Journal of Animal and Feed Sciences, 4, 1995, 95–106

Blue lupin seeds in diets for fattening lambs

M. Urbaniak

Department of Animal Nutrition and Feed Management,
Agricultural University of Poznań
Wołyńska 33, 60-637 Poznań, Poland

(Received 16 March 1995; accepted 28 April 1995)

ABSTRACT

Thirty Polish Merino rams with average initial weight of about 20 kg were divided into 5 groups and fed five isonitrogenous and isoenergetic diets (about 15% crude protein and 11 MJ metabolizable energy/kg dry matter) containing soyabean meal (S) or blue lupin seeds – sweet cv. Remik (R) and cv. Emir (E), semi-bitter-cv. Ignis (I) and bitter-cv. Mirela(M). Mean daily liveweight gains of lambs from groups S, R, E and I were similar (180-188 g), while those of animals from group M (175 g) were significantly lower ($P<0.05$). Lambs fed diets containing M used significantly more ($P<0.05$) crude protein and energy per 1 kg body weight gain. Mean daily clean wool fibre production did not differ significantly between groups (4.50-4.70 g) nor did fibre diameter (3.63-3.83 μm) or sulphur content in wool (3.15-3.29%). No statistically significant differences were observed between groups in regards to dressing percentage (47.7-48.9%) as well as lean meat (11.66-12.11 kg), fat (3.62-4.02 kg) or bone (3.61-3.91 kg) contents in the carcass and also in the chemical composition of empty body weight (EBW). The value of the metabolizable energy utilization coefficient available for growth (k_f) in lambs from groups S, R, E and I was similar (0.42-0.44), while in lambs from group M it was significantly lower (0.39; $P<0.05$). Furthermore, animals from group M deposited significantly ($P<0.05$) less protein in EBW, wool gain and total gain than animals from groups S, R, E and I.

KEY WORDS: lambs, lupins, performance, body composition, protein, energy deposition

INTRODUCTION

Intensive animal production is limited mainly by protein quantity and quality. Shortages of feed proteins and high prices for imported high-protein diet components – primarily soyabean meal – force Poland, like many other European countries, to look for home produced protein components of feeds for pigs, cattle and sheep.

One of the most obvious substitutes for soyabean meal in diets for farm animals in the specific climatic and soil conditions of Poland are lupin seeds. Their nutritive value, however, is limited by the presence of antinutrients, mainly alkaloids (Culvenor and Petterson, 1986), manganese (Cheeke and Kelly, 1988) as well as phomopsins produced by fungi which may cause lupinosis in sheep (Culvenor and Petterson, 1986).

In the eighties, Polish breeders succeeded in obtaining a number of new varieties of blue lupins, including sweet, semibitter and bitter cultivars, whose nutritive value and effectiveness have not been completely ascertained yet because of the limited number of experiments to which they could have been subjected in such a short period of time.

The objective of these investigations was to determine the effect of substitution of soyabean meal with seeds of sweet, semi-bitter and bitter blue lupins in diets for fattening lambs on live weight gains, feed utilization, wool production, diameter of wool fibre as well as body composition and protein and energy deposition in empty body weight (EBW) using the comparative slaughter technique.

MATERIAL AND METHODS

Thirty rams of the Polish Merino breed weighing 20 kg were randomly allocated to five groups (6 animals each) and fed five isonitrogenous (approximately 15% crude protein/kg dry matter) and isoenergetic (approximately 11 MJ metabolizable energy/kg dry matter) diets. They contained soyabean meal (S) or blue lupin seeds – sweet cv. Remik (R) and cv. Emir (E), semi-bitter cv. Ignis (I) or bitter cv. Mirela (M). Lupin seeds contained 0.10, 0.12, 0.30 and 1.98% alkaloids in dry matter, respectively. The rations were made up of concentrate and meadow hay. The chemical composition of lupin seeds is shown in Table 1, the composition of concentrates in Table 2 and diet composition in successive fattening periods in Table 3. The dietary metabolizable energy (ME) contents were calculated on the basis of our own results of chemical analysis and digestibility coefficients using equations given by ARC (1984). Before the beginning of the experiment, four additional lambs weighing 20 kg (group zero) were selected, sheared and then slaughtered to determine the amount of wool and chemical composition of their body.

