions that must be met to make the lambs bred in Poland suitable for profitable meat produc-

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tion is improving their breeding performance and slaughter value (Krupiński, 1992). The use of rams from prolific breeds and rams from meat-type breeds for crossing with ewes of indigenous breeds for production purposes may be one of the possible methods of producing high quality meat-type lambs (Osikowski and Borys, 1989).

The objective of this study was to determine the performance and slaughter value of crossbred lambs of Polish Merino, Booroola and Suffolk breeds.

MATERIAL AND METHODS

In 1994 and 1995, Merinobooroola ewes (50% Merino and 50% Booroola) were mated with Suffolk or Polish Merino rams, obtaining 103 lambs with a genotype of 25% Merino, 25% Booroola and 50% Suffolk (MBS) and 121 lambs with a genotype of 75% Merino and 25% Booroola (MBM). The control group comprised 98 Polish Merino lambs (MM, 100% Merino). During the initial 8-week period of raising, the lambs (ewes and rams) were housed in groups with their mothers in straw lined boxes. In the first 14 days of life triplets and quadruplets were fed additionally three times daily with cow colostrum (not more than 250 g per head in the first week of life), then to the end of the raising period (56 days), with cow's milk, up to 500 g per head daily. From the second week of life all of the lambs were provided with constant access to standard concentrate mixture (CJ) and meadow hay. The amount of feed consumed during this period was not recorded. The lambs were weighed on days 2, 28 and 56 of life.

Fattening performance and slaughter value of lambs representing three genotypes (MBS, MBM and MM) were evaluated on rams (22 animals of each genotype) from singleton, twin and triplet births. After weaning rams were placed in individual straw-lined pens and fed individually with a granulated concentrate mixture until reaching a body weight of 35 ± 1 kg. The amount of feed consumed was

TABLE 1

Composition of concentrate mixture

Ingredient	%
Ground oats	10.00
Ground barley	47.00
Soyabean oilmeal, 45% CP	17.00
Groun field bean	13.00
Dried sugar beet pulp	9.10
Limestone, 37 % Ca	2.73
Fodder salt, 38 % Na	0.17
Beet molassed	1.00

recorded for each ram (Table 1). In order to ensure proper rumen function, meadow hay from the first cutting was additionally provided in an amount of 100 g per day. The rams did not consume the entire amount. The animals were weighed weekly and feed was sampled for analysis. The basic chemical composition of feed was determined using conventional methods (Skulmowski, 1974). Neutral detergent fibre (NDF), acid detergent fibre (ADF) and acid detergent lignin (ADL) in feeds were determined according to Tecator Application Notes (Tecator, Sweden) No. 06/78, 03/78 and 04/78, respectively. Metabolizable energy content (ME) in dry matter (DM) of concentrate was calculated on the basis of the results of our own chemical analyses adapting equation no. 75 given by MAFF (1975):

$$\text{MJ ME/kg DM} = 0.012\ X_1 + 0.031\ X_2 + 0.005\ X_3 + 0.014\ X_4$$

where X_1, X_2, X_3 and X_4 – the content (g/kg DM) in feed concentrate of crude protein, ether extract, crude fibre and N-free extractives, respectively.

The chemical composition of feeds and energy value of the concentrate are given in Table 2.

TABLE 2

Chemical composition of feeds, g/kg DM

Component	Concentrate mixture		Meadow hay	
	g/kg	SD	g/kg	SD
Dry matter	879	18.3	860	34.1
In dry matter				
organic matter	915	7.2	932	13.5
crude protein	209	9.9	116	25.3
crudr fibre	71	10.8	340	22.2
ether extract	22	8.3	17	3.8
N-free extractives	613	21.1	459	36.9
NDF	195	19.6	688	40.8
ADF	96	9.0	386	28.4
ADL	15	5.0	42	5.4
Metabolizable energy, MJ/kg DM	12.1	0.14		

After completion of fattening, the rams were slaughtered and the carcasses subjected to analysis (Nawara et al., 1963). The pH (using a PH-STAR CPU, Germany) and conductivity (LF-STAR CPU, Germany) were measured in the loin and round before dissection (45 min and 24 h after slaughter), and 24 h after slaughter the colour of the loin was evaluated (OPTP-STAR CPU, Germany). After dissecting the carcass into cuts, samples were taken from mid-loin for determination of dry matter (Polish Standards, 1973), fat (Polish Standards, 1972) and crude protein (Polish Standards, 1975).

The results were subjected to multifactorial variance analysis using the least squares method (Harvey, 1990).

