The influence of various leguminous seed diets on carcass and meat quality of fattening pigs

R. Leikus, K. Triukas, G. Švirmickas, V. Juškiene

Institute of Animal Science of Lithuanian Veterinary Academy, Baisogala, Lithuania

ABSTRACT: Two trials were designed to determine the quality of pig carcasses, chemical composition and physical indicators of meat and fatty acid composition of backfat. Growing pigs were offered adequate diets containing field beans (20–25%), sweet lupines (15–20%) or extruded soybeans (18–15.4%) instead of soybean or sunflower oil meal (control). The weight and length of the carcass, dressing percentage, weight of ham, chemical composition and physical indicators of meat of pigs fed diets with different leguminous seeds did not differ significantly from those of pigs fed the control diet. Pigs fed diets containing field beans had 5.7–8.2 mm lower backfat thickness, while pigs fed extruded soybeans had 6.6–7.9% smaller loin lean area and 4.57% lower content of oleic acid in the backfat, but the content of linoleic acid was 5.11% higher.

Keywords: pigs; leguminous seeds; carcass; meat; backfat; fatty acids

Intensive growing of pigs is based on adequate feeding standards and balanced diets that should contain protein feeds. The cheapest are home grown feeds such as field beans, sweet lupines or soybeans that have been started to grow in Lithuania.

Field beans are usually used in the diets of sows, weaner and fattening pigs (McDonald *et al*., 1995; Simon and Jeroch, 1999). Sweet lupine seeds are a natural good source of protein for young and growing pigs (Gdala *et al*., 1996; Flis *et al*., 1996). If compared with soybean oil meal, bean protein contains more lysine but 2–2.5 times less methionine and cystine. Though lupines among legumes take the second place after soya for the protein content, yet lupine protein contains less lysine, methionine and cystine and threonine (McDonald *et al*., 1995). Soya protein has all indispensable amino acids and their good ratio, therefore it is ideal both for animal feeding (Marty and Chavez, 1993; Gundell and Matrai, 1996) and human nutrition (Lusas and Riaz, 1995).

However, these studies hardly presented any data regarding the influence of individual feeds on pig carcasses and meat quality, though the chemical composition of pig meat and composition of carcasses depend not only on the animal breed, sex and age at slaughter (Gu *et al*., 1992; Kulisiewicz *et al*., 1995; Lizardo *et al*., 2001) but also on the composition of animal diets (West and Myer, 1987; Hertzman *et al*., 1988; Thomke *et al*., 1995).

The purpose of our paper was to determine the replacement effects of soybean and sunflower oil meal with legume (lupine, bean, extruded soybean) seeds on carcass, meat and backfat quality of pig.

MATERIAL AND METHODS

Animals and diets. Three groups of crossbred (Lithuanian White × German Landrace) pigs were used in Trial 1. The pigs were raised from 30 kg to slaughter weight (105–110 kg). Two groups of crossbred (Norwegian Landrace × Finnish Landrace) pigs raised from 20–25 kg to slaughter (95–100 kg) were used in Trial 2. In both trials pigs were allotted to analogous groups on the basis of origin, age, weight and sex. In both trials, there were 12 pigs in each of the groups. The pigs were given complete compound feeds, their composition and feeding value are presented in Tables 1 and 2.

In Trial 1, the main protein source for the pigs in the control group (Group 1) was soya and sunflower

Table 1. Composition and nutritive value of diets (Trial 1)