The experimental animals were kept in individual pens throughout the experiments and their rations were divided into equal parts which were fed at 8 a.m. and 2 p.m. Feed consumption and live weight gains were recorded during the entire period of the experiment. The experiment was terminated when the lambs reached 40 kg in weight. The animals were then sheared, the yield of their fleece

TABLE 1

Chemical composition of lupin seeds, %

Item	Variety			
	Remik	Emir	Ignis	Mirela
Dry matter	89.26	88.84	90.01	89.90
Crude protein	32.84	33.10	33.86	33.45
Ether extract	3.76	3.95	4.01	3.60
Crude fibre	12.83	13.42	13.58	11.94
N-free extractives	36.98	35.27	35.23	37.94
Crude ash	2.85	3.10	3.33	2.97
Total alkaloids[a]	0.10	0.12	0.30	1.98

[a] in 100% dry matter

TABLE 2

Composition of concentrate mixtures, %

Feeds	Group[a]				
	S	R	E	I	M
Soyabean meal	15.0	–	–	–	–
Ground lupin cv. Remik	–	25.0	–	–	–
Ground lupin cv. Emir	–	–	25.0	–	–
Ground lupin cv. Ignis	–	–	–	25.0	–
Ground lupin cv. Mirela	–	–	–	–	25.0
Ground barley	40.0	45.0	45.0	45.0	45.0
Ground oat	40.0	25.0	25.0	25.0	25.0
Mineral vitamin premix	5.0	5.0	5.0	5.0	5.0

[a] S-soyabean meal, R-lupin cv. Remik, E-lupin cv. Emir, I-lupin cv. Ignis, M-lupin cv. Mirela

TABLE 3

Composition of diets in successive periods of fattening, kg

Feeds	Liveweight of lambs (kg)	Concentrate mixture	Meadow hay
Diet 1	20-25	0.50	0.50
Diet 2	25-30	0.60	0.60
Diet 3	30-35	0.70	0.70
Diet 4	35-40	0.80	0.80

ascertained and wool samples from their shoulder, side and thigh were collected. These samples were used to determine the yield of clean wool fibre, sulphur content and the diameter of clean wool fibres according to the methods described by Urbaniak (1986). Next the animals were slaughtered in order to determine the chemical composition of their body as well as morphological composition of their carcasses. Lambs were slaughtered and their carcasses dissected according to the method described by Osińska and Ziołecka (1972). The lambs'EBW was ascertained as the sum of all slaughter products (including blood) but without the contents of the gastrointestinal tract, gall bladder and bladder.

Samples were taken from each animal in order to determine the chemical composition of the EBW of lambs as well as protein and energy deposition. The samples were autoclaved and freeze dried and then their chemical composition and energy content were determined. Energy in wool was calculated from its chemical composition by multiplying the protein and fat contents by the energy value coefficients given by Urbaniak and Potkański (1987) which amount to 5.609 kcal/g and 9.741 kcal/g, respectively. Energy and protein retention in lambs' body (including wool) were calculated from the difference between the concentration of these components in animals weighing 40 and 20 kg.

The basic chemical composition of feeds, wool and lyophilizates of slaughter products was determined using standard methods. Alkaloids in lupins were determined by the gravimetric method (Wink and Hartman, 1981). An automatic calorimeter was used to determine the energy content in lyophilizates.

Results were analyzed statistically by analysis of variance (Steel and Torrie, 1960) with Duncan's multiple range test used to compare treatment means with significant F values.

