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Effects of different particle size of rapeseed and linseed in fattening lamb diets. II. Yield of slaughter by-products

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SUMMARY – The effects of feeding rapeseed and linseed (10% of the diet, 2:1 ratio) and their form (whole, or 50 or 100% ground) in intensive fattening of lambs to 30-35 kg body weight on the yield of slaughter by-products were investigated. No statistically significant effect on the yield of slaughter by-products resulting from fattening lambs with rapeseed and linseed, or from the form of these, was found, except for an increased proportion of perirenal fat. Small and rather unspecific differences were observed in the weight of digesta and weight of the urogenital duct, which require further study. Commercial crossbreeding of prolific sheep with Texel rams did not result in significant differences in the yield of lamb slaughter by-products, with a tendency in crossbreds for lighter body conformation (with the head and legs representing a lower proportion) and lower fatness inside the abdominal cavity (intestinal and perirenal fat).

Keywords: Lamb, fattening, rapeseed, linseed, form of oilseeds, slaughter by-products.

RESUME – *"L'effet des différentes tailles de particules des graines de colza et de lin dans la ration alimentaire journalière des agneaux d'engraissement. II. Taux de sous-produits d'abattage". On a étudié l'effet de l'alimentation des agneaux d'engraissement, engraissés intensivement jusqu'à 30-35 kg avec un mélange de graines de colza et de lin (10% de mélange, en proportion colza/lin 2:1), ainsi que l'influence de la forme des graines (graines entières, écrasées à raison de 50 ou 100% de la totalité des graines de la ration) et on a étudié les résultats d'obtention de sous-produits d'abattage. On n'a pas confirmé l'existence d'un facteur d'influence plus spécifique et statistiquement important concernant l'alimentation d'agneaux d'engraissement avec des graines de colza et de lin sur la capacité d'obtention de sous-produits d'abattage, si ce n'était l'accroissement du taux de graisse structurelle autour des reins. Il a été observé une différenciation peu spécifique, en ce qui concerne la masse du contenu du tube digestif et du canal uro-génital, ce qui demande une vérification ultérieure dans les prochaines investigations scientifiques. Le croisement commercial de brebis de races prolifiques avec des béliers de race Texel, n'apportait pas de différences signicatives en ce qui concerne l'obtention de sous-produits d'abattage des agneaux, toutefois il est apparu des tendances significatives chez les individus issus du croisement ayant une conformation de la carcasse plus délicate (une moindre part de la tête et des jambes dans le poids total des carcasses), ainsi qu'un moindre taux de graisse structurelle dans la cavité abdominale (avec de la graisse structurellle autour des intestins et des reins).*

Mots-clés : *Agneau, engraissement, graine de colza, graine de lin, forme des oléagineux, croissance, teneur en viande à l'abattage.*

Introduction

Under current organizational and sanitary conditions, the management or disposal of slaughter byproducts has become an issue of productive and economic importance. Some products obtained when farm animals, including sheep, are slaughtered are fully valuable byproducts used by different branches of industry. However, a large proportion of them are waste products requiring expensive disposal (Zientek-Warga, 2003).

The yield and management of slaughter byproducts have been relatively more thoroughly explored in the main species of slaughter animals, i.e. pigs, cattle and poultry. In the Polish context, the lack of relevant studies in sheep results from the fact that almost all slaughter lambs were exported as live animals. The very few Polish studies in this field have shown differences in the weight of edible and inedible slaughter byproducts depending on the age and body weight of slaughter lambs (Bernacka *et al*., 2002; Dankowski *et al*., 2001; Siminska *et al*., 2002) and a limited effect of commercial crossbreeding of Blackheaded x Polish Merino on the weight and percentage of some slaughter byproducts (Dankowski *et al*., 2001). Also, Borys *et al*. (2005) observed differences in the yield of some slaughter byproducts depending on the genotype and sex of the fattened lambs.

