THE EFFECT OF REPLACING SOYBEAN MEAL WITH RAPESEED MEAL ON THE PRODUCTION PERFORMANCE AND MEAT CHEMICAL COMPOSITION IN PIGS

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Abstract

The aim of this study was to evaluate the effect of replacing soybean meal with rapeseed meal on the carcass characteristics in pigs and chemical composition of pork meat. 72 hybrid pigs of genotype (DanBred)x(LW_DxL) were divided according to their diet into 2 groups. Animals in the control group were fed with a feed mixture containing soybean meal (17.7 - 14 - 9.5%), while the animals in the experimental group were fed with a diet containing rapeseed meal (5 - 7 - 12.43%). In both groups, the feed intake was *ad-libitum* at all fattening stages.

The substitution of rapeseed meal in diet significantly decreased feed intake (2.78 *vs.* 2.56 kg/d, $P = 0.001$) and feed conversion ratio (2.57 *vs.* 2.43 kg/kg, $P = 0.028$) as opposed to the feed intake observed in the control group. Rapeseed meal in the diet significantly increased water content in the ham (71.56 *vs.* 72.53%, $P = 0.045$), decreased crude protein content in the loin (23.18 *vs.* 22.49%, $P = 0.003$) and ash content in the ham (1.40 *vs.* 1.28%, $P = 0.005$). It can be concluded that rapeseed meal can be used as a direct replacement for soybean meal with no associated growth retardation or decrease in carcass characteristics and meat quality.

Key Words: Pig, nutrition, soybean, rapeseed, production performance, pork meat quality

Rapeseed meal (or cakes) is the most widely used protein feed used in mass production in the Czech Republic. Rapeseed meal contains 31-37% of crude protein and forms a protein rich alternative to soya bean meal. Compared to soya bean meal, rapeseed meal has a higher share of sulfur-containing amino acids (methionine and cysteine) and a higher content of phosphorus, which can reduce the cost of mineral feed. It is possible to incorporate up to 15% of rapeseed meal into the diets of pigs, especially in a dry feed system. The use of rapeseed meal and rapeseed cake in fattening pigs is therefore profitable. Many studies indicate that rapeseed meal can be included into a pig diet with no deleterious effects on their performance (Corino *et al*., 1991; Siljanderrasi *et al*., 1996; McDonnell *et al*., 2010), especially on the carcass characteristics (Corino *et al*., 1991; McDonnell *et al*., 2010). On the contrary Castaing *et al.* (1998) ascertained that diet with rapeseed meal increased feed conversion and decreased daily gain. According to Gill *et al*. (1995), the rapeseed meal in pig diet increased back fat thickness, while Warnantse *et al.* (1995) reported that rapeseed in the diet caused the dorsal fat to be weaker, thinner and pink.

The objective of this study was to determine the effects of the substitution of soybean meal with rapeseed meal in the diet on selected production performance characteristics in fattening pigs.

Material and Methods

Animals and nutrition

The experiment was performed at the Test Station Ploskov-Lány. A total amount of 72 hybrid pigs of the (DanBred)x(LW_DxL) genotype were included in the experiment. Initial live weight of the animals with balanced sex ratio (gilts-barrows) was 20.9 kg (69 day-old). The penning and housing of the pigs was carried out in pairs according to methodology published by Stupka *et al.* (2009). The pigs were fed with complete feeding mixtures (CFM) containing three components (wheat, barley and soybean meal) and premix. The diet was mixed separately for each pen in accordance with the above mentioned methodology. The nutrient CFM composition is shown in Table 1. The CFM transition from A_1 to A_2 and CDP during the test was realised continuously. The control group (CG) was fed with CFM containing soybean meal (17.7- 14 - 9.5%) and pigs from the experimental group (EG) were fed with CFM enriched with rapeseed meal (5.-7-12.43%). The feeding intake was *ad libitum*. Each pig was weighed monthly, while the feed intake per pen was measured daily. The average daily gain, feed intake and feed conversion were calculated from the observed values. All pigs were slaughtered at an average live weight of 105 kg.