RESULTS

Animals from groups S, R, E, and I reached similar mean daily gains (180-188 g) and differences between individual groups were not statistically significant (Table 4). Significantly lower ($P < 0.05$) daily live weight gains were observed in lambs from group M (175 g) where the animals were fed diets in which soyabean meal was substituted by seeds of bitter lupin cv. Mirela. Animals from groups S, R, E and I were found to utilize similar amounts of crude protein (975-995 g) and metabolizable energy (72.1-74.0 MJ) per 1 kg of live weight gain, while the lambs from group M used significantly ($P < 0.05$) more protein (1045 g) and energy (76.0 MJ ME), although the latter value was not statistically significant.

Average production of clean wool fibre was similar in all animals and ranged from 4.50 to 4.70 g/day, and the average sulphur content in wool ranged from 3.15 to 3.29% (Table 5). In both cases differences among groups were not

TABLE 4

Live weight gains and feed utilization

Item	Group[a]					SE[b]
	S	R	E	I	M	
Initial weight, kg	20.4	20.3	19.8	20.0	20.1	1.9
Final weight, kg	40.5	40.3	40.8	40.8	40.7	3.4
Fattening duration, days	1077	111	109	114	118	10
Liveweight gain, g/d	188[c]	180[c]	185[c]	182[c]	175[d]	14
Feed utilization:						
– crude protein, g/kg gain	975[c]	988[c]	979[c]	995[c]	1045[d]	91
– metabolizable energy, MJ/kg gain	72.1	73.8	73.5	74.0	76.0	6.3

[a] S-soyabean meal, R-lupin cv. Remik, E-lupin cv. Emir, I-lupin cv. Ignis, M.lupin cv. Mirela
[b] standard error of the mean
[c, d] means in the same row with different superscripts differ $P \leq 0.05$

TABLE 5

Clean wool production and sulphur content in wool

Group[a]	Clean wool production		Sulphur content in wool
	Total, kg	Daily, g	%
S	0.50	4.65	3.15
R	0.52	4.67	3.29
E	0.52	4.70	3.17
I	0.53	4.59	3.20
M	0.53	4.50	3.21
SE[b]	0.04	0.39	0.16

[a] S-soyabean meal, R-lupin cv. Remik, E-lupin cv. Emir, I-lupin cv. Ignis, M-lupin cv. Mirela
[b] standard error of the mean

significant. The diameter of wool fibres collected from the shoulder, side and thigh was similar in all animals and ranged from 30.63 to 30.83 m (Table 6).

Results of the dressing percentage and morphological composition of carcasses (Table 7) were similar in all animals. The dressing percentage ranged from 47.7 to 48.9%, and the contents of lean, fat and bones varied from 11.66 to 12.11 kg, from 3.62 to 4.02 kg and from 3.61 to 3.91 kg, respectively. The substitution of soyabean meal by different blue lupin seeds did not have a significant influence on the chemical composition and energetic value of EBW (Table 8).

The quantity of energy deposited in the body of lambs slaughtered at the same live weight (about 40 kg) was similar in all groups and independent of the amount

TABLE 6

Wool fibre diameter, m

Group[a]	Shoulder	Side	Thigh	Mean
S	30.50	30.84	31.14	30.83
R	30.26	30.81	31.02	30.68
E	30.54	30.61	30.89	30.68
I	30.33	30.58	31.05	30.65
M	29.94	30.80	31.15	30.63
SE[b]	2.33	2.57	2.41	2.44

[a] S-soyabean meal, R-lupin cv. Remik, E-lupin cv. Emir, I-lupin cv. Ignis, M-lupin cv. Mirela
[b] standard error of the mean

TABLE 7

Dressing percentage and morphological composition of lamb carcasses

Group[a]	Dressing percentage, %	Content in carcass, kg		
		lean	bones	fat
S	47.8	11.7	3.8	3.6
R	48.9	11.7	3.6	3.7
E	48.2	12.1	3.8	3.7
I	47.7	11.8	3.9	3.6
M	47.7	11.7	3.9	4.0
SE[b]	3.7	0.9	0.3	0.2

[a] S-soyabean meal, R-lupin cv. Remik, E-lupin cv. Emir, I-lupin cv. Ignis, M-lupin cv. Mirela
[b] standard error of the mean

