

THE EFFECT OF FISH MEAL IN THE NUTRITION OF WEANED PIGLETS

Vladimir Živković¹, Čedomir Radović¹, Marija Gogić¹, Nenad Stojiljković¹, Saša Obradović², Maja Petričević¹, Nikola Delić¹

¹Institute for Animal Husbandry, Belgrade-Zemun, Republic of Serbia

²Faculty of Agriculture Kruševac, University of Niš, Republic of Serbia

Corresponding author: Vladimir Živković, vladimirzivkovic_87@yahoo.com

Original scientific paper

Abstract: The effects of the use of fish meal in the nutrition of weaning piglets were observed. The trial included 80 weaned piglets of the same genotype (Large White x Danish Landrace) distributed in two feeding treatments. In the first period of the experiment, animals were fed during 10 feeding days, with a pre-starter mixture containing 21.1/20.8% of the crude protein. The second period lasted for 25 days and piglets were fed with mixture containing also 21.0/21.1% of the crude protein. And in the final period of the experiment, which lasted 22 feeding days, the meals were formulated to contain 19.5/19.9% of the crude protein. The control group was fed with standard farm mixtures, while the trial group were fed with mixtures containing 4/3/2% of fish meal. The obtained results showed that the use of fish meal resulted in better average daily gain and feed conversion in starter period (27-51 day).

Key words: diet, growth promoters, post-weaning period

Introduction

Fish meal is a byproduct of animal origin and is a source of high-quality protein for animal feed. Currently, fish meal is manufactured from species that are caught in commercial fishing and not adequate for human consumption. Inclusion of high-quality protein sources (fish meal) is important for pig diets to manage digestive disturbances in the weaning period.

According to the decision of the EU Commission 9/2001, all the mixtures which contain fish meal can only be produced in feed mills which don't produce or process any other feeds for ruminants or if they are specialized for this purpose. And also they need proper licence from authorised institutions (*Sardi et al., 2005*). This decision has led to some negative marketing in regard of using animal proteins in livestock feed, which led to further research of the possibility to excluding fish meal from mixtures for pigs and implementing some substitutes.

The weaning period is always stressor to young pigs that typically results in lower feed intake and a decrease in bodyweight for several days immediately after weaning (Hötzel et al., 2011). With a loss of bodyweight, an ileal environment is favorable for the colonization of bacteria resulting in post-weaning diarrhea syndrome (Tsiloyiannis et al., 2001). It is important in the immediate post-weaning period to include high-quality ingredients such as fish meal in diets (DeRouchey et al., 2010), which are proven to increase feed intake and growth performance (Berrocoso et al., 2012).

There is increased concern about overfishing of wild capture fisheries, and as of 2011, 28.8% of the world's fish species were overfished (FAO, 2012). This over-harvest has included species used for fish meal production and when coupled with increasing global demand for fish meal has led to an unsustainable situation (Olsen and Hasan, 2012). Soybean meal is the mostly used protein source in pig diets, but it has its limitations in young pig diets due to anti-nutritional factors, which influences post-weaning diarrhea syndrome (Friesen et al., 1993). Also, it is important to find alternative high-quality protein sources that are more economically efficient and contain minimal anti nutritional factors.

A common practice that inclusion of high quality protein ingredients in piglet diets is the result of their immature and defective digestive system, which can minimize the side effects on digestive function and growth rate in the period of weaning (Che et al., 2012; Sinn et al., 2016).

Fish meal has similar nutritive characteristics like some other alternatives to fish meal, like the plant feed - Ekofish meal used in the nutrition of weaned piglets (Adamović et al., 2006), sows and piglets (Živković et al., 2007a).

Objective of this paper was to investigate the effects of use ultrapure, high protein feed fish meal in diets for weaned piglets.

Material and Methods

The trial included 80 piglets of the same genotype (Large White x Danish Landrace) distributed in two feeding treatments (Table 1). Immediately after the piglets were weaned, groups of 10 piglets were formed on the basis of uniform initial weight, taking into account that in each group the sex ratio is the same. There were 4 repetitions per treatment. All piglets were placed in solid wall boxes, with lattice floor, each containing 10 feeding places. Average initial weight of piglets was 7.64 kg. All piglets came from 8 different mothers, and same father. There were three feeding mixtures for the whole trial period (Table 1.) In the first period of the experiment, animals were fed during 10 feeding days, with a pre-starter mixture containing 21.1/20.8% of the crude protein. The second period lasted for 25 days and piglets were fed with mixture containing also 21.0/21.1% of the crude protein. And in the final period of the experiment, which lasted 22

feeding days, the meals were formulated to contain 19.5/19.9% of the crude protein.

The first group of piglets, control, was fed with standard farm mixture and the other group of piglets with mixtures containing fish meal (Table 2). Food and water were *ad libitum*.

