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Fattening of Polish Lowland lambs on diets with different energy and protein levels

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ABSTRACT

In an experiment conducted on 96 male lambs (3 groups of 32) fattened from 19 to 39 kg on diets containing various levels of crude protein (16 vs 14% in DM) and metabolisable energy (12.4 vs 12.7 MJ/kg DM) no significant differences in daily liveweight gain were noted (272 to 279 g). Feed utilisation was similar in all groups. A tendency ($P>0.05$) towards somewhat better protein utilisation (586 vs 674 g/kg) from isoenergetic rations was observed in lambs fed rations containing 14% CP than in those receiving 16% CP.

Slaughter performance, morphological and chemical composition of the lambs' empty body weight, protein (18.3-19.8%) and fat (17.6-21.4%) deposition in empty body gain did not differ significantly among groups.

Differentiating the level of protein (103-163 g/kg DM) in concentrates used to feed suckling lambs had no effect on liveweight gain during fattening (262-288 g daily).

KEY WORDS: Polish Lowland lambs, protein level, rape seeds, fattening, body composition, feeding standards

INTRODUCTION

Manipulation of sheep diets may affect growth rate and carcass composition. Restricting feed or protein and energy intake can lead to the production of leaner carcasses (Glimp and Snowder, 1989). According to Searle and Griffiths (1976), the composition of weight gain in lambs is approximately the same on all diets that support rapid growth. Some studies pointed out, that nutritional management such as protein or energy level in the diet has little influence on sheep body composition (Beauchemin et al., 1995).

Polish Lowland male lambs (Pająk et al., 1993, 1994) fed isoenergetic rations containing from 14 to 15% crude protein (CP) in dry matter (DM) showed liveweight gains during fattening similar to those fed according to IZ standards (1993) diets containing 16-17% CP. This could have been the result of excess protein in relation to nutritional requirements or a concomitant deficit of energy in the diet.

The literature contains few reports about the effect of feeding suckling lambs or of their growth rate in this period on the results of fattening; the results of the existing reports are conflicting. Bray et al. (1990) found no effect of the growth rate of suckling lambs on their postweaning growth rate or carcass fat depth, however, lambs growing slowly had the lightest carcasses at a common age. During fattening, lambs fed before weaning with a concentrate containing about 17% protein showed slower growth and worse feed utilisation than lambs that had been fed a concentrate containing 12 or 15% CP in DM (Pająk et al., 1994).

The objective of this study was to determine the effect of the protein and energy levels in diets on fattening performance and protein and fat deposition in fattening lambs that during suckling had been fed concentrates with various protein levels.

MATERIAL AND METHODS

Animals

The experiment was conducted on 96 weaned male lambs from twin births that during suckling had been fed meadow hay and concentrates containing from 103 to 162 g CP in DM (Pająk et al., 2000).

From each of four groups numbering 30 suckling male lambs, 24 animals with similar body weights were selected for fattening and allocated by an analog method to 3 subgroups of 8 animals each. Each of these subgroups was assigned to one of the feeding groups during fattening (Table 1): S (standard allowances, IZ, 1993), E (energy-supplemented) and L (low-protein, energy supplemented), each numbering 32 lambs. The animals were maintained 8 per pen on wheat straw with free access to water and salt licks containing trace elements.

Experimental diets

The diets for lambs in groups S and E contained 16% (IZ, 1993), in group L, 14% crude protein in DM. The EM content in the diet for group S was 12.4 MJ/kg DM, in that for groups E and L it was increased by 0.3 MJ/kg DM by adding whole double zero rape seeds (Table 2). Concentrates and hay were given twice daily. Refusals were collected and weighed in the morning before a new ration was given.