TABLE 8

Chemical composition and energetic value of 1 kg empty body weight of lambs

Item	Group[a]					SE[b]
	S	R	E	I	M	
Dry matter, g/kg	481	486	471	478	493	42
Crude protein, g/kg	158	154	156	156	153	14
Ether extract, g/kg	285	290	279	288	305	24
Crude ash, g/kg	38	42	36	37	35	4
Gross energy, MJ/kg	13.70	13.80	13.68	13.82	13.88	1.50

[a] S-soyabean meal, R-lupin cv. Remik, E-lupin cv. Emir, I-lupin cv.Ignis, M-lupin cv. Mirela
[b] standard error of the mean

TABLE 9

Metabolizable energy (ME) utilization by lambs

Item	Group[a]					SE[b]
	S	R	E	I	M	
Total ME intake, MJ/lamb	1471.0	1498.2	1471.7	1516.5	1633.3	136.5
Maintenance requirement, MJ	586.8	610.9	600.2	615.2	640.0	64.0
ME available for growth, MJ	884.2	887.3	871.5	901.3	993.3	85.2
Energy deposition[d], MJ	384.2	380.6	378.2	381.2	386.0	33.3
ME utilization, k_f	0.43[e]	0.43[e]	0.44[e]	0.42[e]	0.39[f]	0.03

[a] S-soyabean meal, R-lupin cv. Remik, E-lupin cv. Emir, I-lupin cv. Ignis, M-lupin cv. Mirela
[b] standard error of the mean
[c] estimated: 418 kJ ME/kg $W^{0.75}$ x mean metabolic weight x duration
[d] wool included
[e, f] means in the same row bearing different superscripts differ $P \leq 0.05$

of alkaloids in the diet (Table 9). However, statistically significant differences were observed in the value of the production utilization of the diet metabolizable energy coefficient (k_f). The values of the kf coefficient in the lambs from groups S, R, E and I were similar (0.42-0.44). On the other hand, the value of this coefficient in lambs fed the diet containing bitter lupin Mirela (group M) was significantly ($P < 0.05$) lower (0.39).

TABLE 10

Protein deposition in lamb body

Item	Group[a]					SE[b]
	S	R	E	I	M	
Protein intake, g/d	183	178	180	180	183	14
Protein deposition:						
in EBW gain, g/d	31.01[c]	30.45[c]	30.75[c]	30.22[c]	28.85[d]	2.73
in wool gain, g/d	4.40	4.46	4.43	4.42	4.25	0.35
total, g/d	35.41	34.91[c]	35.18[c]	34.65[c]	33.10[d]	3.18
in % of protein intake	19.61	19.61	19.50	19.25	19.09	1.56

[a] S-soyabean meal, R-lupin cv. Remik, E-lupin cv. Emir, I-lupin cv. Ignis, M-lupin cv. Mirela
[b] standard error of the mean
[c, d] means in the same row bearing different superscripts differ $P \leq 0.05$

At almost the same quantities of protein consumed by lambs from all experimental groups, significantly ($P<0.05$) lower protein deposition was recorded in lambs whose diets contained bitter lupin cv. Mirela (Table 10). Protein retention expressed as percentage of intake was similar in lambs from groups S. R, E and I (19.25-19.61%) and lower in animals from group M (18.09%). Differences among groups were not significant.

DISCUSSION

The aim of the experiment was to determine possibilities of substituting the soyabean meal in diets for fattening lambs with seeds of different varieties of blue lupin, i.e. sweet cultivars Remik and Emir, semi-bitter Ignis and bitter Mirela. These lupin cultivars were characterized by different alkaloid concentrations, i.e. 0.10, 0.12, 0.30 and 1.98% in 1 kg dry matter, respectively. The daily consumption of lupin seeds per lamb ranged from 125 g at the beginning to 200 g at the end of fattening, and the mean alkaloid concentration in groups R, E, I and M was 0.012, 0.015, 0.037 and 0.24%, respectively.

