

Effect of Dietary Salmon Protein Concentrate on Growth Performance of Weanling Pigs

A.S Leaflet R2221

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Summary and Implications

In this study, 96 weanling pigs were used to determine the effects of dietary dried and condensed salmon protein concentrate (SPC)² on growth performance. This study shows that there were no apparent advantages of including 5 or 10% dried or condensed SPC, respectively, in a corn-soybean meal diet fed to pigs in the first two weeks after weaning.

Introduction

At birth, the intestines of piglets are immature and adapted to secrete digestive enzymes necessary for the digestion of milk, but not other feed ingredients. To counter the young animals' limited abilities to digest plant-derived feed ingredients, starter diets typically include high-quality and sometimes immune-enhancing feed ingredients and additives (e.g., dried whey, fishmeal, spray-dried plasma protein, antibiotic growth promoters). The special processing techniques employed in the manufacturing of salmon protein concentrate (SPC) preserve the inherently high-quality nutrients in the natural Alaskan wild salmon. Moreover, the long-chain omega-3 (ω -3) fatty acids, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), found in high amounts in certain fish oils, generally improve calcium absorption, bone strength, development of brain function and cognition, and health status. In short, SPC is a high-quality feed ingredient capable of promoting growth in young, immature pigs, and may be a viable alternative to spray-dried plasma protein used extensively in pig starter diets.

Material and Methods

Chemical Analysis of Feedstuffs

Condensed and dried SPC were supplied by Alaska Protein Recovery of Juneau, Alaska. Chemical analysis of dried and condensed salmon meal and SDPP was performed

on representative samples prior to diet formulation. Prior to chemical analysis, the condensed SPC was freeze-dried and all analyses performed on the freeze-dried material. Feedstuffs were analyzed for dry matter, total Kjeldahl nitrogen, ether extract and total ash. Also, they were analyzed for amino acid content by ion exchange chromatography at a commercial laboratory, in addition to being analyzed for calcium, phosphorus, sodium and chloride at a commercial laboratory.

Dietary Treatments

All diets were based on corn and soybean meal and formulated to meet or exceed the National Research Council (1998) nutrient recommendations. The experimental diets were formulated using analyzed amino acid values for corn, soybean meal, condensed and dried SPC, and SDPP. The experimental diets, fed during the Starter-1 phase (0–2 weeks post weaning), consisted of 5 and 10% dried and condensed SPC, respectively, a negative control diet, and a positive control diet, the latter of which contained 5% spray-dried plasma protein. The pigs were fed common corn-soybean meal diets in the Starter-2 and -3 phases (2–4 weeks and 4–5 weeks post weaning, respectively). All diets contained an antibiotic growth promoter (40 g/ton of tylosin) in addition to 20% dried whey in the Starter-1 phase and 10% dried whey in the Starter-2 and -3 phases.

Housing and Management

A total of 96 pigs weaned at 21 days of age and averaging 6.35 ± 0.07 kg body weight, were weighed and allotted to raised-deck pens (1.2×1.2 m) according to a randomized complete block design with initial body weight and ancestry as the blocking criteria. Each pen contained 4 pigs with a 4-space feeder; a nipple waterer; and a 5-gauge wire mesh floor. The pigs had free access to feed and water at all times throughout the experiment.

Body weights and feed consumption (measured as feed disappearance) were recorded weekly and the feed utilization calculated as the gain-to-feed ratio.

Statistical Analyses

All data were subjected to analysis of variance (ANOVA) procedures appropriate for a randomized complete block design using JMP 5.1 (SAS Institute, Gary, NC) with 6 blocks (replications). The effects on growth performance of the dietary treatments were evaluated using Fisher's protected least significant difference. Pens served

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² Abbreviations used: ANOVA, analysis of variance; CV, coefficient of variation; EPA, eicosapentaenoic acid; DHA, docosahexaenoic acid; ω -3, omega 3; SDPP, spray-dried plasma protein; SPC, salmon protein concentrate.

as the experimental units and P-values less than or equal to 0.05 were considered significant.

Results

Body Weight Gain

During Weeks 1, 2 and 4, pigs fed SDPP had higher rates of body weight gain ($P < 0.05$) than those fed any other diet (Table 1). During Week 3, pigs fed SDPP in the Starter-1 phase grew faster ($P < 0.05$) than those fed either of the SPC diets. Also, the pigs that consumed the SDPP diet grew faster ($P < 0.05$) than the pigs that consumed either SPC diet throughout the Starter-1 and -2 phases, and throughout the 5 weeks of the study. As a result, the pigs given SDPP had higher body weights ($P < 0.05$) than all other pigs each time they were weighed (Table 2).

Feed Consumption

Average daily feed consumption was higher ($P < 0.05$) for pigs fed SDPP than pigs consuming any other diet during Weeks 1, 2, and 4, and throughout each of the three phases. There were no differences between the control diet and either SPC diet (Table 3).

Feed Utilization

Feed utilization was only affected by the dietary treatments during Week 1, when pigs fed SDPP utilized feed more efficiently ($P < 0.05$) than did pigs fed SPC or the control diet (Table 4).

Discussion

Weaning is a stressful time for piglets and can impact future growth performance. To ensure fast, initial growth, which can improve performance of the pigs later on in life, starter diets often contain high-quality, highly digestible ingredients, such as fishmeal and dried whey. Because of SPC's excellent amino acid profile and contents of highly available lysine and ω -3 fatty acids, the growth performance of pigs fed dried or condensed SPC was expected to be superior to that of pigs fed the control diet and similar to that of pigs fed the SDPP diet. However, the apparent advantages of condensed and dried SPC failed to materialize in this study, where pigs fed the control diet performed equally well as those fed SPC.