TABLE 1

Experimental design

Group at suckling period	Subgroups at fattening period		
C	$_{C}$S	$_{C}$E	$_{C}$L
H	$_{H}$S	$_{H}$E	$_{H}$L
M	$_{M}$S	$_{M}$E	$_{M}$L
L	$_{L}$S	$_{L}$E	$_{L}$L
Group at fattening period →	S	E	L
Protein content in the ration, % DM	16	16	14
Metabolisable energy, MJ/DM	12.4	12.7	12.7

TABLE 2

Composition and nutritive value of dry matter consumed by lambs

Component	Group		
	S	E	L
Concentrate mixture, %	81.4	80.1	81.2
rolled oats	47.8	47.8	67.5
wheat bran	15.4	14.3	8.6
ground wheat	10.2	9.5	5.7
ground triticale	10.2	9.5	5.7
ground field bean	5.1	4.7	2.9
soyabean oilmeal	9.3	8.5	5.1
whole rape seeds	0	3.7	2.5
mineral-vitamin supplement[1]	2	2	2
Meadow hay, %	18.6	19.9	18.8
In DM intake:			
crude protein, g	163	163	144
degradable, g	117	118	105
undegradable, g	46	45	39
digested in small intestine, g	38	37	33
PDIN, g	106	105	95
PDIE, g	100	97	93
UFV	0.94	0.93	0.93
metabolisable energy, MJ	12.4	12.7	12.7

[1] in %: calcium carbonate – 45, dicalcium phosphate – 25, commercial mineral-vitamin supplement Polfamix CJ – 15, sodium chloride – 15

The lambs were weighed every two weeks, and the rations were adjusted according to the average body weight of the animals in a given subgroup. Feed intake, utilisation and daily liveweight gain were determined. Feed intake was compared with the requirements given in the IZ (1993) and INRA (1993) standards.

Slaughter analysis

The morphological and chemical composition of the empty body, protein and fat deposition in empty body gain were determined on 4 representative lambs from subgroup ${}_{H}S$, ${}_{H}E$ and ${}_{H}L$ (Table 1) slaughtered at the end of fattening. Each of these lambs in suckling period had been fed with a concentrate containing 16% crude protein in DM according to IZ standards (1993). Slaughter analysis was carried out as described by Pająk et al. (1992) with modification of separable fat preparation for analysis (Pająk et al., 1993). The initial body composition of lambs was estimated by regression analysis using equations developed from the slaughter data of the initial slaughter groups (Pająk et al., 1999).

Analysis

The chemical composition of feeds and empty body of lambs was determined according to AOAC methods (1990). Protein degradation in the rumen was determined according to Mehrez and Ørskov (1977) on three cows fitted with cannulas to the rumen and duodenum. Effective rumen protein degradation at $k_{0.06}$ was calculated according to Ørskov and McDonald (1979). Ileal digestibility of rumen undegraded protein was determined according to Hvelplund et al. (1992) using the mobile bag method. The PDIN and PDIE contents were calculated according to INRA (1993) on the basis of the determined ruminal protein degradation coefficients and ileal digestibility of rumen undegraded protein. Metabolisable energy was calculated using the MAFF equation (1975). Maintenance requirements were calculated assuming 418 kJ ME/$kg^{0.75}$ (Theriez et al., 1982). The energy values of deposited protein (22.5kJ/g) and fat (39.4kJ/g) were taken from Paladines et al. (1964).

Statistical analysis

The results were subjected to one-way analysis of variance. The significance of differences between means was tested with the Tukey least significance difference test. All calculations were performed using Statgraphics® Plus, ver. 7.0 (1993) software.

RESULTS

The crude protein intake of animals in group L was about 12% less than in the remaining groups (Table 2). The ileal digestible protein intake in group L was nearly 13%, and in group E, nearly 3% less than in group S. The PDI content in the DM of diets E and L was smaller than in diet S by 3 and 7%, respectively.

The value of UFV of all consumed rations was similar. The energy to protein ratio equaled 76; 78 and 88 kJ ME/g CP in the rations consumed by lambs in groups S, E and L, respectively. DM consumption per kg metabolic body weight ($W^{0.75}$) did not differ and equaled: 88-90 g/kg$^{0.75}$ in groups S and E and 87 g/kg$^{0.75}$ in group L.