Item	Groups					
	1		2		3	
Main protein sources	SBM + SFM (n = 12)		Field bean (n = 12)		Sweet lupine (n = 12)	
Body weight (kg)	30–60	over 60	30–60	over 60	30–60	over 60
Ingredients (%)						
Barley	75.5	82.7	66.0	70.7	72.5	76.9
Soybean oil meal (SBM)	12.0	7.0	–	–	–	–
Sunflower oil meal (SFM)	6.0	6.0	7.5	–	6.0	–
Field bean	–	–	20.0	25.0	–	–
Sweet lupine	–	–	–	–	15.0	20.0
Fish meal	2.0	–	2.0	–	2.0	–
Meat and bone meal	2.0	1.5	2.0	1.5	2.0	–
Tricalcium phosphate	0.8	0.7	0.8	1.1	0.8	1.1
Limestone	0.7	1.1	0.7	0.7	0.7	1.0
Premix P 51–7*	1.0	1.0	1.0	1.0	1.0	1.0
Chemical composition/kg feed						
Dry matter (%)	83.0	82.0	83.0	82.0	83.0	82.0
Crude protein (g)	170.4	140.2	163.9	140.1	158.5	136.5
Crude fat (g)	23.4	22.9	22.1	20.0	26.7	25.0
Crude fibre (g)	71.4	73.3	77.6	73.0	86.5	87.9
Calcium (g)	10.8	10.3	10.7	10.0	10.7	9.6
Phosphorus (g)	8.4	7.2	8.5	8.0	8.1	6.8
Lysine (g)	8.5	6.0	8.6	7.4	7.2	5.8
Methionine (g)	4.7	3.7	4.0	2.6	3.9	2.6
Metabolizable energy (MJ)	11.3	11.2	11.2	11.2	11.2	11.2

*Premix P 51-7 contains per 1 kg: vit. A, 300 000 IU; vit. D_3, 80 000 IU; vit. B_2, 0.130 g; vit. B_3, 0.70 g; vit. B_{12}, 2.5 mg; Fe, 1.0 g; Cu, 0.25 g; Zn, 0.4 g; Co, 0.05 g; I, 0.06 g

oil meals. For pigs in Group 2 in the first fattening stage (under 60 kg weight), soybean oil meal was replaced by 20% of field beans, and in the second fattening stage (from 60 kg to slaughter), soybean and sunflower oil meals were replaced by 25% of beans. Pigs in Group 3 were offered 15 and 20% of sweet lupines, respectively. "Danko" variety of white lupines and "Ada" variety of bean seeds containing a low level of tannins were used in this trial. Pigs were fed *ad libitum* twice daily on wet feeds (feed : water as 1 : 2).

In Trial 2, the pigs in Group 1 (control) and Group 2 were offered diets the main protein source of which was, respectively, soybean oil meal (respectively 20.0 and 12.1%) and extruded soybeans (respectively 18.0 and 15.4%). "Progres" variety of soybeans was used in the trial, and the beans were extruded with the apparatus UES-F-8004. The quality of extrusion was controlled by urease activity. In the course of Trial 2, pigs were fed *ad libitum* on dry compound feeds from automatic feeders and watered from automatic waterers.

In both trials, pigs of all groups were kept under the same conditions of 6 animals per pen.

Measurements and laboratory analyses. In both trials, feeds for all groups of pigs were weighed separately for each pen before feeding and weight gain was determined by weighing pigs at the start and end of the trials and every month.

After finishing of the fattening, 2 gilts and 2 barrows were selected from each group for slaughter. The animals were slaughtered and the left half-

Table 2. Composition and nutritive value of diets (Trial 2)

Item	Groups			
	1		2	
Main protein sources	Soybean oil meal (SBM) (n = 12)		Extruded soybean (ESB) (n = 12)	
Body weight (kg)	20–50	over 50	20–50	over 50
Ingredients (%)				
Barley	12.0	84.7	10.0	81.0
Wheat	50.0	–	50.5	–
Maize	7.0	–	7.0	–
Soybean oil meal	20.0	12.1	–	–
Extruded soybean	–	–	18.0	15.4
Sunflower oil meal	–	–	6.0	–
Fish meal	2.0	0.7	2.0	0.9
Meat meal	2.0	0.7	2.0	0.9
Blood meal	2.0	–	2.0	–
Sunflower oil	2.5	–	–	–
Tricalcium phosphate	1.0	0.6	1.0	0.6
Limestone	0.3	0.6	0.3	0.6
Salt (NaCl)	0.2	–	0.2	–
Premix J 10* and J 121**	1.0*	0.6**	1.0*	0.6**
Chemical composition/kg feed				
Dry matter (%)	86.8	85.5	87.2	86.3
Crude protein (g)	204.4	153.2	203.7	156.5
Crude fat (g)	49.0	21.7	53.5	46.8
Crude fibre (g)	34.8	53.5	35.0	52.5
Calcium (g)	7.3	5.6	7.7	5.8
Phosphorus (g)	5.3	4.3	4.5	4.4
Lysine (g)	12.7	7.4	12.2	7.8
Methionine + cystine (g)	5.9	4.4	6.1	4.6
Metabolizable energy (MJ)	13.5	12.0	13.5	12.6

