

EFFECTS OF USING PLANT PROTEIN FEED AS A FISH MEAL REPLACER IN THE NUTRITION OF WEANED PIGLETS*

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Abstract

The possibility of using plant protein feed as a fish meal replacer in the nutrition of weaned piglets was investigated. The results obtained showed that there were no significant differences in the weight gains of piglets. Piglets fed diets based on plant protein consumed 8.72% ($P<0.01$) more feed than piglets fed diets containing fish meal. Fish meal in the diet was responsible for a statistically significant ($P<0.05$) deterioration in the feed conversion ratio compared to plant protein diets. The coefficient of apparent digestibility obtained for total tract nutrients showed better feed utilization in piglets fed plant protein diets compared to piglets receiving fish meal diets. Despite the better feed conversion ratio, the cost of weight gain in weaned piglets fed plant protein diets was 6.60% higher than in piglets fed fish meal diets.

Key words: plant protein, fish meal, weaned piglets

According to European Union Directive 9/2001, mixtures containing fish meal can only be produced in feed mills that do not process feeds for ruminants, are specialized in this area, and have permission from an authorized institution (Sardi et al., 2005). This has led to increased opposition from consumers to the use of animal proteins in livestock feeds, which justifies future research focusing on the elimination of fish meal from pig diets.

The objective of this paper was to evaluate the effect of complete substitution of fish meal with plant protein sources in the nutrition of weaned piglets.

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Material and methods

The study was carried out on the experimental pig farm of the Institute for Animal Husbandry in Belgrade-Zemun.

Plant protein feed was imported from Belgium by Makroprogres of Belgrade, Serbia. The main ingredient of the feed is potato protein, as well as extruded and isolated soybean (Hoorick, 2003), the chemical composition of which is shown in Table 1.

Table 1. The chemical composition of the experimental feeds

Item	Fish meal	Plant protein feed
Metabolizable energy (MJ/kg)	12.55	16.40
Crude protein (%)	65.0	49.3
Ether extracts (%)	13.31	7.54
Crude fibre (%)		2.78
Ash (%)	15.0	10.0
Calcium (%)	4.5	1.7
Total phosphorus (%)	2.7	1.2
Some of the essential amino acids (g/16 g N):		
Lys	7.81	7.44
Met + Cys	3.71	3.71
Try	1.00	1.18
Thr	4.20	4.50

Based on their origin, sex and initial body weight, piglets were divided into two equal groups, with special attention paid to the composition of groups to ensure that there were no siblings among the piglets in each group. Animals received feed and water on an *ad libitum* basis. The first group of piglets (control) was fed a fish meal diet, and the second group of piglets (experimental) received a diet in which fish meal was completely replaced with the experimental plant protein feed (Table 2).

In this study, nutrient use was investigated in addition to production parameters. Total-tract nutrient digestibility was determined by way of the indirect method using Cr_2O_3 at the end of the study, when animals reached approximately 23 kg body weight. Faecal collection was carried out in 12 animals (6 animals from each group).

The following parameters were used in evaluating the results obtained: average daily gain of piglets, average feed intake and feed conversion ratio, coefficient of total-tract nutrient digestibility, and economic justification for the introduction of the investigated feed expressed as the cost of 1 kg of gain.

The results obtained for weight gain, feed intake, feed conversion ratio and coefficients of nutrient digestibility were analysed statistically using analysis of variance and differences between means were determined using the t-test.

Table 2. The composition and nutritive value of the experimental diets

Item	Weaned piglets			
	Prestarter		Starter	
	the first 7 days of the experiment		till the end of experiment	
	group			
Period of the experiment	1	2	1	2
Fish meal	+	-	+	-
Plant protein feed	-	+	-	+
	%			
Corn	54.44	51.76	58.67	56.40
Wheat middlings	-	-	5.0	5.0
Sugar	3.0	3.0	-	-
Soybean oil meal	21.9	22.5	16.5	17.0
Full-fat soybean	10.0	10.0	10.0	10.0
Sunflower oil meal	-	-	2.5	2.5
Milk replacer for piglets	3.0	3.0	-	-
Fish meal	5.0	-	4.5	-
Plant protein feed	-	6.5	-	5.8
Limestone	0.6	0.6	0.8	0.8
Dicalcium phosphate	1.2	1.6	1.1	1.4
Salt	0.11	0.29	0.18	0.34
Vitamin-mineral premix	0.5	0.5	0.5	0.5
L-lys HCl	-	-	-	0.01
Zeolite	0.25	0.25	0.25	0.25
Total:	100.0	100.0	100.0	100.0
The price of diet. (EURO/kg)	0.27	0.30	0.22	0.24

Nutritive value of the diets (calculated)

ME (MJ/kg)	13.92	14.06	13.58	13.71
Crude protein (%)	22.20	22.20	20.20	20.20
Ether extract (%)	5.13	4.86	5.33	5.10
Crude fibre (%)	3.13	3.29	3.77	3.92
Ash (%)	5.61	5.91	5.52	5.72
Calcium (%)	0.90	0.90	0.90	0.90
Total phosphorus (%)	0.70	0.70	0.70	0.70
Lys (%)	1.31	1.31	1.14	1.14
Met + Cys (%)	0.74	0.73	0.70	0.70
Try (%)	0.27	0.27	0.24	0.25
Thr (%)	0.88	0.89	0.80	0.81

Results

This study investigated the possibility of completely replacing fish meal with plant protein feed in the nutrition of weaned piglets.