Assessment of the growth of all of the lambs (ewes and rams) in the rearing period was analyzed using the model:

$$Yijkl = u + ai + bj + ck + dl + eijkl$$

Assessment of performance and slaughter value of rams was analyzed using the model:

$$Yijk = u + ai + bj + (a \times b)ij + ck + eijk$$

where:

Yijk(l) – the analyzed trait
u – overall average
ai – effect of year (1, 2)
bj – effect of genotype (1, 2, 3)
ck – effect of birth type (1, 2, 3, 4)
dl – effect of sex (1, 2)
(a x b)ij – interaction (year x genotype)
eijk(l) – error

RESULTS AND DISCUSSION

Merinobooroola ewes bore lambs with significantly ($P \leq 0.01$) lower body weights (MBS=3.8 kg and MBM=3.4 kg) (Table 3) than Merino ewes (MM lambs=4.4 kg), which is in agreement with our earlier results (Klewiec and Gabryszuk, 1996). These differences were probably related to the younger age and larger litters of ewes carrying the Booroola genes than of Merino ewes (Anderson et al., 1997). In the first month of rearing, in which birth weight and the mother's milk yield have the greatest influence on a lamb's growth (Dankowski et al., 1993), the Merino lambs (MM) had the highest average daily weight gains (226 g), significantly exceeding that of MBS (207 g; $P \leq 0.05$) and MBM (187 g; $P \leq 0.01$) crossbreeds. In the next 4 weeks (days 29-56 of life), the MBS crossbreeds grew fastest, and their daily gains (229 g) were significantly higher than those of the MBM (184 g; $P \leq 0.01$) and Merino lambs MM (210 g; $P \leq 0.05$). During the entire period of rearing (days 2 – 56 of life) the daily gains of MBS lambs and Merino lambs were similar (215 and 212 g, respectively) and significantly ($P \leq 0.01$) higher than of MBM lambs (181 g). The MBS lambs were characterized by fast growth and at the age of 56 days did not differ in terms of body weight (15.6 kg) from Merino (MM) lambs (16.0 kg), whose dominance over the crossbreeds was visible at birth and at 28 days of life. Of the three compared genotypes, MBM lambs performed least

TABLE 3

Liveweight (kg) and daily liveweight gain (g) of weaning lambs

Item	Type of birth	Genotype						Sex				
		MBS		MBM		MM		ewes		rams		SEM
		n		n		n		n		n		
Liveweight at the age, days												
2	1	17	4.7^{A}	6	3.7^{B}	25	5.4^{C}					
	2	43	3.8^{A}	71	3.6^{A}	66	4.5^{B}					
	3	32	3.4^{A}	35	2.8^{B}	7	3.7^{A}					
	4	11	2.7	9	2.5	0						
	mean	103	3.8^{A}	121	3.4^{B}	98	4.4^{C}	153	3.5^{A}	169	3.8^{B}	0.07
28		86	9.3^{A}	110	8.3^{B}	87	10.2^{C}	133	9.0^{A}	150	9.5^{B}	0.19
56		85	15.6^{A}	105	13.3^{B}	82	16.0^{A}	127	14.4^{A}	145	15.5^{B}	0.30
Daily liveweight in the period, days												
2-28		82	207^{a}	104	187^{Ab}	82	226^{Bb}	125	202	143	212	5.1
29-56		84	229^{Aa}	99	184^{B}	79	210^{Ab}	121	201^{b}	141	215^{a}	4.7
2-56		84	215^{A}	105	181^{B}	81	212^{A}	126	195^{B}	144	210^{A}	4.0

a, b – P≤0.05; A, B – P≤0.01

well during the rearing period. Similar relationships indicating lower viability and poorer growth during rearing of Merino lambs having Booroola genes were found by Osikowski and Borys (1996).

On the day that fattening began, MBS and MM rams had similar body weights (17.7 kg and 18.7 kg, respectively), which were significantly (P≤ 0.01) higher than the body weight of MBM rams (15.5 kg) (Table 4). MBS and MM rams achieved slaughter weight fastest (at the age of 106 and 110 days, respectively). The fattening of MBM rams lasted 16 days longer than MBS rams (P≤ 0.01) and 12 days longer than MM rams MM (P≤ 0.05). During the fattening period MBS rams showed the largest daily weight gains (372 g); this was significantly more (P≤ 0.01) than the gains of MBM (301 g) and MM (309 g) rams. Concentrate feed utilization was also best in the MBS group, where a significantly smaller amount of dry matter (P≤ 0.01) was used per kg weight gain (2.9 kg, 3.5 kg and 3.5 kg, respectively), crude protein (608 g, 735 g and 721 g, respectively) and metabolizable energy (35.29 MJ, 42.63 MJ and 41.86 MJ, respectively) in comparison with MBM and MM rams. MM and MBM rams had better performance indicators than those given by Gut and Wawrzyniak (1991), and Borys and Osikowski (1996) for Merino rams and their crossbreeds with Booroola (daily gains under 300 g; consumption of concentrate per kg body weight gain, from 4.6 kg to 4.9 kg). In the