*Premix J 10 contains per kg: vit. A, 1 000 000 IU; vit. D_3, 200 000 IU; vit. E, 2.0 g; vit. K_3, 100.0 mg; vit. B_1, 200.0 mg; vit. B_2, 400.0 mg; vit. B_3, 1.2 g; vit. B_4, 40.0 g; vit. B_5, 2.5 g, vit. B_6, 400.0 mg; vit. B_c, 60.0 mg; vit. B_{12}, 2.5 mg; Zn, 15.0 g; Mn, 8.5 g; Fe, 20.0 g; Cu, 16.5 g; I, 100.0 mg; Co, 20.0 mg; Se, 40.0 mg; methionine, 120 g; lysine, 270 g
**Premix J 121 contains per kg: vit. A, 500 000 IU; vit. D_3, 60 000 IU; vit. E, 3.0 g; vit. K_3, 100.0 mg; vit. B_1, 100.0 mg; vit. B_2, 300.0 mg; vit. B_3, 1.5 g; vit. B_4, 30.0 g; vit. B_5, 1.5 g; vit. B_6, 200.0 mg; vit. B_c, 50.0 mg; vit. B_{12}, 1.5 g; Zn, 8.0 g; Cu, 15.0 g; Fe, 6.0 g; Mn, 4.0 g; I, 60.0 mg; Se, 40.0 mg; Co, 20.0 mg; methionine, 80.0 g; lysine, 330.0 g; threonine, 120.0 g

carcass was dissected according to the Methods of Control Pig Fattening and Slaughtering (1978). All carcass traits were corrected for 100 kg weight.

The samples of the longissimus muscle of the back (*m. longissimus dorsi*) were analysed in duplicate for dry matter, crude protein by a block digestion method, crude ash and ether extract were determined according to standard AOAC methods (AOAC, 1990a), tryptophan – with p-dimethylamino benzaldehyde by Miller (1967), oxyproline – as described in Methodical Guidelines (1978), meat pH – after 48 h following slaughter, colour intensity and water-binding capacity – by the method of Grau and Hamm as described by Gumeniuk and Tcherkasskaja (1977), cooking losses of meat – by the method of Schilling (1966). The quality indicators of the backfat were determined as follows: melting temperature by the capillary tube method, saponification number according to AOAC methods (AOAC, 1990b) and fatty acid composition. Extraction of lipids for fatty acid analysis was completed using chloroform : methanol (2 : 1, v/v) as described by Folch *et al*. (1957). Fatty acid methyl esters (FAME) were prepared using the procedure of Christopherson and Gloss (1969). The FAME were separated and quantified using a gas chromatograph (Chrom 5) equipped with a flame ionization detector and integrator (CJ-100). A glass column of 2.5 × 3 mm containing 0.160–0.200 mm Chromaton N-AW-HMDS with 15% diethylene glycol succinate was used. The carrier gas was nitrogen at a flow rate of 100 ml/min. The detector was supplied with dried air at 400 ml/min and hydrogen at 40 ml/min. The detector and injector were maintained at 250°C and the column was maintained at 180°C. Peaks were identified by comparison with the retention times of the standard FAME (Sigma Chemical Co.).

Statistical analyses. The data were processed statistically. The arithmetic average values ($\bar{x}$), standard deviation ($s_{\bar{x}}$) were calculated for all data. The significance of differences between the average values was determined according to Snedecor and Cochran (1989). $P < 0.05$ was an indicator of the data significance.

RESULTS

Growth pigs

In Trial 1, the replacement of soybean and sunflower oil meals in the compound feed by 20% of field bean and 15% of lupine meal for growing pigs (up to 60 kg weight) and 25% of field bean and 20% of lupine meal for finishing pigs (over 60 kg) had no significant influence on the growth and feed intake of pigs. In Trial 2, the weight gains of pigs fed extruded soybeans were similar to those of control pigs, but the experimental pigs consumed by 4.3% less feed per kg gain.