Table 1 . Composition of diets for weaned piglets in the trial

Group	Pre-starter, Day 18-27		Starter, Day 27-51		Grower, Day 52-73	
	C(control)	T(trial)	C(control)	T(trial)	C(control)	T(trial)
Ingredients, g/kg						
Maize	265.1	282.0	270.3	283.0	312.9	313.5
Barley	100.0	100.0	100.0	100.0	187.5	187.5
Triticale	100.0	100.0	100.0	100.0	65.0	65.0
Soybean meal	334.0	278.0	379.0	337.0	100.0	100.0
Soybean semolina	-	-	-	-	284.0	264.0
Milk replacer	50.0	50.0	-	-	-	-
Whey	40.0	40.0	40.0	40.0	-	-
Sunflower oil	10.0	10.0	10.0	10.0	-	-
Fish meal	-	40.0	-	30.0	-	20.0
Mineral-vitamin premix 1*	100.0	100.0	100.0	100.0	-	-
Mineral-vitamin premix 2**	-	-	-	-	50.0	50.0
L-Lysine	0.5	-	0.4	-	0.5	-
DL-Methionine	0.4	-	0.3	-	0.1	-
Calculated nutrient composition, g/kg of feed						
Crude protein	211.11	208.60	210.10	211.10	195.10	199.00
Lysine	12.50	12.50	12.30	12.30	11.10	11.20
Methionine	3.80	3.70	3.50	3.50	3.10	3.30
Cysteine	3.50	3.30	3.10	3.50	3.40	3.40
Threonine	8.00	8.20	7.90	8.20	7.60	7.80
Tryptophan	2.60	2.60	2.70	2.60	2.40	2.40
Crude fibre	34.20	31.00	37.10	34.80	39.70	38.60
Crude fat	29.30	32.80	29.50	32.10	69.00	67.20
Calcium	12.10	12.10	12.11	12.11	10.82	10.82
Phosphorus	7.36	7.36	7.37	7.37	7.55	7.55
DE content, MJ/kg	15.03	15.07	15.01	15.04	16.68	16.64

*The commercial premixes (10% premix for piglets).

*The commercial premixes (5% premix for piglets).

Table 2. Nutritive value of the Fish meal used in the experiment

Composition	Fish meal
ME,MJ/kg	13.20
Moisture, %	8.0
Crude protein, %	62.0
Crude fiber, %	3.0
Ash, %	4.0
Calcium, %	0.90
Phosphorus total, %	0.54
Sodium, %	0.16
Some essential amino acids, g/16 gN :	
Lysine	7.82
Methionine + cystine	4.00
Tryptophane	1.06
Threonine	3.96

During the starter and grower period, the following production indicators were monitored: body weight, average daily gain, average daily food consumption and feed conversion. The data obtained were processed using the software package "STATISTICA" (*Stat Soft Inc, 2012*). ANOVA was used while the Tukey test served to determine the statistical significance of the differences between individual means values.

Results and Discussion

Production performances (Table 3.) were shown that during the whole trial period, it was found that there were no significant differences in average feed intake, daily gain and feed conversion. Statistical significance was noted in ADG and FCR during starter period, trial group had better average daily gain (15.64%) and feed conversion (13.63%). In the grower period only statistical difference were noted for ADG where control, group had better ADG for 9.37%. Durring whole trial period there were no mortalities.

Table 3. Production performance

	Treatments		SEM	p
	C	T		
Starter period (27-51d)				
FI, g/d	501.76	510.61	0.098	0.746
ADG, g/d	286.72 ^b	331.57 ^a	0.145	p<0.05
FCR, g/g	1.75 ^a	1.54 ^b	0.123	p<0.05
Grower period (52-73d)				
FI, g/d	963.89	977.98	0.089	0.566
ADG, g/d	465.65 ^a	436.60 ^b	0.163	p<0.05
FCR, g/g	2.07	2.24	0.137	0.112
Whole period (27-73d)				
FI, g/d	714.29	720.14	0.046	0.899
ADG, g/d	370.10	377.04	0.076	0.788
FCR, g/g	1.93	1.91	0.029	0.856

SEM, Standard error of the means; FI, feed intake; ADG, average daily gain; FCR, feed conversion rate; ^{a, b}. In a row, the least squares means with a different superscript differ significantly (p<0.05)

Some researchers have concluded that piglets fed with products based on soybean proteins can progress almost equally to piglets fed with the fish meal (*Min et al., 2003; Sardi et al., 2005*). Soybean meal are a very good substitute to fish meal (*Ebert et al., 2005a*) and because of arginine could be even better than whey protein (*Ebert et al., 2005b*), but they are pretty inferior compared to casein (*Junghans et al., 2004*).