TABLE 4

Results of rams fattening

Item	Genotype			Type of birth			SEM
	MBS	MBM	MM	1	2	3	
Age, days							
initial	55	55	55	55	55	55	0.3
final	106^{A}	122^{Ba}	110	106	119^{B}	113	2.1
Liveweight, kg							
initial	17.7^{A}	15.5^{B}	18.7^{A}	18.7^{A}	16.3^{B}	17.0	0.38
final	35.8^{A}	35.0^{B}	35.1^{B}	35.4	35.4	35.1	0.10
Fattening period, days	50^{A}	67^{Ba}	55^{b}	50^{A}	64^{B}	58	2.1
Daily liveweight gain, g	372^{A}	301^{B}	309^{B}	349^{a}	312^{b}	321	7.0
Intake/kg liveweight gain							
dry matter, kg	2.9^{A}	3.5^{B}	3.5^{B}	3.1^{A}	3.5^{B}	3.2	0.06
crude protein, g	608^{A}	735^{B}	721^{B}	653^{A}	738^{B}	673	13.2
ME, MJ	35.3^{A}	42.6^{B}	41.9^{B}	37.9^{A}	42.9^{B}	39.1	0.77

a, b – $P \leq 0.05$; A, B – $P \leq 0.01$

case of MBS rams, performance indicators were also better than those obtained for rams from meat lines (Śliwa and Wójtowski, 1992; Gut, 1994) and confirmed the suitability of Suffolk for the production of light (liveweight under 40 kg) meat-type lambs (Wolf et al., 1980).

The carcass dressing percentage of MBS rams (Table 5) was similar to that of MBM rams (48.2% and 49.1%, respectively) and lower ($P \leq 0.05$) than of Merino rams MM (49.5%). The value of this trait was in the upper limits of the range (45%-50%) given for Merino lambs and their crossbreeds (Gut and Wawrzyniak, 1991; Borys and Osikowski, 1996) and lambs from meat lines (Gut, 1994) intensively fattened to a body weight of 35-40 kg. Similarly as in the case of carcass dressing percentage, the share of valuable cuts in the right side of MBS rams was similar to the value obtained for MBM rams (43.2% and 43.7%, respectively) and significantly ($P \leq 0.01$) lower than in MM rams (44.3%). Differences in the content of valuable cuts between MBS and MM rams were probably related to the greater share of neck and thin flank in MBS sides (9.0% and 16.2%, respectively) than in MM lambs (8.5% and 15.0%, respectively) and did not have a significant effect on the tissue composition of the sides. The share of muscle and fat in the sides of MBS rams (58.4% and 20.3%, respectively) and MM rams (59.1% and 19.6%, respectively), was similar. However, in comparison with MBM rams, the sides of MBS and MM lambs contained more muscle and less fat (the differences were

TABLE 5

Slaughter value of fattened rams

Item	Genotype			Type of birth			SEM
	MBS	MBM	MM	1	2	3	
Slaughter weight, kg	33.6[a]	32.9[b]	32.9[b]	33.5[a]	33.3[a]	32.7[b]	0.12
Cold dressing percentage	48.2[a]	49.1	49.5[b]	49.5	48.7	48.6	0.25
Kidney fat, %	1.5	1.7[a]	1.4b	1.4	1.4	1.7	0.05
Fat thickness on loin-eye, mm	2.7[a]	3.2[Bb]	2.5[A]	2.8	2.9	2.6	0.10
Loin-eye area, cm2	14.7	13.8[a]	15.1[b]	14.6	14.6	14.3	0.28
Valuable cuts, %	43.2[A]	43.7	44.3[B]	43.3[a]	43.6	44.3[b]	0.15
In half carcass, %							
meat	58.4[a]	57.1[B]	59.1[A]	58.5	58.4	57.7	0.28
fat	20.3[a]	21.9[Bb]	19.6[A]	20.2	20.0	21.6	0.33
bones	19.9	19.5	20.0	19.5[a]	20.4[b]	19.5[a]	0.18
In loin, %							
dry matter	23.9[A]	24.7[B]	24.4	24.3	24.3	24.3	0.08
protein	20.4	20.2	20.5	20.3	20.3	20.2	0.05
fat	2.4[A]	3.2[B]	2.8	2.8	2.8	2.9	0.09