Carcass value

After replacement of soybean oil meal and sunflower oil meal by 20 (first fattening stage) and 25% (second fattening stage) of meal from field beans (Table 3), the weight of carcass, dressing percentage, ham weight and loin lean area were similar to those of control pigs. However, the backfat at withers, at

Table 3. Carcass quality

Item	Trial 1						Trial 2			
	Control (n = 4)		Field beans (n = 4)		Sweet lupines (n = 4)		SBM (n = 4)		ESB (n = 4)	
	$\bar{x}$	$s_{\bar{x}}$	$\bar{x}$	$s_{\bar{x}}$	$\bar{x}$	$s_{\bar{x}}$	$\bar{x}$	$s_{\bar{x}}$	$\bar{x}$	$s_{\bar{x}}$
Average weight before slaughter (kg)	106.8	1.10	107.3	3.60	108.5	1.80	98.8	2.76	98.3	5.06
Carcass weight (kg)	72.3	1.48	71.3	1.92	71.8	1.09	75.8	2.18	76.6	3.40
Dressing percentage	67.7	1.06	66.4	1.30	66.2	1.12	76.7	0.54	77.9	1.38
Carcass length (cm)	97.4	1.70	98.8	2.70	99.6	3.40	102.0	3.36	101.0	1.86
Ham weight (kg)	9.2	0.29	8.9	0.61	9.1	0.78	11.3	0.24	11.6	0.44
Backfat thickness (mm)										
at withers	46.5	3.30	38.3	5.40	42.7	5.40	42.2	5.02	47.5	3.44
at 6–7th rib	33.7	2.20	26.8*	3.30	31.7	5.80	27.1	5.60	27.8	2.16
at last rib	28.0	2.80	22.3*	2.40	24.4	4.80	22.0	4.70	23.0	4.02
Loin lean area (cm^2)	33.2	3.00	34.7	3.70	29.5	1.80	42.5	1.74	39.7	1.74
Lean meat area (cm^2)	37.4	3.80	39.7	4.20	35.1	3.30	47.1	1.66	43.4	1.58
Backfat area (cm^2)	29.2	3.40	21.7	2.80	28.2	7.50	22.3	2.28	23.5	6.74
Lean meat : backfat area ratio	1.28		1.83		1.24		2.11		1.85	

SBM – soybean oil meal (control)
ESB – extruded soybeans

the 6th–7th rib and at the last rib was lower by 8.2 (0.1 > P > 0.05), 6.9 (P < 0.05) and 5.7 mm (P < 0.05), respectively, than that of control pigs. Bean meal has by the 43% increased ratio of lean meat : fat in the carcass.

Pigs fed diets containing 15 and 20% of sweet lupine meal had almost the same weight of carcass, dressing percentage, ham weight and backfat thickness as the pigs in the control group. Lupine meal had no significant influence on the loin lean area and meat : fat ratio in the carcass.

Feeding pigs the diet with extruded soybeans reduced the loin lean area by 6.6% and lean meat area by 7.9% and increased the backfat area by 5.4%, but these differences were statistically insignificant.

Extruded soybeans had no significant influence on the other carcass characteristics.

Physicochemical indicators of meat and backfat

The results of the study indicate (Table 4) that the replacement of soybean and sunflower oil meals by 20 (1st stage) and 25% (2nd stage) of bean meal had no negative influence on the chemical composition, pH, water-binding capacity, cooking losses and colour intensity of meat.

The chemical composition and pH-value of meat of pigs fed 15 and 20% of sweet lupine meal did not undergo any significant changes. Lupine meal had no significant influence on water-binding capacity and cooking losses of meat, it only reduced colour intensity (P < 0.05). Fat melting temperature and saponification number were similar for all groups of pigs.

