Characteristics of Pork Fed Potato Chipper By-Product

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Introduction

The potential use of various by-products by nonruminant animals has received renewed attention recently due to the world feed-grain supply and demand situation. A by-product of the potato chip industry, known as potato chipper by-product, may offer a potential as a valuable alternative nutrient source for swine.

Other by-products have already proven to be acceptable as energy sources for growing and finishing swine. Nu (1980) found that sweet potato chips fed in addition to the basal diet significantly increased daily gain and improved the feed to gain ratio. Cline et al. (1976) reported condensed soybean solubles, a by-product of the isolated soybean protein industry, can replace corn up to 10% of the diet without adversely affecting performance. It has also been demonstrated that citrus pulp is 97% and 96%, respectively, as valuable as corn at levels of 10% and 20% of the diet (Baird, et al., 1972).

Potato chipper by-product contains a high amount of fat (Table 1) composed primarily of vegetable oils. Therefore, diets containing the by-product have elevated levels of fat and unsaturated fatty acids. Stahly and Cromwell (1979) concluded that at 22.5ºC and 35ºC, dietary fat supplementation improved growth rate and efficiency of energy utilization, but that carcass backfat thickness and total percent of fat in tissues increased at the same time. Tribble et al. (1979) reported swine fed added fat required less feed per unit of gain. Average daily gain and carcass characteristics showed no adverse effects from the added fat. Barrick et al. (1953) and Day et al. (1953) demonstrated improved gains and efficiencies from adding fat to the diets of swine.

Previous research has revealed that many characteristics of pork fat are influenced to a large extent by the amount and the chemical composition of ingested fat. Wahlstrom et al. (1971), Villegas et al. (1973) and Skelley et al. (1975) reported whole soybeans in swine rations produced carcasses of acceptable quality and cuts which had a greater percentage of linoleic acid.

The objective of this study was to determine the value of potato chipper by-product as a sole energy source or combined with grain in the diets of growing-finishing swine.

Materials and Methods

Animals and Diets. Eighty-four Yorkshire cross feeder pigs grading U.S. No. 1 were used in this experiment. Thirty-eight (38) barrows and 44 gilts averaging 33.2 kgms were randomly allotted within sex and weight into six pens containing fourteen pigs each. Each pen was randomly assigned to one of three treatments and two pens per treatment were provided. The composition of the three dietary treatments is shown in Table 1. All rations were balanced according to NRC standards for protein, minerals, and vitamin levels. The hogs were slaughtered when the average pen weight reached 95.5 kgms.

Slaughter and Measurements. The animals were removed from the official test, fasted for 24 hours, and then slaughtered at a commercial slaughterhouse. After a 24-hour chill at 0ºC, carcass measurements were taken. Objective measurements included carcass weight, dressing percentage, average backfat thickness, carcass length, USDA grade, and area of longissimus dorsi muscle. Subjective measurements included degree muscling, belly firmness score, loin color score, loin firmness score, loin moisture score, loin marbling score, and ham PSE score. Muscling was scored on the USDA scale of 1 to 6 where 1 is very thin and 6 is very thick. Firmness was evaluated on a scale of 1 to 5 with 1 as soft and 5 as very firm. Color was appraised on a scale of 1 to 5 where 1 is extremely pale and 5 is dark. Moisture was ranked on a 1 to 5 scale with 1 as watery and 5 as very dry. Marbling was scored on a scale of 1 to 5 as illustrated by the Wisconsin Pork Quality Standards (1963). Ham PSE was evaluated on a 1 to 5 scale where 1 is extremely pale, soft, and watery and 5 is dark, very firm, and very dry. The left side of each carcass was cut, and the ham and loin were weighed. The carcass cutting and trimming were performed by the same individuals throughout the test.