Pigs fed SDPP consumed more feed, gained body weight at a faster rate, and utilized feed more efficiently than other pigs during Week 1 of the study. This response to dietary SDPP was consistent with that of pigs raised in an unsanitary environment and indicated that the immune-enhancing effects of the ω -3 fatty acids in SPC were not sufficient to overcome the stresses of the unsanitary environment in the present study. Nevertheless, it is possible that there would be some long-term benefits of the ω -3 fatty acids in the SPC that were not detected in this relatively short study. Due to the high moisture content of the

condensed SPC, the diet containing it tended to bridge and stick to the feeders and became slightly moldy³. If this product is to be used more extensively, it needs to be made more stable to avoid mold formation.

³ It is unlikely that the adverse physical effects of condensed SPC had an impact on pig performance, because the pigs fed condensed SPC consumed as much feed and gained body weight at a similar rate as those fed the dried SPC and the control diet.

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Table 1. Average daily body weight gain of pigs fed salmon protein concentrate (SPC) or spray-dried plasma protein (SDPP).^{1,2}

Week or phase	Diet				SEM ³
	Control	Dried SPC	Condensed SPC	SDPP	
	----- kg/day -----				
1	0.05 ^b	0.06 ^b	0.06 ^b	0.12 ^a	0.10
2	0.25 ^b	0.26 ^{ab}	0.24 ^b	0.30 ^a	0.01
3	0.41	0.36	0.36	0.40	0.02
4	0.61 ^{ab}	0.58 ^b	0.59 ^b	0.69 ^a	0.03
5	0.65	0.59	0.67	0.68	0.03
Starter 1	0.15 ^b	0.16 ^b	0.15 ^b	0.21 ^a	0.01
Starter 2	0.51 ^{ab}	0.47 ^b	0.47 ^b	0.54 ^a	0.02
Overall	0.40 ^{ab}	0.37 ^b	0.38 ^b	0.44 ^a	0.01

¹Pigs were fed the experimental diets during the first 2 weeks after weaning (Starter-1). During the Starter-2 and -3 phases (Weeks 3–4 and 5 post-weaning, respectively), all pigs were fed a common corn–soybean meal based diet.

²Values are means of 6 pens, each containing 4 pigs, per dietary treatment.

³Pooled standard error of the means.

^{ab}Means with different superscripts within the same row are different ($P < 0.05$).

Table 2. Body weights of pigs fed salmon protein concentrate (SPC) or spray-dried plasma protein (SDPP).^{1,2}

Week	Diet				SEM ³
	Control	Dried SPC	Condensed SPC	SDPP	
	----- kg/pig -----				
0	6.29	6.33	6.28	6.43	0.12
1	6.65 ^b	6.75 ^b	6.70 ^b	7.32 ^a	0.10
2	8.39 ^b	8.57 ^b	8.33 ^b	9.38 ^a	0.18
3	11.22 ^b	11.11 ^b	10.85 ^b	12.16 ^a	0.29
4	15.52 ^b	15.15 ^b	14.96 ^b	16.98 ^a	0.38
5	20.07 ^b	19.30 ^b	19.64 ^b	21.74 ^a	0.51

¹Pigs were fed the experimental diets during the first 2 weeks after weaning (Starter-1). During the Starter-2 and -3 phases (Weeks 3–4 and 5 post-weaning, respectively), all pigs were fed a common corn–soybean meal based diet.

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³Pooled standard error of the means.

^{ab}Means with different superscripts within the same row are different ($P < 0.05$).

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Table 3. Average daily feed consumption of pigs fed salmon protein concentrate (SPC) or spray-dried plasma protein (SDPP).^{1,2}

Week or phase	Diet				SEM ³
	Control	Dried SPC	Condensed SPC	SDPP	
	----- kg/day -----				
1	0.12 ^b	0.13 ^b	0.13 ^b	0.19 ^a	0.01
2	0.32 ^b	0.32 ^b	0.29 ^b	0.38 ^a	0.02
3	0.51	0.45	0.46	0.52	0.03
4	0.79 ^b	0.78 ^b	0.70 ^b	0.94 ^a	0.04
5	0.98	0.95	0.97	1.05	0.03
Starter 1	0.22 ^b	0.22 ^b	0.21 ^b	0.28 ^a	0.01
Starter 2	0.65 ^b	0.62 ^b	0.58 ^b	0.73 ^a	0.02
Overall	0.54 ^B	0.52 ^B	0.50 ^B	0.61 ^A	0.02

¹Pigs were fed the experimental diets during the first 2 weeks after weaning (Starter-1). During the Starter-2 and -3 phases (Weeks 3–4 and 5 post-weaning, respectively), all pigs were fed a common corn–soybean meal based diet.

²Values are means of 6 pens, each containing 4 pigs, per dietary treatment.

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Table 4. Feed utilization of pigs fed salmon protein concentrate (SPC) or spray-dried plasma protein (SDPP).^{1,2}

Week or phase	Diet				SEM ³
	Control	Dried SPC	Condensed SPC	SDPP	
	----- g gain/kg feed -----				
1	408 ^b	474 ^b	459 ^b	658 ^a	52
2	792	823	805	787	32
3	800	833	785	758	59
4	775	740	848	742	48
5	663	623	690	650	14
Starter 1	685	727	695	745	28
Starter 2	783	767	820	747	83
Overall	735	707	765	712	20

¹Pigs were fed the experimental diets during the first 2 weeks after weaning (Starter-1). During the Starter-2 and -3 phases (Weeks 3–4 and 5 post-weaning, respectively), all pigs were fed a common corn–soybean meal based diet.

²Values are means of 6 pens, each containing 4 pigs, per dietary treatment.

³Pooled standard error of the means.

^{ab}Means with different superscripts within the same row are different ($P < 0.05$).