Table 4. Physicochemical indicators of meat and fat

Item	Trial 1						Trial 2			
	Control (n = 4)		Field beans (n = 4)		Sweet lupines (n = 4)		SBM (n = 4)		ESB (n = 4)	
	$\bar{x}$	$s_{\bar{x}}$	$\bar{x}$	$s_{\bar{x}}$	$\bar{x}$	$s_{\bar{x}}$	$\bar{x}$	$s_{\bar{x}}$	$\bar{x}$	$s_{\bar{x}}$
M. longissimus dorsi										
Dry matter (%)	24.97	0.91	24.83	0.48	24.79	0.58	25.01	0.46	24.94	0.98
Protein (%)	21.59	0.32	21.53	0.38	21.54	0.35	21.70	0.32	21.84	0.82
Fat (%)	2.21	0.73	2.12	0.11	2.08	0.54	2.26	0.68	2.07	0.80
Ash (%)	1.02	0.02	1.02	0.04	1.00	0.07	1.01	0.04	1.03	0.04
Tryptophan (mg/100 g)	388	28.57	388	14.75	371	21.30	318	14.54	317	10.34
Oxyproline (mg/100 g)	55	5.76	54	7.02	61	6.73	66	16.00	69	7.50
Tryptophan : oxyproline ratio	7.18		7.19		6.08		4.82		4.59	
Meat pH	5.62	0.12	5.69	0.18	5.88	0.27	5.23	0.04	5.30	0.06
Water-binding capacity (%)	58.7	3.17	60.9	4.34	59.6	3.92	53.3	2.76	54.6	4.18
Cooking losses (%)	41.2	0.32	42.3	2.42	39.9	2.58	43.2	1.60	43.4	0.92
Colour intensity (units)	76	3.63	75	11.76	62*	8.99	59	13.02	53	18.52
Quality indicators of backfat										
Melting temperature (°C)	39.1	2.55	38.1	3.20	38.3	2.78	38.8	4.86	39.8	1.64
Saponification number	20.3	0.07	20.1	0.15	20.0	0.22	18.9	0.01	18.9	0.18

SBM – soybean oil meal (control)
ESB – extruded soybeans
*P < 0.05 (compared with control)

The content of the amino acid oxyproline increased in the *m. longissimus dorsi* by 4.5% and the colour intensity of meat decreased by 10.2% for pigs fed extruded soybeans, but these differences were statistically insignificant. Extruded soybeans had no significant influence on the other indicators of the chemical composition of *m. longissimus dorsi*. There were no significant changes for the pH-value, water-binding capacity and cooking losses of meat, and quality indicators of backfat.

Fatty acid composition of backfat

The composition and ratio of fatty acids in the backfat of pigs fed diets with field beans and sweet lupines were almost the same (Table 5).

When pigs were offered extruded soybeans, the content of oleic acid in the backfat was by 4.57% ($P < 0.05$) lower, but that of linoleic by 5.11% ($P < 0.05$) higher. The content of the other fatty acids did not change.

DISCUSSION

The results from our study indicated that the weight and length of carcass, dressing percentage and ham weight of pigs fed diets containing leguminous meals – field beans, sweet lupines and extruded soybeans – did not differ significantly from those of pigs fed diets with soybean and sunflower oil meals. This is in agreement with the results of Cannon *et al*. (1992), who also found that

Table 5. Fatty acid composition of backfat (% of total fatty acids)

Fatty acids	Trial 1						Trial 2			
	Control (n = 4)		Field beans (n = 4)		Sweet lupines (n = 4)		SBM (n = 4)		ESB (n = 4)	
	$\bar{x}$	$s_{\bar{x}}$	$\bar{x}$	$s_{\bar{x}}$	$\bar{x}$	$s_{\bar{x}}$	$\bar{x}$	$s_{\bar{x}}$	$\bar{x}$	$s_{\bar{x}}$
Saturated					0.72	0.13				
myristic C 14:0	0.67	0.17	0.72	0.10	27.40	1.16	1.36	0.12	1.32	0.14
palmitic C 16:0	28.17	0.90	28.29	0.80	12.21	0.74	28.89	0.50	27.71	1.12
stearic C 18:0	13.39	2.47	13.20	0.69	40.33	1.45	13.76	1.28	13.92	1.34
Total	42.23	2.64	42.21	0.57			44.01	1.25	42.95	2.09
Unsaturated										
monounsaturated										
palmitoleic C 16:1	2.49	0.63	2.72	0.57	2.49	0.25	2.70	0.66	2.19	0.46
oleic C 18: 1	50.00	2.16	50.00	1.40	50.88	1.00	41.23	0.56	36.66*	1.24
Total	52.49	2.55	52.72	1.03	53.37	1.27	43.93	0.71	38.85*	1.27
polyunsaturated										
linoleic C 18:2	4.70	0.45	4.45	0.44	5.57	0.59	9.86	1.16	14.97*	2.44
linolenic C 18:3	0.55	0.07	0.53	0.09	0.66	0.03	1.30	0.14	2.07	0.36
Total	5.25	0.59	4.98	0.50	6.23	0.71	11.16	1.19	17.04*	2.48
Others	0.03	0.05	0.09	0.06	0.07	0.05	0.90	0.46	1.16	0.49

SBM – soybean oil meal (control)
ESB – extruded soybeans
*$P < 0.05$ (compared with control)

carcass weight and length, all measures of backfat thickness and longissimus muscle area were not different between pigs given different dietary treatments.