Adding lecithin and enzyme to diets based on soybean meal could not reach the same level of feed utilization as the one based on fish meal (*Kovčín et al., 2005*). According to *Sardi et al. (2005)* fish meal used in weaned piglet diets can be replaced by almost same amounts of vegetable protein. Some newer studies (*Chia et al., 2019*) even include insect meal as alternative to fish meal. *Živković et al. (2007b)*, have shown that use of plant based fish meals could be as efficient as fish meal, and beneficial for suckling and weaned piglets.

Jeong and Kim (2015) found no differences on growth performance, in weaned pigs when other products replaced half of the fish meal in diets. Fish meal from different sources can have different effect growth performance (*Cho et al., 2012*). *Jones et al. (2015)* concluded that adding 3% fish meal to diet improved ADG, and adding 6% improved both ADG and FCR.

Fish meal is widely used in weaned piglet diets as a highly digestible protein with excellent amino-acid profile and very high level of vitamins and minerals (*Sun et al. 2009*).

Conclusion

Results obtained in starter period are promising, and it could be recommended that fish meal can be used in the first 25 days after weaning. However, results obtained in the second part of the experiment could not justify usage of fish meal over a less expensive soybean meal. In the last ten years many researchers and companies searched for adequate substitute for fish meal. However recent studies suggest using fish meal and its superiority in some aspects, over substitutes. So maybe the future holds reinstating fish meal as main animal feed for young pigs. Also further investigation, considering influence of fish meal on post-weaning diarrhea syndrome, should be done.

Efekat korišćenja ribljeg brašna u ishrani zalučene prasadi

Vladimir Živković, Čedomir Radović, Marija Gogić, Nenad Stojiljković, Saša Obradović, Maja Petričević, Nikola Delić

Rezime

Ispitivani su uticaji korišćenja ribljeg brašna u ishrani prasadi u odgoju. Ogled je sproveden na 80 prasadi, genotipa Veliki jorkšir x Danski landras, podeljenih u dve grupe tokom celog perioda istraživanja. U prvom periodu eksperimenta, životinje su hranjene tokom 10 dana, predstarter smešom koja je sadržala 21,1/20,8% sirovog proteina. Drugi period je trajao 25 dana, a prasadi su hranjeni smešom koja je sadržala 21,0/21,1% sirovog proteina. U poslednjem periodu eksperimenta, koji je trajao 22 dana, obroci su formulisani tako da sadrže 19,5/19,9% sirovih proteina. Kontrolna grupa je hranjena sa standardnim farmskim smešama, dok je ogledna grupa hranjena smešama koje su sadržale riblje brašno u koncentraciji od 4/3/2%. Dobijeni rezultati su pokazali da korišćenjem ribljeg brašna dolazi do poboljšanja prirasta i konverzije hrane u periodu nakon zalučenja (27-51 dan).

Ključne reči: ishrana, promotor porasta, period nakon zalučenja

Acknowledgement

The results of the research presented in this paper were financed by the Ministry of Education, Science and Technological Development of the Republic of Serbia, on the basis of the Agreement on the realization and financing of scientific research work of SRO in 2021 no. 451-03-9/2021-14/200022.

References

- ADAMOVIĆ M., VESELINOVIĆ V., TOMOVIĆ R., VRANJEŠ B. (2006): Efikasnost korišćenja zamene za riblje brašno – Ekofish meal u ishrani prasadi po odbijanju. XVII Inovacije u stočarstvu. Biotehnologija u stočarstvu 22, 669-677.
- BERROCOSO J.D., SERRANO M.P., CÁMARA L., REBOLLAR P.G., MATEOS G.G. (2012): Influence of diet complexity on productive performance and nutrient digestibility of weanling pigs. *Animal Feed Science and Technology* 171, 214–222.
- CHE L., ZHAN L., FANG Z., LIN Y., YAN T., WU D. (2012): Effects of dietary protein sources on growth performance and immune response of weanling pigs. *Livestock Science* 148, 1–9.
- CHIA S.Y., TANGA C.M., OSUGA I.M., ALARU A.O., MWANGI D.M., GITHINJI M., SUBRAMANIAN S., FIABOE K.K.M., EKESI S., VAN LOON J.J.A., DICKE M. (2019): Effect of Dietary Replacement of Fishmeal by Insect Meal on Growth Performance, Blood Profiles and Economics of Growing Pigs in Kenya. *Animals (Basel)*, 9, 10, 705.
- CHO J.H., CHOI Y.J., KIM I.H. (2012): Effects of fish meal from various origins on growth performance and nutrient digestibility hi piglets. *Journal of Animal and Veterinary Advances* 11, 9, 1435-1440.
- DEROUCHEY J.M., GOODBAND R.D., TOKACH M.D., NELSEN J.L., DRITZ S.S. (2010): Nursery swine nutrient recommendations and feeding management. In *National swine nutrition guide* (ed. DJ Meisinger), US Pork Center of Excellence, Ames, IA, USA, 65–79.
- EBERT A., BERMAN A.S., HARREL R.H., CORNELIUS S.G., ODLE J. (2005a): Liquid diets containing vegetable proteins accelerate piglet growth above milk-protein-based diets, despite lower ileal digestibility. *Journal of Animal Science* 82, 1, 24.
- EBERT A., BERMAN A., HARREL B., CORNELIUS C., ODLE J. (2005b): Vegetable Protein Sources for diets of Suckling Piglets. North Carolina State University, Animal Science Department Report.
- FOOD AND AGRICULTURE ORGANIZATION (FAO) 2012. The state of the world fisheries and aquaculture 2012. FAO Fisheries and Aquaculture Department, Food and Agriculture Organization of the United Nations, Rome, Italy.
- FRIESEN K.G., GOODBAND R.D., NELSEN J.L., BLECHA F., REDDY D.N., REDDY P.G., KATS L.J. (1993): The effect of pre- and postweaning exposure to soybean meal on growth performance and on the immune response in the early-weaned pig. *Journal of Animal Science* 71, 2089–2098.
- HÖTZEL M.J., DE SOUZA G.P.P., COSTA O.A.D., MACHADO FILHO L.C.P. (2011): Disentangling the effects of weaning stressors on piglets behaviour and feed intake: changing the housing and social environment. *Applied Animal Behaviour Science* 135, 44–50.