The consumed feeds covered from 90 to 93% of DM requirements according to IZ standards (1993) for lambs gaining 250 g daily, while coverage of energy requirements was 2-4% lower (Table 3). The nutritional value of the consumed diets according to the INRA system (1993) was 98-102% of energy requirements, PDI consumption exceeded the requirements of male lambs gaining 250 g day daily by 8% in group L to 13-15% in the remaining groups.

The daily liveweight gains of lambs (272 to 279 g), duration of fattening (76 to 78 days), DM utilisation (4.1 to 4.2 kg/kg body weight gain), and energy utilisation did not depend on the type of diet. In the lambs from group L a tendency was seen towards somewhat better ($P>0.05$) PDI and crude protein utilisation than in the other groups (Table 4).

No significant differences were found in most of the analyzed slaughter performance indicators among groups (Table 5). Lowering the protein content of the

TABLE 3

The nutritive value of rations in comparison with recommended allowances by IZ and INRA standards[1]

Intake as per cent of requirement	Group		
	S	E	L
IZ (1993) standards			
dry matter	91	93	90
crude protein	95	96	83
net energy	87	91	87
INRA (1993) standards			
PDIN[2]	119	125	110
PDIE[2]	113	115	108
UFV	98	102	99

[1] male gained 250 g/day, moderate growth potential

[2] as per cent of PDI requirement

TABLE 4

Fattening performance – body weight, liveweight gain and feed utilisation of fattening lambs

Indices	Group			SEM
	S	E	L	
Body weight, kg				
initial	18.9	18.9	18.9	0.56^{NS}
final	39.2	39.5	39.1	0.32^{NS}
Daily liveweight gain, g	272	279	278	8.7^{NS}
Fattening period, days	78	76	76	3.7^{NS}
Feed intake/kg gain				
dry matter, kg	4.23	4.14	4.07	0.225^{NS}
crude protein, g	692	674	586	36.8^{NS}
metabolisable energy, MJ	52.7	52.4	51.5	2.85^{NS}
UFV	3.97	3.87	3.78	0.214^{NS}
PDIN, g	449	434	388	24.0^{NS}
PDIE, g	425	402	379	22.5^{NS}
Rearing + fattening, days	170	167	167	3.6^{NS}

TABLE 5

Slaughter performance of fattening lambs

Indices	Group			SEM
	S	E	L	
n	4	4	4	
Initial body weight, kg	19.2	18.3	19.1	0.93^{NS}
Final body weight, kg	39.4	40.9	39.4	0.77^{NS}
greasy wool, g	1100	1025	1150	90.9^{NS}
Days of fattening	74^{a}	84^{b}	77^{ab}	$3.0^{P<0.05}$
Daily liveweight gain, g	276	267	266	8.3^{NS}
Daily wool gain, g	15.2	12.1	15.1	1.50^{NS}
Empty body weight				
initial, kg	16.2	15.5	16.1	0.75^{NS}
final, kg	33.0^{ABa}	34.1^{Aa}	31.1^{Bb}	$0.47^{P<0.01}$
Daily empty body gain, g	229^{a}	219^{ab}	196^{b}	$7.3^{P<0.05}$
Cold carcas, kg	17.3^{a}	18.0^{a}	16.2^{b}	$0.33^{P<0.05}$
lean, %	55.4	53.0	53.1	0.86^{NS}
separable fat, %	17.1	19.8	19.5	0.92^{NS}
connected tissue, %	7.2	7.2	7.2	0.50^{NS}
bones, %	20.3	20.0	20.2	0.43^{NS}
fat + connected tissue, %	24.3^{a}	27.0^{b}	26.7^{ab}	$0.78^{P<0.05}$

ration did, however, have an unfavourable effect ($P<0.05$) on empty body gain and cold carcass weight, although no differences were found in daily liveweight gain. At the same slaughter weight in groups S and L, the carcasses of group S lambs were 1 kg heavier than in group L. After slaughter, group L lambs had from 1.5 to 2 kg more intestinal content (8.3 kg) than lambs in the remaining groups (6.4 to 6.8 kg). No significant differences in meat or separable fat were found, although the carcasses of group S lambs contained about 2% more meat and about 2.5% less separable fat than the carcasses of lambs from the remaining groups.

