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Effect of Feeding Extruded Flaxseed in Growing and Finishing Stages on Pig's Performance

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Abstract. A study was conducted to determine the effects of feeding extruded flaxseed on performance, carcass characteristics and backfat fatty acid (FA) profile of pigs. A total of 75 pigs were divided into three equal groups. Two groups were fed either a control diet or a 15% extruded flaxseed for 70 days while the 3rd group was fed the control diet for 30 days followed the extruded flaxseed diet for 40 days. Dietary treatments had no effect on feed intake, body weight gain, and carcass traits. Concentration of linolenic acid (C18:3) in backfat increased with the inclusion of extruded flaxseed and with increasing of feeding time. The concentration of oleic acid was reduced only when extruded flaxseed was fed for 70 days. Pigs fed the extruded flaxseed diets deposited more unsaturated and less saturated FA than pigs fed the control diet. This study showed that extruded flaxseed can be used to later FA composition of pork fat.

Keywords: Flaxseed, Fatty acids, Omega-3 fatty acid, Pork

1. Materials and Methods

Seventy five pigs with average body weight of 42.4 ± 3.51 kg were divided into 3 groups of 25 pigs. Each group consisted of 5 pens (3 males and 2 females per pen). Two isoenergetic diets were formulated to meet the nutrient requirement of pigs; a control diet and an extruded flaxseed diet (15% of the diet dry matter). The extruded flaxseed product consisted of 75% extruded flaxseed and 25% ground alfalfa meal. One group of pigs received the control diet for 70 days, the second group received the extruded flaxseed diet for 70 days and the third group received the control diet for 30 days followed by the extruded flaxseed for 40 days. Feed intake, body weight gain and feed conversion were determined on pen basis At the end of the trial one male and one female were randomly selected from each pen and were slaughtered to measure carcass parameters, meat, and fat chemical analysis and fatty acid profile. Sub-samples of feeds were ground through a 1-mm screen and analyzed for chemical constituents using standard procedures (AOAC, 1990; McCleary et al., 1997). Feed and fat samples were methylated using direct method for fatty acid methyl ester synthesis according to O'Fallon et al. (2007) and fatty acids were measured using capillary gas chromatography Carcass data were analyzed as a 3 x 2 factorial design (i.e. three treatments and two sexes) using PROC MIXED of SAS (1989). Performance data (feed intake, daily gain, and conversion ratio) were analyzed as a completely randomized design with 5 replicates (n = 5 pens) using PROC MIXED of SAS (1989). When significant effects were detected ($P<0.05$), least significant difference was used for mean separation.

2. Results and Discussion

2.1. Pig performance and Carcass Characteristics

Diets had no effect on dry matter (DM) intake (average 2.86 kg/day), daily gain (average 1.08 kg/day), and feed conversion ratio (average 2.64) (data not shown). In agreement with our results, Romans et al. (1995) found that feeding flaxseed to growing pigs up to 15% of the diet DM had no effect on animal performance. Diets had no effect on carcass characteristics or loin meat chemical composition (Table 2).

Feeding diets high in poly-unsaturated fatty acids with moderate fat levels had no detrimental effects on carcass characteristics of pigs (Romans et al., 1995, Wannants et al., 1999). All differences observed for carcass characteristics and loin meat composition were attributed to sex.

Table 1: Ingredients and Chemical composition of dietary treatments of control and flaxseed diets (DM basis)

	Dietary Treatment	
	Control	Extruded flaxseed
Ingredients, % of DM		
Corn	66.56	59.55
Extruded flaxseed product		15.00
Soybean meal 48%	19.28	12.4
Corn distillers grains	10.00	10.00
Calcium	1.22	1.10
Soy Oil	0.93	
Trace mineral mix	0.90	0.90
Phospherous	0.42	0.24
NaCl	0.34	0.33
Lysin HCL	0.24	0.37
Choline chloride	0.1	0.10
Methionine	0.01	0.01
Chemical composition, % of DM		
Ash	6.2 ±0.56	6.5±0.49
Ether extract	4.6 ±0.51	6.0 ±0.22
Starch	46.8±2.80	39.1 ±2.75
CP	20.7 ±0.70	20.5 ±1.04
NDF	13.1 ±0.92	16.8 ±0.89
Fatty acids % of DM		
C16:0	0.63 ±0.050	0.66 ±0.019
C18:0	0.09 ±0.015	0.14±0.008
C18:1 n9c	1.01±0.094	1.23±0.039
C18:2 n6c	2.69 ±0.299	2.63 ±0.103
C18:3n3	0.18 ±0.022	1.31 ±0.070