- JEONG J.S., KIM I.H. (2015): Comparative efficacy of up to 50% partial fish meal replacement with fermented soybean meal or enzymatically prepared soybean meal on growth performance, nutrient digestibility and fecal microflora in weaned pigs. *Animal Science Journal* 86, 624–633.
- JONES A. M., WOODWORTH J.C., GOODBAND R.D., TOKACH M.D., DRITZ S.S., DEROCHEY J.M. (2015): Effect of Fish Meal Source on Nursery Pig Performance. *Kansas Agricultural Experiment Station Research Reports*, 1 (7).
- JUNGHANS P., DERNO M., JENTSCH W., KUHLA S., BEYER M. (2004): Effect of a soy protein diet on protein and energy metabolism and organ development in protein-restricted growing pigs. *Arhiv of Animal Nutrition* 58, 6, 453-461.
- KOVČIN S., STANAČEV VIDICA, BEUKOVIĆ M., KOROLJEV Z.(2005): Efekti isključenja hraniva životinjskog porekla uz dodatak enzima na proizvodnju zalučene prasadi. *Veterinarski Glasnik* 59, 5-6, 683-686.
- MIN B. J., KIM I. H., HONG J. W., KWON O. S., LEE W. B., SON K. S., KIM J. H., SHO W. C. (2003): Effect of feeding processed soy protein on the growth performance in weanling pigs. *Journal of Animal Science* 81, 206.
- OLSEN R.L., HASAN M.R. (2012): A limited supply of fishmeal: impact on future increases in global aquaculture production. *Trends in Food Science and Technology* 27, 120–128.
- SARDI L., PAGANELL R., PARISINI P., SIMIOLI M., MARTELLI G. (2005): The replacement of fishmeal by plant proteins in piglet production. *Italian Journal of Animal Science* 4, 2, 449-451.
- SINN S.M., GIBBONS W.R., BROWN M.L., DEROCHEY J.M., LEVESQUE C.L. (2016): Evaluation of microbially enhanced soybean meal as an alternative to fishmeal in weaned pig diets. *Animal* 11, 784–793.
- SUN Z.T., MA Q.G., LI Z.R., JI C. (2009): Effect of partial substitution of dietary spray-dried porcine plasma or fishmeal with soybean and shrimp protein hydrolysate on growth performance, nutrient digestibility and serum biochemical parameters of weanling piglets. *Asian-Australasian Journal of Animal Sciences* 22, 1032–1037.
- TSILOYIANNIS V.K., KYRIAKIS S.C., VLEMMAS J., SARRIS K. (2001): The effect of organic acids on the control of porcine post-weaning diarrhoea. *Research in Veterinary Science* 70, 287–293.
- ŽIVKOVIĆ B., MIGDAL V., VESELINOVIĆ V., RADOVIĆ Č., KOSOVAC O., FABJAN M. (2007a): The effect of substitution of fish meal with high protein plant feed in nutrition of sows and piglets. *Biotechnology in Animal Husbandry* 23, 5-6, 445-455.
- ŽIVKOVIĆ B., VESELINOVIĆ V., MIGDAL W., RADOVIĆ Č., FABJAN M., KOSOVAC O., MARINKOV G., PEJČIĆ S. (2007b): Nutritivna vrijednost visokoproteinskog krmiva biljnog porekla u hranidbi svinja. 14. Međunarodno savjetovanje “Krmiva 2007”, 11-14.06., Opatija, 30-31.