Poland's accession to the European Union and the resultant need to conform to stringent sanitary (veterinary) and ecological requirements, as well as the restrictions imposed on the transport of live slaughter animals, will require in the near future that sheep be slaughtered, and sheep meat (especially lamb meat as an attractive export product) produced in Poland.

It was therefore appropriate to undertake studies to determine the effect of different factors on the quantity of lamb slaughter byproducts. An important reason for these observations was also to lay the foundations for viable and maximal use of these products as food and industrial raw materials. The aim of this study was to determine differences in the weight and percentage of edible and inedible byproducts obtained at the time of slaughter according to the type of ingredients used in fattening diets and to lamb genotype.

Material and methods

The observations were made on 24 ram lambs fattened intensively to 30-35 kg body weight with four types of complete mixtures (with a structural supplement of hay) that differed in composition: group C – standard diet without oilseeds, and three experimental (E) groups – 10% rapeseed and linseed at a 2:1 ratio; whole seeds in group E1, 50% whole and 50% ground seeds in group E2, and 100% ground seeds in group E3. All feeding groups (each having 6 rams) included 50% prolific lambs (PP; Polish Merino crossed with prolific, Finn and Romanov breeds) and Texel ram x PP commercial crossbreds.

Lambs were slaughtered and slaughter byproducts classified according to the procedures developed at the National Research Institute of Animal Production for Ram Testing Stations (Nawara *et al*., 1963). Measurements of the weight of slaughter byproducts were made directly *postmortem* in unchilled state with 1 g accuracy. The results were analysed based on arithmetic means from absolute measurements of weight (plus measurement of small intestine length) and their percentage values in relation to the preslaughter body weight of the lambs, which was determined after 24 h fasting in animals with free access to drinking water.

The results were analysed statistically using the ANOVA procedure of the Statistica 6.0 Pl packet in a two-factorial arrangement (feeding, genotype), and significant differences between the feeding groups were estimated using Duncan's test.

Results and discussion

Lambs from the experimental E groups were characterized by higher body weight before slaughter, with the differences in relation to the control group C ranging from 3.5% for group E3 ($P \leq 0.05$) to 6.1% for group E2 ($P \leq 0.01$) (Table 1). These differences resulted from the greater body weight of group E lambs at the end of fattening (see part I of the study), with considerable although non-significant differences in body weight loss during fasting – which, in absolute values (kg) and in percentage terms in relation to the final fattening weight (before fasting), were approx. 16% lower in groups E1 and E2 than in groups C and E3.

The differences in the preslaughter body weight of lambs resulted in corresponding differences in absolute values for the weight of several slaughter byproducts, but significant differences were confirmed only for the weight of the urogenital duct without testes between group E2, in which these products were 31.5 and 22.9% ($P \leq 0.01$) heavier than in groups C and E3, respectively (Table 2). For the weight of the urogenital duct, statistically significant differences were also found for its percentage ratio in relation to preslaughter weight; in group E2 it was higher than in the other groups by an average of 0.10 percentage units, the differences in relation to groups C and E3 being significant at $P \leq 0.05$.

Table 1. Edible slaughter byproducts

		Feeding				Genotype		SEM
		C	E1	E2	E3	PP	TxPP	
No. of lambs		6	6	6	6	11	13	
Live weight before slaughter	kg	31.3[ABa]	32.8[B]	33.2[A]	32.4[a]	32.6	32.3	0.21
Fasting losses	kg	2.25	2.00	1.83	2.31	2.04	2.16	0.15
	%††	6.43	5.78	5.25	6.63	5.91	6.23	0.40
Lungs with trachea, heart and diaphragm	g	1149	1179	1213	1119	1198	1138	20
	%†	3.66	3.59	3.65	3.45	3.67	3.52	0.05
Liver	g	746	807	778	763	784	764	15
	%†	2.38	2.46	2.34	2.36	2.41	2.36	0.05
Kidneys	g	115	107	103	113	110	109	2
	%†	0.37	0.33	0.31	0.35	0.34	0.34	0.01
Omental fat	g	708	707	744	709	746	695	17
	%†	2.26	2.15	2.24	2.19	2.28	2.15	0.05
Kidney fat	g	195	237	287	245	246	236	15
	%†	0.62	0.72	0.86	0.76	0.75	0.73	0.04

†In relation to live weight before slaughter.
††In relation to live weight after finish of fattening.
AA, BB: P≤0,01; aa: P≤0,05.