a, b – P≤0.05; A, B – P≤0.01

significant at P≤ 0.05 and P≤ 0.01). The lower (P≤ 0.05) content of kidney fat in MBS and MM sides in comparison with MBM (1.5, 1.4 and 1.7%, respectively) also points to the lower fat content in these rams, as does the smaller (P≤ 0.05 and P≤ 0.01) fat layer around the eye of the loin (2.7, 2.5 and 3.2 mm, respectively) and fat content of the loin (2.4, 2.8 and 3.2 %, respectively). Changes in the tissue composition of ram sides were small and clearly related to the age at slaughter: as the age increased the increase in muscle tissue slowed and fat deposition increased (Wolf et al., 1980). The muscle and fat contents of sides were satisfactory and comparable with Polish (Gut and Wawrzyniak, 1991; Borys and Osikowski, 1996) and foreign results (Wolf et al., 1980; Ellis et al., 1997) for growing meat-type lambs. Similarly as in the studies of Tański et al. (1994) no significant differences were found among genotypes in the average pH values, conductivity and meat color (Table 6). The pH of the loin and round 24 h after slaughter ranged from 5.60 to 5.70, reflecting a normal rate of glycolysis, and was within the range (5.5-5.9) given by Schieffer and Scharner (1977) for high quality meat. These indicators confirmed the high slaughter value of all three genotypes of rams. However, MBS and MM rams had superior slaughter values, since the fat content of sides, an important quality parameter, was lower than in the MBM sides.

TABLE 6

Physicochemical properties of meat

Item	Genotype			Type of birth			SEM
	MBS	MBM	MM	1	2	3	
Electric conductivity, mS							
45 min after slaughter							
loin	3.06	3.12	3.07	3.07	3.09	3.09	0.053
leg	4.13	4.18	4.05	4.05	4.09	4.20	0.059
24 h after slaughter							
loin	2.61	2.46	2.71	2.48	2.64	2.66	0.067
leg	3.42	3.46	3.70	3.44	3.49	3.64	0.094
Colour, %							
loin	66.9	66.3	66.3	65.2	66.8	67.4	0.97
pH							
45 min after slaughter							
loin	6.65	6.69	6.68	6.75^{A}	6.71	6.56^{B}	0.029
leg	6.53	6.44	6.56	6.51	6.51	6.48	0.033
24 h after slaughter							
loin	5.66	5.70	5.64	5.65	5.66	5.69	0.024
leg	5.61	5.64	5.63	5.66^{A}	5.61^{B}	5.60	0.012

a, b – $P \leq 0.05$

CONCLUSIONS

The results of this experiment indicate that the lambs borne by Merinobooroola ewes weighed less at birth than those from Merino ewes. The 25% share of the Booroola genotype in the MBM lambs caused a significantly lower increase in body weight (up to 15%) during the period of rearing (from days 2 to 56) in comparison with the gains of Merino lambs, MM. These unfavourable effects of Booroola genes were offset by the 50% share of Suffolk genes in MBS lambs. During intensive fattening MBS rams had greater daily body weight gains in comparison with MBM and Merino rams (by 19 and 17 %, respectively). MBS rams also utilized feed most efficiently, using about 16.5% crude protein and metabolizable energy less than the other rams. The slaughter value of MBS rams was similar to that of MM rams, and better than that of MBM lambs, in which a greater fat contents of sides was found.

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STRESZCZENIE

Wyniki produkcyjne i wartość rzeźna jagniąt mieszańców z udziałem krwi merynosa polskiego, boorooli i suffolka

Jagnięta-mieszańce z udziałem w genotypie 25% merynosa polskiego, 25% boorooli i 50% suffolka (MBS), mieszańce z udziałem 75% merynosa polskiego i 25% boorooli (MBM) oraz jagnięta merynosa polskiego (MM, grupa kontrolna) odłączano od matek w wieku 56 dni, a następnie tryczki intensywnie tuczono do masy ciała 35 kg, ubijano i poddawano analizie rzeźnej. W okresie odchowu (od urodzenia do 56 dnia życia) stwierdzono istotnie (P≤0,01) gorsze dzienne przyrosty jagniąt MBM (181 g) niż jagniąt MBS (215 g) i jagniąt merynosowych MM (212 g). W okresie tuczu przyrosty dzienne tryczków MBS były istotnie (P≤0,01) większe (372 g) niż tryczków MBM (301 g) i tryczków MM (309 g). Podobne zależności między genotypami stwierdzono w wykorzystaniu suchej masy paszy, białka ogólnego i energii metabolicznej na 1 kg przyrostu masy ciała (MBS odpowiednio 2,9 kg, 608 g i 35,29 MJ; MBM odpowiednio 3,5 kg, 735 g i 42,63 MJ; MM odpowiednio 3,5 kg, 721 g i 41,86 MJ) Wyniki oceny poubojowej potwierdziły dobrą wartość rzeźną tryczków wszystkich trzech genotypów, lepszą wartością rzeźną charakteryzowały się tryczki MBS i MM, których otłuszczenie tuszy było mniejsze niż tryczków MBM.