The chemical composition of empty body weight and empty body gain did not differ significantly among groups (Table 6). The protein and ether extract contents in empty body weight of group S and L lambs were similar despite their diets differing in protein and metabolisable energy levels. Increasing the energy content from 12.4 to 12.7 MJ ME/kg DM in the diet for group E caused a nearly 2% rise ($P>0.05$) in the share of either extract in empty body weight and almost 4% in empty body gain at the expense of a slight decrease in the share of protein in the body and gain.

The applied method of rearing suckling lambs caused a significantly worse ($P<0.01$) growth rate from day 28 to weaning at about 90 days of age of lambs that during suckling had been fed concentrates with the lowest (103 g/kg DM) CP content (Table 7). These lambs where the lightest at the beginning of fattening, but this had no effect on the growth rate during fattening in comparison with lambs that had been fed with a higher-protein concentrate mixture (135-162 g/kg DM). Feeding during suckling also had no effect on the size of the daily liveweight gain from day 28 of life to a weight of about 40 kg.

TABLE 6

Chemical composition of the empty body

Indices	Group			SEM
	S	E	L	
n	4	4	4	
Empty body weight, kg	33.0^{ABa}	34.1^{Aa}	31.1^{Bb}	$0.47^{P<0.01}$
dry matter, %	38.6	39.6	39.5	0.68^{NS}
crude protein, %	18.1	17.5	18.0	0.31^{NS}
ether extract, %	16.3	18.1	16.8	0.68^{NS}
crude ash, %	3.0	3.3	3.2	0.15^{NS}
Empty body gain, kg	16.8^{ab}	18.6^{a}	15.0^{b}	$0.82^{P<0.05}$
As per cent of empty body gain				
dry matter	42.2	44.0	44.4	1.38^{NS}
crude protein	19.8	18.3	19.6	0.69^{NS}
ether extract	17.6	21.4	18.8	1.47^{NS}

TABLE 7

Fattening performance related to protein level in creep feed during the rearing period

Indices	Group in rearing period				SEM
	C	H	M	L	
n	24	24	24	24	
REARING					
Body weight, kg					
at 2 day of age	4.5	4.6	4.6	4.4	0.12^{NS}
at 28 day of age	10.2	9.5	9.5	10.0	0.29^{NS}
at weaning	20.1^{A}	19.2^{AB}	18.7^{AB}	17.8^{B}	$0.62^{P<0.01}$
Days of age at weaning	93^{A}	89^{C}	93^{A}	91^{B}	$0.4^{P<0.01}$
Daily liveweight gain, g					
from 2 to 28 days of age	217^{a}	187^{b}	191^{ab}	215^{ab}	$10.5^{P<0.05}$
from 28 days of age to weaning	152^{A}	160^{A}	141^{AB}	122^{B}	$7.6^{P<0.01}$
FATTENING					
Body weight, kg					
initial	20.1^{A}	19.2^{AB}	18.7^{AB}	17.8^{B}	$0.62^{P<0.01}$
final	39.4	38.7	39.6	39.4	0.37^{NS}
Fattening period, days	69^{a}	79^{ab}	76^{ab}	82^{b}	$4.2^{P<0.05}$
Daily liveweight gain, g	286	262	288	271	9.9^{NS}
REARING + FATTENING					
Days of age	162	167	169	173	4.1^{NS}
Daily liveweight gain, g	216	207	211	204	5.4^{NS}

DISCUSSION

The applied experimental factors, increasing the metabolisable energy content and lowering the crude protein level in diets did not significantly affect liveweight gains or feed utilisation by Polish Lowland lambs fattened from 19 to 40 kg body weight (Table 4). Only a tendency towards somewhat better DM and CP (by 2-3%) utilisation was found when the energy level of isonitrogenous diets was increased by 0.3 MJ/kg DM. Decreasing the protein content of the diet from 16 to 14% in the DM of isoenergetic diets slightly improved DM utilisation, and CP utilisation per kg liveweight gain was about 13% ($P>0.05$) smaller.