Carcass value

To assess the quantitative carcass value traits, carcass measurements were carried out according to Scheper and Scholz (1985). The pig carcasses were weighed and the right half was measured. From the quantitative carcass value characteristics, the lean meat percentage, main meat parts and belly share were evaluated. The loin, ham, neck and shoulder were dissected into meat with bone and fat covering with skin.

Chemical analysis

Representative samples from the loin, ham, neck and shoulder were taken from the right half-carcass, homogenised and subjected to chemical analysis. The water content (from the difference between the sample weight before and after drying with sea sand), intramuscular fat (IMF; *via* gravimetric determination following extraction with petroleum ether in solvent extractor; SER 148, VELP Scientifica, Usmate, Italy), crude protein (CP; amino nitrogen determined according to the Kjeldahl method; KjelFlex K-360, Büchi, Flavil, Switzerland) and ash (*via* burning the sample at 550°C until all the organic substances were burned; Ht40AL oven, LAC, Rajhrad, Czech Republic) were determined.

Statistical analysis

The obtained experiment data were evaluated with the statistical program SAS® Propriety Software Release 6.04 (2001) using analysis of variance (ANOVA). The differences between the individual treatments were tested *via* a t-test.

Table 1. Ingredients and nutrient composition of the diets [a].

Ingredient (g/kg)	C G			E G		
	A_1	A_2	CDP	A_1	A_2	CDP
Wheat	440.0	400.0	378.0	413.2	453.6	536.2
Barley	353.0	432.0	500.0	300.0	300.0	300.0
Soybean meal - 48	177.0	140.0	95.0	184.8	131.7	0.0
Premix	30.0	28.0	27.0	33.3	30.3	25.8
Extruded rapeseed meal	-	-	-	50.0	70.0	124.3
Rapeseed oil	-	-	-	18.7	14.4	13.7
Analysed nutrient composition						
Mep by calculation (MJ/kg)	12.9	12.8	12.7	13.1	13.0	12.9
Crude protein	180.0	165.1	147.4	186.8	173.1	138.7
Crude fibre	35.9	36.8	37.2	43.9	44.0	44.3
Lysine	10.7	9.6	8.3	12.0	11.0	8.5
Methionine	3.1	2.9	2.7	3.3	3.0	2.4
Methionine + cysteine	6.6	6.2	5.7	6.7	6.3	5.3
Threonine	6.7	6.1	5.4	7.8	7.1	5.5
Tryptophan	2.2	2.0	1.8	2.3	2.1	1.6
Calcium	7.1	6.6	6.3	7.5	7.0	6.0
Phosphorus - digestible	4.9	4.7	4.5	5.8	5.5	5.3
Sodium	1.8	1.7	1.6	1.9	1.7	1.5

[a] - A_1, A_2 and CDP are CFM which are fed to pigs in accordance with live weight interval. For 28-35 kg is A_1, 35.1-60 kg A_2 and 60.1-110 kg CDP

Results and Discussion

The pig performance results are shown in Table 2. The table shows that inclusion of rapeseed meal in the diet significantly decreased the feed intake (2.78 *vs.* 2.56 kg/d, $P = 0.001$) as well as feed conversion rate (2.57 *vs.* 2.43 kg/kg, $P = 0.028$). The body weight and daily gain was not influenced. Contrary to our results, Sobotka *et al.* (2012) state, that fattening pigs receiving a genetically modified soybean meal had higher daily gains (by 4.7%) and better feed conversion ratio (by 4.8%) when compared to the animals fed with mixture containing protein from rapeseed meal. Based on the information published in various studies (Corino *et al*., 1991; Siljanderrasi *et al*., 1996; McDonnell *et al*., 2010) it is evident that substituting soybean meal for rapeseed meal does not affect fattening capacity, that is, the daily gain, feed intake and feed conversion ratio.