2.2. Back fat Fatty Acid Profile

Pigs fed extruded flaxseed diets had greater (P < 0.05) C18:3n3 content in backfat than those fed the control diet (Table 3). Furthermore, the concentration of C18:3n3 increased (P<0.05) as pigs remained on flaxseed diet for longer period. Warnants et al. (1999) reported a linear increase in the concentration of C18:3n3 in backfat as a result of feeding polyunsaturated fatty acids (PUFA) for up to 6 weeks. However, the authors reported a plateau in C18:3n3 concentration after feeding PUFA for more than 6 weeks. Feeding extruded flaxseed at either period reduced (P<0.05) the concentrations of C14:0 and C16:0. However, the concentration of C18:1 was reduced (P<0.05) by feeding extruded flaxseed for extended period only (i.e. growing and finishing period). Concentrations of unsaturated fatty acids increased (P<0.05) by while those of saturated fatty acids decreased (P<0.05) as a result extruded flaxseed feeding. However, increasing the period of feeding had no a cumulative effects. The reduction in the concentrations of saturated fatty acids is likely due to the dilution of these fatty acids as a result of feeding extruded flaxseed, which is rich in polyunsaturated fatty acids. The reduction in C18:1 concentration can be attributed to a decrease in the activity of stearoyl-CoA desaturase which will depress the synthesis of C18:1 in adipose tissue (Klingenberg et al., 1995).

3. Conlusions

Our results showed that feeding extruded flaxseed (15% of diet dry matter) had no detrimental effects on pig performance or carcass traits. Extruded flaxseed can be used effectively to increase the concentration of C18:3n3 in pork backfat and increasing the period of feeding can lead to a cumulative increase in the concentration of C18:3n3.

Table 2: Effects of feeding extruded flaxseed on carcass characteristics

	Dietary Treatment			SEM	Sex		SEM
	Control	Growing	Finishing		Female	Male	
Backfat thickness (mm)	26.04[a]	20.00[b]	26.55[a]	1.652	21.59[b]	26.80[a]	1.348
Weight (kg)							
Hot eviscerated carcass	90.95	88.07	88.39	1.390	85.26[b]	93.01[a]	1.140
Cold eviscerated carcass	82.97	79.15	81.07	1.819	76.38[b]	85.75[a]	1.486
Cold right carcass	40.74	38.88	40.44	0.977	37.68[b]	42.36[a]	0.798
Right belly	6.63	6.31	6.47	0.300	5.84[b]	7.10[a]	0.245
Right leg	11.18	10.84	11.00	0.244	10.42[b]	11.59[a]	0.199
Right Loin	10.34	9.32	9.60	0.428	8.76[b]	10.75[a]	0.350
Right shoulder	11.43	9.50	11.35	0.642	10.77	10.75	0.524
% of cold right carcass weight							
Right belly	16.00	16.36	16.06	0.448	15.67	16.60	0.366
Right leg	27.10	28.29	27.73	0.608	28.18	27.24	0.496
Right loin	24.94	24.19	23.75	0.446	23.53[b]	25.05[a]	0.364
Right shoulder	27.68	27.61	28.43	0.598	29.04[a]	26.77[b]	0.488
Loin meat chemical composition, % of dry matter							
Ash	4.06	4.06	3.94	0.065	4.16[a]	3.89[b]	0.053
CP	82.04	80.92	82.13	1.080	85.21[a]	78.18[b]	0.882
Total Fatty acids	13.12	16.14	15.74	1.077	11.52[b]	18.49[a]	0.879
Fat	16.54	17.54	15.97	1.172	13.08[b]	20.29[a]	0.957

a,b Mean in the same row with different superscripts are different ($P<0.05$)

4. References

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Table 3: Effects of feeding flaxseed on fatty acids profile of loin fat layer (% of total fatty acids)

	Dietary Treatment			SEM	Sex		SEM
	Control	Growing	Finishing		Female	Male	
% of total Fatty Acids							
C14:0	1.09 [a]	0.97 [b]	0.97 [b]	0.029	0.96 [b]	1.06 [a]	0.024
C16:0	23.19 [a]	20.51 [b]	21.00 [b]	0.454	20.55 [b]	22.58 [a]	0.371
C17:0	0.62	0.50	0.53	0.049	0.55	0.55	0.040
C18:0	11.65 [a]	10.20 [ab]	9.93 [b]	0.457	10.24	10.94	0.373
C20:0	0.16	0.15	0.16	0.008	0.15	0.16	0.007
C16:1	1.50	1.27	1.41	0.090	1.31	1.47	0.073
C17:1	0.47	0.36	0.42	0.044	0.40	0.43	0.036
C18:1 n9c	38.78 [a]	35.53 [b]	38.49 [a]	0.729	36.78	38.42	0.596
C18:2 n6c	19.58	17.97	18.08	0.823	20.36 [a]	16.73 [b]	0.672
C18:3n3	1.86 [c]	10.72 [a]	7.29 [b]	0.392	7.05	6.19	0.320
C20:2	0.71 [a]	0.61 [b]	0.67 [ab]	0.028	0.72 [a]	0.60 [b]	0.022
C20:4n6	0.24 [a]	0.14 [b]	0.29 [a]	0.020	0.23	0.21	0.016
C22:1n9	0.16 [c]	1.08 [a]	0.76 [b]	0.045	0.68	0.65	0.037
Saturated fatty acids	36.70 [a]	32.33 [b]	32.59 [b]	0.812	32.45 [b]	35.29 [a]	0.663
Unsaturated fatty acids	63.30 [b]	67.67 [a]	67.41 [a]	0.812	67.55 [a]	64.71 [b]	0.663

a,b Mean in the same row with different superscripts are different ($P<0.05$)