Pigs fed field beans had lower backfat thickness, and those fed extruded soybeans showed a tendency towards higher backfat thickness ($0.1 > P > 0.05$), and in this case the loin lean area was reduced. This, presumably, depends on the protein : fat ratio in the consumed feeds. Dusel *et al*. (2000) observed that the lower the protein content in the diet, the lower the lean meat content in the carcass and the higher the backfat thickness, though the differences were statistically insignificant. Kulisiewicz *et al*. (1995) found that increasing the protein as well as both protein and energy content in the diet increased the meat content in carcasses of pigs. In our experiments, the pigs of experimental groups received different contents of crude fat: the diet with field beans contained 14.3 g of fat (control group – 16.3 g)/100 g protein and the diet with extruded soybeans contained 29.9 g of fat (control group – 14.2 g) per 100 g of protein.

There was no significant difference in the chemical composition of meat of pigs fed diets with different leguminous seeds. There were no significant differences in the composition of nutrients in the diets, except for a minor difference in crude fat. In accordance with Cannon *et al*. (1992), higher content of fat in the *m. longissimus dorsi* was not found when the diet with soybean addition contained 10.28% of fat vs. 2.93% of fat in the control diet.

Physical parameters of longissimus muscle and fat did not change significantly on feeding pigs with field beans, sweet lupines or soybeans, except for colour intensity that tended to be lower when feeding sweet lupines and soybeans. Bergkamp and Topel (1970) found that the two rations (soybean meal plus soybean oil; infrared roasted soybeans) fed had no major influence on longissimus muscle colour, pH, water-holding capacity or marbling score. Cannon *et al*. (1992) reported that the percentage of cooking loss did not differ between the four dietary treatments.

The results of our trials indicated that when growing pigs were fed extruded soybeans, the content of oleic acid in the backfat was lower and that of linoleic acid became higher. A number of researchers (Larick *et al*., 1992; Morgan *et al*., 1992; Myer *et al*., 1992) found that the high unsaturation of fat in the feeds resulted in an increase of unsaturated fatty acid content of pork tissues. According to Monari (1990), McDonald *et al*. (1995) the oil of soybeans has the highest content of unsaturated fatty acids, especially that of linoleic acid (51.0–52.1% of all fatty acids), and therefore pigs fed diets with soybeans had more linoleic acid in the fat. Feeding soybeans resulted in softer backfat due to a higher content of unsaturated fatty acids (Bergkamp and Topel, 1970; Madsen *et al*., 1992). Nevertheless, the biological value of this backfat was higher because the products, especially soya, with higher content of linoleic acid are more suitable for human nutrition than those with higher content of saturated fatty acids (Ascherio and Willet, 1995; Lusas and Riaz, 1995).

In general it can be concluded that diets containing leguminous seeds had a certain influence on the qualitative traits of pig carcass and fat.

CONCLUSIONS

On the basis of the obtained results one can say that in an *ad libitum* feeding regime the replacement of soybean and sunflower oil meals by other protein and energy sources (field beans, sweet lupines, extruded soybeans) has no significant effect on fattening performance. Only the replacement of extruded soybeans can decrease feed consumption per kg gain to a small extent (by 4.3%).

On the basis of the obtained results one can conclude that in an *ad libitum* feeding regime the replacement of soybean and sunflower oil meals by other protein and energy sources (field beans, sweet lupines, extruded soybeans) has no significant effect on carcass value.

As for some observed trends, it is obvious that the replacement of field bean meal positively influenced the backfat – backfat thickness was by 5.7–8.2 mm ($P < 0.05$) lower, and the lean meat : fat ratio increased by 43% at the same time.

As for some observed trends, it is obvious that the replacement of extruded soybeans may result in the loin lean area smaller by 6.6% and backfat area larger by 5.4%.