The selected carcass characteristics are demonstrated in Table 3. It is obvious that lean meat share, carcass half weight and main meat part share are not influenced by the diet. In accordance with that finding Corino *et al*. (1991) and McDonnell *et al*. (2010) stated that rapeseed meal in diet has no harmful effects on the carcass value characteristics. In addition, Siljanderrasi *et al.* (1996) showed that slaughter losses in pigs increased linearly ($P < 0.05$) when soybean meal was replaced with rapeseed meal, otherwise carcass quality is similar. Replacing soybean meal with rapeseed meal did not affect most of the chemical composition characteristics in main meat parts. The inclusion of rapeseed meal in diet significantly increased water content in the ham (71.56 *vs.* 72.53%, $P = 0.045$), decreased crude protein content in the loin (23.18 *vs.* 22.49%, $P = 0.003$) and ash content in the ham (1.40 *vs.* 1.28%, $P = 0.005$). Siljanderrasi *et al.* (1996) showed that the intramuscular fat content in the loin decreased ($P < 0.05$) with increased share of the rapeseed meal in the diet.

Table 2. Fattening capacity characteristics (mean ± SD)

Item	C G	E G	Significance
Live weight (kg)	104.7 ± 4.20	105.0 ± 5.27	ns
Average daily gain (g/d)	1073.9 ± 41.19	1064.4 ± 76.29	ns
Average feed consumption (kg/d)	2.78 ± 0.18	2.56 ± 0.07	0.001
Average feed : gain ratio (kg/kg)	2.57 ± 0.12	2.43 ± 0.16	0.028

Table 3. Carcass characteristics (mean ± SD)

Item		C G	E G	Significance
Lean meat share (%)		56.09 ± 1.87	55.88 ± 1.26	ns
Right half carcass weight (kg)		39.35 ± 2.10	39.58 ± 1.96	ns
Ham (%)	meat + bone	21.08 ± 1.11	21.19 ± 0.86	ns
	fat cover + skin	5.63 ± 0.57	5.56 ± 0.84	ns
Neck (%)	meat + bone	6.79 ± 0.56	6.66 ± 0.81	ns
	fat cover + skin	1.20 ± 0.21	1.14 ± 0.25	ns
Shoulder (%)	meat + bone	9.94 ± 0.59	10.28 ± 0.59	ns
	fat cover + skin	3.74 ± 0.63	3.94 ± 0.48	ns
Loin (%)	meat + bone	12.21 ± 0.68	11.99 ± 0.67	ns
	fat cover + skin	4.52 ± 0.75	4.47 ± 0.50	ns
Belly (%)	total	17.30 ± 0.80	17.65 ± 1.13	ns

Table 4. Chemical composition of the main meat parts (mean ± SD)

Content (%)		C G	E G	Significance
Water:	loin	73.84 ± 0.66	74.07 ± 1.03	ns
	ham	71.56 ± 0.99	72.53 ± 1.26	0.045
	shoulder	75.81 ± 0.83	76.07 ± 0.64	ns
	neck	70.39 ± 2.59	71.44 ± 2.28	ns
IMF:	loin	2.43 ± 0.60	2.74 ± 1.37	ns
	ham	3.13 ± 0.86	3.10 ± 1.36	ns
	shoulder	2.55 ± 0.51	2.31 ± 0.48	ns
	neck	8.31 ± 3.18	7.70 ± 2.34	ns
CP:	loin	23.18 ± 0.59	22.49 ± 0.47	0.003
	ham	23.55 ± 0.87	23.47 ± 1.25	ns
	shoulder	21.03 ± 0.67	21.15 ± 0.63	ns
	neck	19.85 ± 0.78	20.26 ± 0.94	ns
Ash:	loin	1.21 ± 0.09	1.19 ± 0.07	ns
	ham	1.40 ± 0.09	1.28 ± 0.08	0.005
	shoulder	1.05 ± 0.05	1.05 ± 0.08	ns
	neck	1.03 ± 0.06	1.05 ± 0.05	ns

Conclusion

The substitution of soybean meal with rapeseed meal, decreased feed intake and feed conversion ratio. On the basis of the results obtained, one could say that rapeseed meal can be used as a direct replacement for soya bean meal without any production performance decrease (including the quality of pork meat).

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