The fact that no statistically significant differences in liveweight gains and feed utilization were found between animals from the control group and lambs fed diets containing seeds of sweet and semi-bitter lupins indicates that the fattening animals fully tolerate alkaloid concentrations up to 0.037%. On the other hand, significantly lower gains and higher protein and energy intake by lambs from group M where soyabean meal was replaced by seeds of bitter lupin cv. Mirela indicate that the level of alkaloids in diets reaching 0.24% was too high under the conditions of this experiment. It is interesting to note that the animals from this group did not respond to this by reducing feed consumption.

Godfrey et al. (1985) found that growing pigs did not reduce feed consumption and growth rate if the level of alkaloids in the diet did not exceed 0.02%. However, in experiments carried out by Hale and Miller (1985) and Pearson and Carr (1977) production results of experimental animals were significantly worse in fatteners fed diets containing about 0.03% alkaloids. Sheep, unlike monogastric animals, exhibit a higher tolerance to alkaloids (Dixon and Hosking, 1992; Nowak and Potkański, 1993). It may, therefore, be assumed that the acceptable concentration of alkaloids in diets for fattening lambs is higher than the level used in this experiment in group I, 0.037%. However, the steep-almost six fold-increase in the concentration of alkaloids in group M (0.24%) makes it impossible to estimate what the acceptable level of their concentration could be.

The results of this experiment are not in agreement with those obtained by Nowak and Potkański (1993). In their trials they also fed lambs diets containing 0.32% alkaloids and the main protein source were seeds of bitter lupin cv.

Mirela. However, they did not observe a decrease in the growth rate of lambs, although they did record a reduction in feed utilization. Positive results obtained in this study correspond with data from numerous other experiments (Kenney, 1987; Gonzalez et al., 1984; Bailey and Mackintosh, 1986; Aitchison et al., 1988).

In our experiment we did not observe negative effect of the substitution of soyabean meal by seeds of sweet, semi-bitter and bitter lupins on wool production, fibre diameter and sulphur content in wool. Similar total and average daily wool production was recorded in all experimental groups, even in the group of lambs fed diets containing seeds of bitter lupin cv. Mirela. The similar diameter of wool fibres as well as comparable concentrations of sulphur in wool (exceeding 3%) indicate that the applied diets covered the requirements of lambs in all experimental groups for sulphur-containing amino acids (Urbaniak, 1986). These findings correspond with the results of other authors who also observed a positive influence of the addition of lupins on wool production in sheep (Cottle, 1988; Kenney, 1987; Aitchison, et al., 1988; Hill,1988).

The obtained values of the dressing percentage (47.7-48.9%) were in agreement with results of Theriez et al. (1982) and Urbaniak (1986). However, Nowak and Potkański (1993) in their experiment in which lambs were fattened on diets containing lupins of varying alkaloid concentration (cv. Remik, Ignis, Mirela) obtained lower dressing percentage (45.1-45.9%) but differences between groups in their experiment were not statistically significant, either.

The meat, bones and fat contents in carcasses were similar to the results obtained by Urbaniak (1986) in which the experimental animals were also Merino lambs slaughtered at about 40 kg live weight.

The chemical composition of the EBW was similar in all groups with the exception of group M in which a tendency for increasing the fat content was observed. Gonzales et al. (1984) observed an increase in the amount of meat when soyabean meal in the diet was substituted by seeds of white lupin cv. Multolupa (14% of the diet). One of the possible explanations for this discrepancy may be the fact that, in our investigations, we used the bitter variety of lupin and, consequently, the concentration of alkaloids was several times higher.

The evaluation of the utilization of diet metabolizable energy (ME) on the growth of lambs using the slaughter method requires determination of the energy intake, energy concentration in the body of animals at the beginning and end of the experiment and their maintenance requirements. With the exception of the latter, all of the above mentioned values were determined in this experiment. It was assumed, after Theriez et al. (1982) and Urbaniak (1986), that maintenance requirements amounted to 418 kJ ME per 1 kg $W^{0.75}$. The study showed a significant fall in the production utilization of the diet metabolizable energy

coefficient (k_f) in lambs which were fed the diet containing bitter lupin cv. Mirela. This decline was caused by a very high alkaloid concentration in the diet which amounted to 0.24% dry matter. It is interesting to note that the utilization of diet ME per 1 kg body gain by animals from group M was only slightly worse than in the remaining groups. The values of the k_f coefficient obtained in these investigations are within the limits of 0.30 to 0.60 given by Reid (1980) for this production group of sheep.