On the basis of the obtained results one can state that in an *ad libitum* feeding regime the replacement of soybean and sunflower oil meals by other protein and energy sources (field beans, sweet lupines, extruded soybeans) has no significant effect in pork meat quality. Only a low effect was observed when feeding pigs with extruded soybeans – by 5.11% ($P < 0.05$) higher content of linoleic acid in fat.

REFERENCES

AOAC (1990a): Official Methods of Analysis of the Association of Official Analytical Chemists, 15th ed., chapter 39.

AOAC (1990b): Official Methods of Analysis of the Association of Official Analytical Chemists, 15th ed., chapter 41.

Ascherio A., Willet W.C. (1995): New directions in dietary studies of coronary heart disease. J. Nutr., *125* (suppl.), 647–655.

Bergkamp J.L., Topel D.G. (1970): Effect of feeding swine infrared roasted soybeans on some physical and chemical characteristics of muscle and fat tissue. J. Anim. Sci., *31*, 1015 (abstr.).

Cannon J.E., Bechtel P.J., Easter R.A., Cook H., McKeith F.K., Leszczynski D.E. (1992): Effects of diet containing extruded full – fat soybeans or butter on the growth, compositions and sensory characteristics of pork. J. Anim. Sci., *70,* 3651–3656.

Christopherson S.W., Gloss R.L. (1969): Preparation of milk fat methylesters by alkoholysis in an essentially nonalcoholic solution. J. Dairy Sci., *52*, 1289–1290.

Dusel G., Rademacher M., Hagemann L. (2000): Effect of reducing dietary crude protein on growing-finishing pig performance and carcass characteristics. In: Bižokas V. (ed.): Veterinary Medicine and Zootechnics. Lithuanian Veterinary Academy, Kaunas, LT, 27–30.

Flis M., Sobotka W., Meller Z. (1996): The use of dehulled or fat supplemented yellow lupin seeds in feeding growing pigs. J. Anim. Feed Sci., *5*, 49–62.

Folch J., Less M., Sloane-Stanley G.H. (1957): A simple method for isolation and purification of total lipids from animal tissues. J. Biol. Chem., *226*, 497–509.

Gdala J., Jansman A.J.M., van Leeuwen P., Huisman J., Verstegen M.W.A. (1996): Lupins (*L. luteus, L. albus, L. angustifolius*) as a protein source for young pigs. Anim. Feed Sci. Tech., *62*, 239–249.

Gu Y., Schinckel A.P., Martin T.G. (1992): Growth, development and carcass composition in five genotypes of swine. J. Anim. Sci., *70*, 1719–1729.

Gumeniuk G.A., Tcherkasskaja N.V. (1977): Methodical guidelines for assay of feeds and animal production (in Russian). Kiev, 145 pp.

Gundell I., Matrai T. (1996): Different methods of heat treatment for soybeans in piglets nutrition. In: 2nd Fullfat Soya Conference, ASA, Budapest, 433–450.

Hertzman C., Göransson L., Ruderus H. (1988): Influence of fish meal, rape-seed and rape-seed meal in feed on the fatty acid composition and storage stability of porcine bodyfat. Meat Sci., *23*, 37–53.

Kulisiewicz J., Sokol J.L., Rekiel A., Inarski R., Lenartowicz P. (1995): Growth rate and carcass value of three types of crossbred pigs fed *ad libitum* diets with different protein and energy contents. J. Anim. Feed Sci., *4*, 11–19.

Larick D.U., Turner B.E., Schoenherr W.D., Coffey M.T., Pilkington D.H. (1992): Volatile compound content and fatty acid composition of pork as influenced by linoleic acid content of the diet. J. Anim. Sci., *70*, 1397–1403.

Lizardo L., Gonzalez J., Soler J., Gispert M., Tibau J., Mounier A., Mourot J. (2001): The influence of sex, genotype and live weight at slaughter on the fatty acid composition of total body lipids in the growing-finishing pig. In: Van der Honing Y. (ed.): Book of Abstracts of the 52nd Annual Meeting of the European Association for Animal Production. Budapest, Hungary, No. 7, 285.

Lusas E.W., Riaz M.N. (1995): Soy protein products: processing and use. J. Nutr., *125* (suppl.), 573–580 s.

Madsen A., Jakobsen K., Mortensen H.P. (1992): Influence of dietary fat on carcass fat quality in pigs. A review. Acta Agric. Scand. Sect. A, Anim. Sci., *42,* 220–225.