Chemical Analysis. A sample of the raw longissimus muscle at the 8th rib was analyzed for percentages of protein, moisture, fat, and ash outlined by the A.O.A.C. (1975). Final pH of the sample was also obtained. Backfat samples were taken at the 8th rib for analysis of fatty acid composition. The lipids from this adipose tissue were extracted according to the procedure outlined by Marmer and Maxwell (1981). The fatty acids were transesterified with sodium methoxide according to the method described by Pitas and Jensen (1974). The methyl esters of the fatty acids were analyzed using gas liquid chromatography (GLC). The colum was packed with 15% - OV-275 on 100/120 Chromosorb P AW-DMCS (Supelco, Inc., Bellefonte, Pa.). Identifications of fatty acids were based on retention times of known fatty acids and carbon number plots.

Warner-Bratzler Shear and Taste Panel Evaluation. A six-member sensory panel evaluated the tenderness, juiciness, flavor, and overall acceptability of pork chops from the 9th and 10th rib of each carcass. The panel members were selected and trained according to the methods of Cross et al. (1978). All chops were frozen and stored at -35ºC for approximately 3 months prior to resting. Chops were thawed for 18 hours at 1ºC prior to cooking. They were cooked in an electric oven set at 205ºC for approximately 7 minutes on each side, giving an internal temperature of approximately 70ºC. Cores 2.5 cm in diameter were served warm to the panel members. All ratings were made on an 8-point hedonic scale, with 1 being least desirable and 8 being most desirable.

The same size cores were also used while warm with the Warner-Bratzler shear to evaluate tenderness.

Statistical Analysis. Analysis of variance, f-tests, and t-tests were performed according to the methods described by Snedecor and Cochran (1967).

Table 1

Rations[1]

	A	B	C
Potato Chipper By-Product[4]	-	40.50	80.50
Corn	81.25	40.50	-
Soybean Meal	15.00	15.75	16.00
Multifos[2]	3.00	3.00	3.25
Salt	.50	-	-
Nopcosol[3]	.25	.25	.25
	100.00%	100.00%	100.00%

1 Calculated on an as-fed percentage wight basis.
2 Dicalcium and phosphorus additive.
3 Vitamin premix by Diamond Shamrock.
4 Analysis of Potato Chipper By-Product:

Dry matter 97.12%
Protein 7.85%
Crude fat 39.92%
Crude fiber 1.56%
Ash 5.38%
NFE 45.30%

Results and Discussion

The weights and feedlot performance of the animals on each treatment, the dressing percent, and the percent of ham loin are given in Table 2. Animals on treatments A and B were significantly heavier and had higher average daily gains than those on treatment C. However, animals in treatments B and C showed significantly more desirable ratios of feed to gain and higher dressing percentages than those on the control (treatment A). The ham and loin, calculated as a percentage of chilled carcass weight, decrease significantly as percentage of potato chipper by-product increased in the ration.

Table 2

Weights, Performance and Percentage of Cuts by Treatment

Factor	Treatments A	B	C
No. of animals	28	28	26[d]
Initial wt., kg.	33.22	32.72	32.65
Final wt., kg.	94.86[a]	94.08[a]	89.07[b]
Daily gain, kg.	.66[a]	.66[a]	.54[b]
Feed/gain ratios	4.03[a]	3.09[b]	2.73[b]
Carcass wt., kg.	65.31	67.46	63.65
Dressing percent	68.21[a]	71.07[b]	70.67[b]
Ham and loin %[e]	46.73[a]	43.65[b]	42.06[c]

a, b, c Means on same lines followed by different superscripts are significantly different ant the 5% level.
d 2 pigs died prior to slaughter.
e Cuts are recorded as a percentage of carcass weight.

The carcass measurements given in Table 3 show an increase in average backfat as the by-product increased in the ration. Animals on ration C also showed decreased length, longissimus muscle area, and muscling score. As a result, with ration C, the USDA grade was significantly (P .05) higher at 2.2 compared with 1.4 and 1.6 for rations A and B respectively.