The results obtained (Table 3) showed that there were no significant differences in the weight gains of piglets. Piglets fed plant protein diets consumed 8.72% ($P<0.01$) more feed than animals fed fish meal diets, and 3.51% ($P<0.05$) less feed per kg of body weight gain.

The coefficients of total-tract apparent digestibility (Table 3) showed that feeding experimental diets improved the degree of utilization of dry ($P<0.01$) and organic ($P<0.05$) matter, crude protein, ether extracts, crude fibre and N-free extracts (NFE) ($P<0.05$) compared to fish meal diets.

Table 3. Performance, nutrient digestibility and economic analysis of weaned piglets in the experiment

Item	Group	
	1 control	2 experimental
Number of animals in the experiment:		
at the beginning	18	24
at the end	15	22
Body weight of piglets (kg):		
at the beginning	8.65	8.40
at the end	25.00	24.95
Duration of the experiment (days)	51.5	52.5
Average daily gain (g)	317	315
In comparison to the control group (%)	100.00	99.37
Average daily feed intake (kg)	0.676A**	0.735A
In comparison to the control group (%)	100.00	108.72
Feed conversion ratio (kg)	2.28a	2.20a
In comparison to the control group (%)	100.00	103.51
Digestibility of nutrients for weaned piglets (%)		
Dry matter	77.60A	81.77A
Organic matter	79.50a	82.31a
Crude protein	75.48	76.04
Ether extracts	45.13	47.49
Crude fibre	42.20	53.55
NFE	87.95A	90.87A

**The same small letters in rows denote statistical differences at $P<0.05$, capital letters at $P<0.01$.

The economic analysis showed that the use of plant protein feeds in weaned piglet nutrition (Table 3) increased the cost of the meal by an average of 10.47% compared to the cost of the control diet based on fish meal. Despite the better feed conversion

ratio, by 3.51%, the cost of weight gain in piglets fed plant protein diets was 6.60% higher than in piglets fed fish meal diets.

Discussion

In piglet nutrition, the effect of potato protein is equal (Sève, 1977; Latore et al., 2001; Jergensen, 2004) or even superior to fish meal protein (Ziggers, 2002; Sardi et al., 2005). Maribo (2001) reported that fish meal in piglet diets can be successfully replaced with a yeast-based feed protein product, NuPro 200.

With regard to soybean products, hydrolyzed protein from soybean is an excellent source of nutrients for piglets (Ferrini et al., 2004). Partial replacement of soybean meal with soybean protein concentrate increases the length of villi in the small intestines (Li et al., 1991), thereby improving the productivity of piglets (Lenehan et al., 2003). In addition to improved productivity, fermented soybean may have a positive effect on diarrhoea control in weaned piglets (Kiers et al., 2003).

Overall, the present results show that the use of the plant protein feed analysed can be recommended as a substitute for fish meal in the nutrition of weaned piglets. The less favourable cost of weight gain in piglets fed plant protein diets shows that more attention should be paid to costs.

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Wpływ zastosowania białek roślinnych jako zamiennika mączki rybnej w żywieniu warchlaków

STRESZCZENIE

Badano możliwość zastosowania białek roślinnych jako zamiennika mączki rybnej w żywieniu warchlaków. Wykazano, że nie było statystycznie istotnej różnicy w przyrostach masy ciała warchlaków. Warchlaki żywione mieszankami opartymi na białkach roślinnych zjadały o 8,72% ($P \leq 0,01$) więcej paszy niż warchlaki żywione mieszankami zawierającymi mączki rybne. Mączki rybne, w porównaniu z mieszankami zawierającymi białko roślinne, powodowały statystycznie istotnie ($P \leq 0,05$) gorsze wykorzystanie paszy. Uzyskane wyniki współczynników strawności pozornej składników pokarmowych wskazują, że warchlaki żywione mieszankami zawierającymi białka roślinne lepiej wykorzystywały paszę niż warchlaki żywione mieszankami pełnoporcjowymi z udziałem mączki rybnej. Pomimo lepszych wyników wykorzystania paszy koszty przyrostu masy ciała warchlaków żywionych mieszankami pełnoporcjowymi z udziałem białka roślinnego były wyższe o 6,6% w porównaniu z kosztami przyrostu masy ciała warchlaków żywionych mieszankami pełnoporcjowymi z udziałem mączki rybnej.