Total protein deposition in EBW of lambs from groups S, R, E and I was similar (34.6-35.4 g/d), while in group M it was significantly lower and amounted to 33.1 g/d confirming the production results. Kung et al., (1991) also carried out experiments on growing lambs and showed that it is possible to substitute soyabean meal in the diet by white lupin seeds without negatively influencing nitrogen retention. The protein retained by lambs in their experiment was lower than in our investigations. However, it should be pointed out that nitrogen retention in their experiments was determined using the classical method (urine and faeces collection). Our results concerning protein deposition in lambs' body correspond with those carried out by Amos and Evans (1980) and Urbaniak (1986).

In summary, it can be said that the obtained results indicate that soyabean meal in diets for fattening lambs may be completely substituted by seeds of sweet and semi-bitter varieties of blue lupins. Such substitution enables obtaining similar production results and protein and energy deposition in lambs' body. Under the conditions of this experiment, the maximum alkaloid concentration in the diet dry matter which did not reduce animals performance was 0.037%. It is possible that lambs may tolerate higher levels of alkaloids, but this requires further study.

REFERENCES

Aitchison E.M., Rix G.S., Rowe J.B., 1988. Improving the nutritive value of round bales of oat straw by treatment with urea supplementation with lupins. Proceedings of the Australian Society of Animal Production 16, 123-126

Amos H. E., Evans J. J., 1980. Nitrogen metabolism of growing lamb fed coastal bermuda grass as influenced by formaldehyde treatment and glucose. J. Anim. Sci. 51, 712-721

ARC, 1984. The Nutrient Requirements of Ruminant Livestock. Commonwealth Agric. Bureaux, London

Bailey A.N., Mackintosh J.B., 1986. A lupinseed pellet for shipboard feeding of sheep. Proceedings of 4th International Lupin Conference, Geraldtown, Australia

Cheeke P.R., Kelly J.D., 1988. Metabolism, toxicity and nutritional implications of quinolizidine (lupin) alkaloids. Proceedings of the 1st International Workshop on "Antinutritional Factors in Legume Seeds", Wageningen, the Netherlands

Cottle D. J., 1988. Effects of defaunation of the rumen and supplementation with amino acids on the wool production of housed Savon Merinos. 1. Lupins and extruded lupins. Aust. J. Exp. Agric. 28, 173-178

Culvenor C.C.J., Petterson D.S., 1986. Lupin toxins – alkaloids and phomopsins. Proceedings of 4th International Lupin Conference, Geraldtown, Australia

Dixon R. M., Hosking B. J., 1992. Nutritional value of grain legumes for ruminants. Nutr. Res. Rev. 5, 19-43

Godfrey N.W., Mercy A.R., Emms Y., Payne H.G., 1988. Tolerance of growing pigs to lupin alkaloids. Aust. J. Exp. Agric. 25, 791-795

Gonzalez V., Fernandez E., Vidal Herrero de Frutos M., 1984. Substitucion de la forta de soja y de girasol por harina de altramuz dulce (*Lupinus albus* var. *Multolupa*) en raciones para cebo intensivo de corderos. Avances en Alimentacion y Mejora Animal 25, 161-166

Hale O.M., Miller J.D. 1985. Effect of either sweet or semi-sweet blue lupin on performance of swine. J. Anim. Sci. 60, 989-992

Hill G.D., 1988. Lupins in sheep nutrition. Proceedings of the 6th International Lupin Conference, Poznań, Poland

Kenney P.A., 1987. Lupins in grain diets for drought-affected lambs weaned at different ages. Aust. J. Exp. Agric. 27, 625-628