Carcass quality ratings evidenced a distinct advantage to ration A. A firmer belly (P .05) was produced by treatment A, the corn-soybean meal ration. Ration A also gave a more desirable lean color and moisture score from the loin. The loin marbling socre was again highest for treatment A, but was not significantly higher than treatment C. Ham quality scores and lean firmness scores from the loin revealed significant (P .05) differences with the highest for ration A, followed by ration C, while ration B gave the lowest score.

Table 3

Carcass Measurements and Carcass Quality Ratings by Treatment

Factor	Treatments A	B	C
Backfat, cm	3.13[a]	3.41[ab]	3.71[b]
Length, cm	80.36[a]	79.69[a]	76.58[b]
Area of longissimus muscle, cm^2	24.51[a]	22.27[a]	19.05[b]
Muscling	4.14[a]	4.17[a]	3.69[b]
USDA grade	1.39[a]	1.57[a]	2.16[b]
Belly firmness[f]	3.96[a]	2.71[b]	2.50[b]
Lean firmness[f]	2.75[a]	1.43[c]	1.88[b]
Lean Color[g]	2.64[a]	2.00[b]	2.08[b]
Moisture[h]	2.82[a]	2.00[b]	2.00[b]
Marbling score[j]	1.96[a]	1.21[b]	1.81[a]
Ham quality[k]	2.96[a]	1.79[c]	2.27[b]

[a, b, c] Means on same line followed by different superscripts are significantly different at the 5% level.
[f] = slightly thin, 4 = moderately thick, 5 = thick
[g] USDA grade where U.S. #1 = 1 and U.S. #2 = 2
[h] Soft = 1, moderately soft = 2, moderately firm = 3, firm = 4, very firm = 5
[j] Mat.pale = 1, pale = 2, grayish pink = 3, moderately dark = 4, dark = 5
[k] Watery = 1, moderately watery = 2, moderately dry = 3, dry = 4, very dry = 5
Wisconsin Standards (1963). 1 = least marbling, 5 = most marbling
[f] = PSE, 5 = DFD

Proximate analysis of samples from the longissimus muscle are presented in Table 4. This revealed that protein was significantly lower for ration C. Rations B and C were lower in moisture and ash content as compared to ration A. Carcass fat content increased significantly (P .05) as by-product increased in the rations. pH determinations showed no significant difference between treatments, indicating the lower quality scores from the potato chipper by-product fed hogs probably resulted from softer fat rather than actual PSE.

Table 4

Proximate Analysis of Longissimus Muscle by Treatment

Factor	Treatments A	B	C
Protein %	22.90[a]	22.48[a]	20.90[b]
Moisture %	68.95[a]	61.37[b]	62.19[b]
Fat %	2.06[a]	3.54[b]	5.71[c]
Ash %	1.14[a]	1.11[b]	1.09[b]
pH	5.60	5.59	5.64

[a, b, c] Means on the same line followed by different superscripts are significantly different at the 5% level.

Results of the fatty acid analysis are incomplete. However, preliminary data show a higher level of unsaturated fatty acids in the backfat of pigs fed potato chipper by-product. Skelley et al. (1975) noted a similar shift when feeding whole roasted soybeans rather than soybean meal. The data thus far support this work, as the potato chipper by-product contains a high content of vegetable oils. Completed data will be presented when available. Sensory panel results are also not completed and will be reported later.

Summary

Three treatments with 28 swine per treatment were conducted to determine the substitution value of potato chipper by-product for corn in the diets of swine. Treatment A was a typical corn-soybean meal ration, whereas treatments B and C replaced half and all the corn, respectively. While average daily gain was lower for treatment C than A or B, the feed/unit of gain ratio favored both treatment B and C. The control (treatment A) group produced carcasses more desirable in all characteristics measure with treatment B generally ranking second best, and the treatment C carcasses, although acceptable, being the least desirable.

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