Marty B.J., Chavez E.R. (1993): Effect of heat processing on digestible energy and other nutrient digestibilities of fullfat soybeans fed to weaner, grower and finisher pigs. Can. J. Anim. Sci., *73*, 411–419.

McDonald P., Edwards R.A., Greenhalgh J.F.D., Morgan C.A. (1995): Animal nutrition. Longman Scientific and Technical. Harlow Essex (England) and New York. pp. 525–528.

Methods of control pig fattening and slaughtering (in Lithuanian) (1978): Lithuanian Ministry of Agriculture, Vilnius, 12 pp.

Methodical guidelines for assay quality of carcass, meat and hypodermic fat of slaughtered pigs (in Russian) (1978): VASHNIL, Moscow, 43 pp.

Miller E.L. (1967): Determination of the tryptophan content of feedingstuffs with particular reference to cereals. J. Sci. Fd. Agric., *18*, 381–386.

Monari S. (1990): Fullfat Soya Handbook. American Soybean Association, Brussels, 22–28.

Morgan A.C., Noble R.C., Cocchi M., McCartney R. (1992): Manipulation of the fatty acid composition of pig meat lipids by dietary means. J. Sci. Food and Agric., *58*, 357–368.

Myer R.O., Johnson D.D., Knauft D.A., Gorbet D.W., Brendemuhl J.H., Walker W.R. (1992): Effect of feeding high-oleic-acid peanuts to growing-finishing swine on resulting carcass fatty acid profile and on carcass and meat quality characteristics. J. Anim. Sci., *70*, 3734–3741.

Schilling E. (1966): Muskelstruktur und Fleischqualität. Tierzucht und Zuchtsbiologie, *82*, 219–243.

Simon O., Jeroch H. (1999): Feed raw materials. Part 2, The up – and – coming legumes. Feed Techn., V 3, No. 2, 29–32.

Snedecor G.W., Cochran W.G. (1989): Statistical methods. 8th ed. Iowa University Press, Ames, Iowa, 503 pp.

Thomke S., Madsen A., Mortensen H.P., Sundstol F., Vangen O., Alaviuhkola T., Anderson K. (1995): Dietary energy and protein for growing Pigs. 1. Performance and carcass composition. Acta Agric. Scand. Sect. A, *45*, 45–53.

West R.L., Myer R.O. (1987): Carcass and meat quality characteristics and backfat fatty acid composition of swine as affected by the comsumption of peanuts remaining in the field after harvest. J. Anim. Sci., *65*, 475–480.

Received: 04–04–26
Accepted after corrections: 04–08–16

ABSTRAKT

Vliv různých krmných dávek obsahujících semena luskovin na kvalitu jatečně upraveného těla a masa u výkrmových prasat

Byly uskutečněny dva pokusy zaměřené na stanovení kvality jatečně upraveného těla (JTU) prasat, chemické složení a fyzikální ukazatele masa a složení aminokyselin v hřbetním tuku. Rostoucí prasata dostávala odpovídající krmné dávky, které místo sójového či slunečnicového extrahovaného šrotu (kontrola) obsahovaly bob obecný (20–25 %), lupinu (15–20 %) nebo extrudovanou sóju (18–15,4 %). Hmotnost a délka JUT, jatečná výtěžnost, hmotnost kýty, chemické složení a fyzikální ukazatele masa prasat, která dostávala krmné dávky obsahující semena různých luskovin, se významně nelišily od těchto ukazatelů u prasat, kterým byly podávány kontrolní krmné dávky. Prasata, která dostávala krmné dávky s obsahem bobu obecného, měla o 5,7–8,2 mm nižší výšku hřbetního tuku, zatímco prasata, kterým byla podávána extrudovaná sója, měla o 6,6–7,9 % menší plochu bederního svalu a o 4,57 % nižší obsah kyseliny olejové v hřbetním tuku, ale obsah kyseliny linolové byl o 5,11 % vyšší.

Klíčová slova: prasata; semena luskovin; jatečně upravené tělo; maso; hřbetní tuk; mastné kyseliny

Corresponding Author

R. Leikus, Institute of Animal Science of Lithuanian Veterinary Academy, R. Žebenkos 12, Baisogala, Lithuania, LT–82317
E-mail: LGI@lgi.lt