Table 2. Inedible slaughter byproducts

		Feeding				Genotype		SEM
		C	E1	E2	E3	PP	TxPP	
Skin	g	3105	3195	3397	3285	3357	3151	86
	%†	9.90	9.71	10.21	10.11	10.27	9.74	0.23
Blood	g	1601	1594	1625	1604	1597	1614	26
	%†	5.10	4.86	4.88	4.95	4.90	4.99	0.08
Head	g	1606	1687	1728	1623	1710[a]	1620[a]	20
	%†	5.12	5.14	5.20	5.01	5.24[a]	5.01[a]	0.05
Legs	g	754	785	779	796	811[a]	751[a]	13
	%†	2.41	2.39	2.34	2.46	2.49[a]	2.32[a]	0.04
Empty digestive tract	g	2765	2802	2727	2840	2815	2757	40
	%†	8.83	8.54	8.21	8.76	8.66	8.53	0.14
Contents of digestive tract	g	5877	6660	6182	7028	6415	6455	252
	%†	18.74	20.31	18.56	21.72	19.69	19.96	0.78
Urogenital duct	g	276	298	374	277	314	300	15
	%†	0.88	0.91	1.12	0.85	0.96	0.93	0.04
without testicles	g	143[A]	162	188[AB]	153[B]	162	161	6
	%†	0.46[a]	0.49	0.57[ab]	0.47[b]	0.50	0.50	0.02
with testicles	g	132	137	186	136	152	143	10
	%†	0.42	0.42	0.56	0.42	0.46	0.44	0.03
Length of small intestine	m	27.50	27.08	27.58	27.00	27.59	27.04	0.22

†In relation to live weight before slaughter.
AA, BB: P≤0,01; aa: P≤0,05.

For the weight and percentage of edible slaughter byproducts, no great differences were observed between the lambs of the control group C and the experimental groups (E) in terms of edible products such as lungs with trachea, heart and diaphragm, liver and kidneys (Table 1). More pronounced differences in percentage were only observed for perirenal fat, which was much more abundant in lambs fed oilseeds, the lambs from group E2 clearly showing more fat than those from groups E1 and E3. Differences in the weight of perirenal fat between the E groups and group C were much greater than when expressed in relation to the preslaughter body weight and were 47.2% for E2, and 23.5% on average for the similar groups E1 and E3 (all non-significant), while the differences in percentage in relation to preslaughter body weight were 0.24 (E2) and 0.12 percentage units (E1 and E3). The tendency towards greater fatness in rapeseed- and linseed-fed lambs was not confirmed for intestinal fat, the percentage of which in E1 and E3 lambs was even lower than in the control group (Table 1). The different effects of feeding oilseeds on fatness parameters are confirmed by the slaughter values of the analysed lambs (part I of the study), which indicate no differences in the fatty tissue content of the leg and significantly greater external fatness of the carcasses of E than of C lambs. At the same time, no great differences were found in intramuscular fat content between the E groups and the control group C (part III of the study). This confirms the well-known physiological patterns concerning the uneven rate at which fatty tissue is deposited in animals' bodies, which is further modified by many genetic and environmental factors (Dankowski and Zielinska, 1999).