It is thought that adding fat to sheep diets to increase their energy value may unfavourably affect the activity of rumen bacteria, especially when freely dispersed vegetable oils are added (Pallister and Smithard, 1987; Szumacher-Strabel and Potkański, 1997). This depends, however, on the amount of fat and the form in which it is used. The addition of 4% rape seed oil in the form of whole seeds,

a mixture of oil and rape seed oil meal or extruded seeds to rations for adult wethers did not adversely affect fermentation in the rumen or fibre digestibility (Pallister and Smithard, 1987). The growth rate of the lambs that received 0, 40, or 60 g whole rape seeds during fattening in their daily ration did not differ significantly, however, the animals receiving rape seed had slightly increased meat fat and total blood lipids, however, there were no differences in fatty acid profiles of meat fat between groups (Borowiec et al., 1996).

In our experiment, despite the smaller share of rape seeds in the ration than in the studies cited above, somewhat more separable fat, a greater share of ether extract in empty body weight and empty body gain were found in the experimental groups as compared with the controls.

Rape seeds can be a good source of energy for sheep, since their hulls delay release of fat in the rumen thanks to which the amount of unsaturated fatty acids absorbed in the small intestine increases. The results of the experiments of Borowiec et al. (1996) did not, however, show differences in the proportions of fatty acids in the meat fat of lambs fed diets containing various amounts of rape seeds.

The crude protein content of consumed feeds can affect the growth rate of lambs, but this depends on their age, breed, and proportion of protein to energy in the diet.

The better gains of lambs than in previous experiments (Pająk et al., 1993, 1994) may have been caused by catch-up growth after the protein-sparing feeding during suckling, but it seems that the large share of lambs from young mothers was also important. Peeters et al. (1995) found that lambs of yearling ewes had lower growth rates than other lambs during the suckling period, but higher growth rates during the fattening period; this finding is confirmed by the results of rearing (Pająk et al., 2000) and fattening in the present experiment.

The liveweight gains of Polish Lowland lambs, a breed obtained by crossing primitive local breeds mainly with the Polish Merino and with Kent, and in some regions of Poland to a limited degree also with Leine and Texel, are larger than those of Merino lambs and equal from 220 to 240 g (Pająk et al., 1993; 1994). The lambs of the Polish Merino usually have smaller gains, about 170-190 g (Urbaniak, 1986, 1994, 1995a). Crossbred Polish Lowland sheep of the Żelazna variety (Polish Lowland ewes x Suffolk or Berrichon du Cher rams) were heavier than purebred Polish Lowland lambs from days 28 to 100 of age ($P<0.05$), but there was no significant difference between the breed types at birth and 150 days of age (Niżnikowski et al., 1997).

Andrews and Ørskov (1970) showed that while the growth rate of lambs slaughtered at 27.5 kg liveweight was greater for those given diets containing 17.5 rather than 15% CP, there were no differences in growth rate for lambs receiving 17.5 or 15.0% protein when they were slaughtered at 40 kg liveweight, which is related to the decline in their protein requirement with age during fattening.

Similar growth rates, no differences in feed intake or utilisation were also found, among others, in the fattening of crossbred Suffolk x Scottish Blackface lambs fed 120 or 180 g CP/kg DM (Sinclair et al., 1991), as well as Thracian Fine-Fleeced male lambs given 130-189 g CP/kg DM (Shindarska, 1987). Better production performance was obtained in Polish Merino lambs fed diets containing 12 MJ ME and 124 g CP/kg DM than with diets containing 93 to 159 g CP/kg DM (Urbaniak, 1986). Chios male lambs fed diets containing 16% CP grew faster than those receiving 14 or 18% CP/kg DM (Hadjipanayiotou, 1982).