Kung L., Jr., Maciorowski K., Powell K. M., Weidner S., Eley C. L., 1991. Lupin as a protein supplement for growing lambs. J. Anim. Sci. 69, 3398-3405

Nowak W., Potkański A., 1993. Utilization of three varieties of *Lupinus angustifolius* of different levels of alkaloids as high protein components of concentrates for lambs. Lupin Newsletter 16, 37-44

Osińska Z., Ziołecka A., 1972. A note on the protein content of the empty body of young Polish Black and White Lowland bulls. Anim. Prod. 14, 119-122

Pearson G., Carr J.R., 1977. A comparison between meals prepared from the seeds of different varieties of lupin as protein supplements to barley based diets for growing pigs. Anim. Feed Sci. Technol. 2, 49-58

Reid J. T., 1986. Nutritional energetics of livestock: some present boundaries of knowledge and future research needs. J. Anim. Sci. 51, 1393-1415

Steel R. G. D., Torrie J. H., 1960. Principles and Procedures of Statistics. McGrow – Hill Book Co., New York

Theriez M., Castrillo C., Villette Y., 1982. Influence of metabolizable energy content of the diet and of feeding level on lamb performances. ll. Utilization of metabolizable energy for growth and fattening. Livest. Prod. Sci. 9, 487-500

Urbaniak M., 1986. The protein requirement by Merino – type lambs fattened from 20 to 40 by live weight (in Polish). Rocz. Akad. Rol., Poznań, Rozpr. Nauk., No. 161

Urbaniak M., Potkański A., 1987. Tissue protein and energy deposition in lamb body fed isocaloric complete pelleted diets with different levels of nitrogen. Proceedings of the 5th International Symposium on Protein Metabolism and Nutrition, Rostock, Germany

Wink M., Hartman T., 1981. Enzymatic synthesis of quinolizidine alkaloids and their accumulation in *Lupinus polyphyllus*. Z. Pflanzenphysiol. Biol. 102, 337-344

STRESZCZENIE

Nasiona łubinów wąskolistnych w dawkach dla tuczonych jagniąt

Trzydzieści tryczków rasy merynos polski o średniej początkowej masie ciała około 20 kg podzielono na 5 grup i żywiono pięcioma izobiałkowymi i izoenergetycznymi dawkami (około 15% białka ogólnego i 11 MJ energii metabolicznej / kg suchej masy), zawierającymi śrutę sojową (S) lub nasiona łubinów wąskolistnych – słodkich odmiany Remik (R) i Emir (E), półgorzkiego odmiany Ignis (I) oraz gorzkiego odmiany Mirela (M). Średni dzienny przyrost masy ciała jagniąt z grup S, R, E i I był podobny (180-188 g), natomiast zwierząt z grupy M (175 g) istotnie mniejszy ($P<0.05$). Jagnięta żywione dawką z udziałem M zużywały istotnie więcej ($P<0.05$) białka i energii na przyrost 1 kg masy ciała. Średnia dzienna produkcja czystego włókna wełny nie różniła się istotnie pomiędzy grupami (4,50-4,70 g), podobnie jak grubość włókna (3,63-3,83 m) oraz zawartość siarki w wełnie (3,15-3,29%). Nie stwierdzono statystycznie istotnych różnic pomiędzy grupami w wydajności rzeźnej (47,7-48,9%) oraz zawartości mięsa (11,66-12,11kg), tłuszczu (3,62-4,02 kg) i kości (3,61-3,91 kg) w tuszy, jak również w składzie chemicznym masy ciała netto (MCN). Wartość współczynnika wykorzystania energii metabolicznej na wzrost (k_f) była podobna u jagniąt z grup S, R, E, i I (0,42-0,44), a u zwierząt z grupy M istotnie ($P<0,05$) niższa (0,39). Jagnięta z grupy M odkładały również istotnie ($P<0.05$) mniej białka w MCN, w przyroście wełny oraz w całkowitym przyroście, niż jagnięta z grup S, R, E i I.