No statistically significant effect of crossing prolific sheep with Texel rams on the magnitude of fasting losses or on the weight and percentage of edible slaughter byproducts was observed (Table 1). However, there was a tendency towards greater fasting losses in crossbreds, both in absolute values (by 5.9%) and in percentage ratio to body weight at the end of fattening (before fasting), by 0.32 percentage units (Table 1). Despite similar preslaughter weights (after fasting) between lambs from the two genotypes, T x PP group showed a certain reduction in the weight and percentage of most of the slaughter byproducts as compared to PP group. This reduction concerned primarily the weight of lungs with trachea, heart and diaphragm (difference of 5% between T x PP and PP) and intestinal fat (difference of 6.8%), and to a lesser extent perirenal fat (4.1%).

In crossbreds the reduction of the weight and percentage of both these fat depots located in the abdominal cavity is consistent with the effect of crossing PP ewes with Texel rams on decreases in external carcass fatness (part I of the study) and in intramuscular fat content (part III). The beneficial effect of crossbreeding with Texel rams in order to decrease fatness in crossbred lambs is confirmed by most of the studies and review papers in this area (e.g. Dankowski and Zielinska, 1999; Sañudo *et al*., 1998).

Feeding lambs with oilseeds had no great effect on the proportion of inedible slaughter byproducts such as skin, blood, head, legs and empty digestive tract (Table 2). The analysed nutritional factors did not result in great differences in the length of the small intestine.

An observation that we found difficult to explain was the increase in the percentage of digesta in group E1, and especially in group E3, in relation to groups C and E2 that were similar in this respect. The respective differences averaged 1.7 percentage units for group E1 and 3.1 percentage units for group E3 (all non-significant).

Greater differences, some of them being statistically significant, were found for the weight and percentage of urogenital duct and its constitutive elements. The heaviest urogenital duct, which also represented the greatest percentage of body weight, was found in E2 rams. In this group, compared to the other groups that were similar in this respect, the urogenital duct was an average of 31.7% heavier and represented a 0.24 percentage units greater percentage of body weight (differences not significant). These differences concerned both the testes, which are considered edible by some consumers (respective differences of 37.8% and 0.14 percentage units, NS), and the other elements of the urogenital duct.

Commercial crossing of prolific sheep with Texel rams reduced the weight and percentage of several inedible slaughter byproducts, as was the case for edible slaughter byproducts. Greater differences between T x PP crosses and PP were found for skin (differences of 6.1% in weight and of 0.53 percentage units in percentage), head (5.3% and 0.23 percentage units – $P \leq 0.05$) and legs (7.4% and 0.17 percentage units – $P \leq 0.05$, respectively) The decreases in a considerable part of the edible and inedible slaughter byproducts in T x PP crosses is not consistent with the slaughter yield (which was lower than in PP rams), i.e. with the lower percentage of fat found in studies of their slaughter value (part I of the study). The lower weight and percentage of skin, head and legs in T x PP crosses indicates a tendency for more light body (and bone) conformation compared to the foundation ram lambs of prolific populations.

No great differences were found between lamb genotypes in terms of weight and percentage of empty digestive tract or digesta (Table 2). This is partly confirmed by the findings of Borys *et al*. (2005), who showed that crossing prolific sheep with the Texel breed had no effect on the weight of empty digestive tract, while a 6 - 9% decrease in the weight of the digestive tract was observed in crossbreds compared with lambs from the foundation populations.

No differences according to lamb genotype were observed in the weight or percentage of urogenital duct or in the length of the small intestine.

In terms of the analysed parameters, no statistically significant feeding group x lamb genotype interactions were found, which is indicative of the similar response of lambs of the compared genotypes to the nutritional factors investigated.

Conclusion

No statistically significant effect on the yield of slaughter byproducts of fattening lambs fed diets including rapeseed and linseed, in different form, was found except for an increased proportion of perirenal fat. Small and rather unspecific differences were observed in the weight of digesta and of the urogenital duct, which require further study.

Commercial crossbreeding of prolific sheep with Texel rams did not result in significant differences in the yield of lamb slaughter byproducts, with a tendency in crossbreds for more thin-body conformation (with the head and legs representing a lower proportion) and lower fatness inside the abdominal cavity (intestinal and perirenal fat).

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