The lack of differences in daily liveweight gains in lambs fed diets often differing considerably in their protein contents may result from overfeeding or the inappropriate composition of the diets. This conclusion is supported, among others, by the observation that urinary N increased in response to increments of dietary CP concentration (Hadjipanayiotou, 1982), which could have been caused by excess protein when energy requirements were covered or by an energy deficit.

Consumption of crude protein in group L was 17%, in the remaining groups, 4-5% lower than given in the IZ standards (1993) for male lambs gaining 250 g daily. The net energy deficiency in the consumed diets was 9% in group E and 13% in the others. It may be concluded that the IZ standards (1993) are too high for this type of lamb. Comparison of the nutritional value of the consumed diets with the INRA system requirements (1993) suggests that the protein requirements of the Polish Lowland lamb are 10-15% higher than given in these standards, and that its energy requirements are more or less in agreement with these standards.

The effect of dietary protein level on slaughter performance was not unequivocal and it seems that similarly as in the case of gains, it depends on genetic potential, accurate determination of nutritional requirements, formulation of diets according to them, as well as on the effect of environmental factors.

The share of meat in lamb carcasses in this experiment was 53-55%, in an earlier study, 55-58% (Pająk et al., 1993). The carcasses of Polish Lowland lambs in other flocks where they were fattened to 40-43 kg contained about 62-64% meat and about 20-17% separable fat (Gruszecki, 1998) or at a body weight of about 41 kg they had about 58% meat and 20% separable fat (Szymanowski, 1999). The adiposity of the lambs in our experiment (about 15-20%) was similar or smaller than the studies cited above. There is little data relating to the body composition of Polish Lowland lambs. Moreover, in various regions of the country these sheep differ slightly, different fattening systems are used, hence comparison of our data to others is more difficult.

Increasing dietary CP (120 vs 180 g/kg DM) increased cold carcass weight, carcass protein content and fatness class (Sinclair et al., 1991). The CP level (15 vs 18% CP in DM) and protein degradability had little effect on growth and carcass characteristics. In addition, supplemental undegradable protein is not required when diets are formulated using primarily barley and canola meal (Beauchemin et al.,

1995). Carcass fat and protein were not affected by dietary protein (15 or 20% CP) between weaning and puberty in ewe lambs (Zhang et al., 1995).

As the protein level increased from 130 to 189 g CP/kg DM of isoenergetic diets, its deposition in the body increased, especially in the initial phase of fattening, that is, from 13 to 25 kg body weight. Fat deposition also increased as the protein level of the diet rose, especially in the final period of fattening, i.e. from 25 to 40 kg body weight (Shindarska, 1987). In contrast, the average weight of carcass fat, and kidney plus channel fat in Border Leicester x Blackface wethers of a body weight of 33 kg, fed isoenergetic diets (12.2 MJ EM/kg DM) containing 120 or 148 g CP/kg DM was significantly smaller when low protein diets were fed (Coelho et al., 1986).

In the present experiments we did not find any significant differences in the chemical composition of empty body weight or empty body gain of lambs depending on the protein and energy levels of the diets. Protein source had no effect on the chemical composition of empty body weight of Polish Merino lambs (Urbaniak, 1995a). However, protein deposition was highest in sheep fed on fish meal (35.5 g/day), followed by blood meal, soyabean meal and casein diet (31.7; 30 and 23.7 g/day, respectively (Urbaniak, 1995a). In this experiment, Polish Lowland lambs deposited about 38 (group L) to 45 g (group S) protein daily.

In our experiment differentiating the protein level (103-162 g/kg DM) in concentrates for suckling lambs during rearing had no effect on their gains during fattening (262-288 g/day).

Lambs fed limited amounts of feed during a preliminary period (of 128 days), in a subsequent experimental period (90 – days), fed *ad libitum* had higher rates of liveweight gain, carcass weight and all non-carcass components than lambs fed *ad libitum* in the preliminary period (Hegarty et al., 1999). At any rate of carcass gain, lambs fed limited amounts of feed in the preliminary period, contained a significantly lower proportion of fat in carcass gain than lambs fed *ad libitum* in both periods.

Nutritional history may also have modified the effect on carcass composition by changing the partial efficiency of use of available energy for protein deposition without changing the partial energetic efficiency of fat deposition. Lambs fed limited amounts during a preliminary period deposited significantly more carcass tissue per kg of metabolisable energy available for growth than lambs fed *ad libitum* in the preliminary period. They deposited more protein/MJ metabolisable energy available for growth, while deposition of carcass fat/MJ ME_g did not differ between groups (Hegarty et al., 1999).

In groups S and E that received 16% crude protein in DM, utilisation of metabolisable energy available for growth (k_f) was somewhat better (0.31; 0.31 vs 0.28) than in group L, fed the diet with a 14% protein content. Urbaniak (1994) found similar (k_f - 0.27 to 0.33) utilisation of energy available for growth in Polish Merino lambs.

In Polish Lowland male lambs the worst energy utilisation, $k_f = 0.27$, was found when the diet containing about 18% CP and 62 kJ metabolisable energy per gram of crude protein was fed, while the best, $k_f = 0.43$ at a ratio of 74 kJ/g when the diet the diet containing about 14% CP (Pająk et al., 1993) was provided.

In later experiments of Urbaniak (1995b), Polish Merino lambs receiving isonitrogenous (15% CP) rations containing various sources of protein utilized this energy better (0.42-0.44) (Urbaniak, 1995b), but those that received casein as the main source of nitrogen in the diet had a k_f of only 0.20 (Urbaniak, 1995a). No explanation for these differences was found and no dependence between the protein level in the diet or the ratio of energy to protein and the utilisation of metabolisable energy available for growth was found.

CONCLUSIONS

The gains of lambs that during fattening were fed diets containing 14 or 16% crude protein in DM are similar regardless of the dietary energy level, and limiting the protein level during rearing does not have a significant effect on fattening performance.

The addition of whole rape seeds in amounts of 2.5-3.7% concentrate has no significant effect on production performance or body composition of lambs.

The consumption of dry matter by Polish Lowland lambs during fattening is lower than given in the nutritional standards for sheep in the traditional system, it is therefore necessary to revise these requirements.

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STRESZCZENIE

Tucz jagniąt polskiej owcy nizinnej żywionych dawkami o różnej zawartości białka i energii

W doświadczeniu przeprowadzonym na 96 tryczkach (3 grupy po 32) tuczonych od 19 do 39 kg, żywionych dawkami różniącymi się poziomem białka ogólnego (16 vs 14% w s.m.) i energii metabolicznej (12.4 vs 12.7 MJ/kg s.m.) nie stwierdzono istotnych różnic w przyrostach (272 do 279 g) masy ciała. Wykorzystanie paszy było podobne we wszystkich grupach. Stwierdzono tendencję nieco lepszego ($P>0.05$) wykorzystania białka (586 vs 674 g/kg) z dawek izoenergetycznych przez jagnięta otrzymujące w dawce 14 w porównaniu z 16% b. og. Pobranie s.m. przez jagnięta było o 7-10% mniejsze niż przewidują Normy IZ.

Wskaźniki ubojowe, skład morfologiczny i chemiczny masy ciała netto jagniąt oraz odłożenie białka (18.3-19.8%) i tłuszczu (17.6-21.4%) w przyroście masy ciała netto nie różniły się między grupami.

Zróżnicowanie poziomu białka ogólnego (103-163 g/kg s.m.) w mieszankach stosowanych do dokarmiania jagniąt w odchowie przy matkach nie miało wpływu na przyrosty jagniąt w czasie tuczu (262-288 g dziennie).