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# Roasted Soybeans for Growing-Finishing Swine

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A.S. Series 70-35

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Research conducted many years ago showed that pigs fed whole soybeans had poor growth and feed efficiency. It was found that raw soybeans contain an anti-growth factor and that this factor can be destroyed by heating the soybeans to a temperature of at least 225° F.

Soybeans contain about 18% fat. In the past it has been economical to process the soybeans into soybean oil and soybean meal. Soybean meal is the major protein supplement fed to swine. The recent development of new equipment to cook soybeans on the farm has resulted in a renewed interest in the use of cooked soybeans in swine rations. The objectives of the study reported here were to compare the performance of pigs fed whole soybeans that had been cooked in a "Roast-a-tron" cooker with those fed soybean meal and to study the effects of whole soybeans on the carcasses produced.

## Experimental Procedure

Seventy-two crossbred pigs averaging 65 lb. were allotted on the basis of litter, sex and weight into 12 lots of six pigs (3 barrows and 3 gilts) each. Three lots were randomly allotted to each of the four treatments which were:

1. Diet A - soybean meal
2. Diet B - one-half of supplemental protein from soybean meal and one-half from cooked soybeans
3. Diet C - cooked soybeans
4. Diet D - cooked soybeans plus lysine and methionine

The composition of the diets is shown in table 1. The whole soybeans were cooked in a "Roast-a-tron" cooker which heated them to a temperature of about 256° F. The cooked soybeans were ground and mixed with the corn and other ingredients as the diets were mixed. Feed and water were provided ad libitum with waterers being located in the house and feeders in the connecting outside, concrete pens. Pigs were weighed biweekly and removed from the experiment at an average weight of about 205 lb.

All of the barrows were slaughtered at the SDSU Meat Laboratory and carcass data were obtained. In addition, a fat sample was taken from the loin fat over the last rib for fatty acid and iodine number determination. Approximately a 4.5 inch loin sample was removed from the right side starting at the 10th rib for chemical analyses, tenderness and taste panel evaluations.

## Results

The growth performance and carcass data are summarized in table 2. All pigs gained at a very acceptable rate and there were no real differences in rate of gain between treatments which ranged from 1.80 to 1.88 lb. per day. Pigs fed the soybean meal diet consumed significantly more feed than did the

pigs receiving the diets containing cooked soybeans. About 6% less feed was required to produce a pound of gain when pigs were fed cooked soybeans. Feed efficiency was 3.36 for the pigs fed the soybean meal, 3.23 for those receiving half of their supplemental protein from each protein source and 3.15 and 3.16 for the two groups fed the cooked soybeans. The improved efficiency of the diets containing cooked soybeans is no doubt due to the higher energy content of these diets, as it has been reported that soybeans contain about 20% more gross energy than soybean meal. There was no advantage of adding supplemental lysine or methionine to the cooked soybean diets.

The only significant difference in carcass data was in dressing percentage. Pigs fed the soybean meal diet, diet A, dressed 70.4% compared to 70.9, 72.4 and 72.6% for pigs fed diets B, C and D, respectively. Average carcass backfat, length, loin eye area or ham and loin percent did not differ significantly between treatments. It was observed that carcasses from pigs fed soybean meal were slightly firmer than those from pigs fed cooked soybeans.

Table 3 gives the results of chemical and physical tests, taste panel evaluation and cooking losses of pork loin chops from pigs fed soybean meal or cooked soybeans. Chemical analyses revealed that there were no differences in water, fat or protein content. Cooking losses also were similar and a taste panel found no difference in tenderness, flavor or juiciness of the loin chops produced from pigs fed cooked soybeans or soybean meal. A Warner-Bratzler shear, which measures the force required to shear a 1 inch core of meat, also showed no difference in tenderness. Other factors studied were cooking loss, color, marbling and water holding capacity. None of these factors were different between treatments.

The iodine number and fatty acid analysis of fat samples are shown in table 4. The data indicate a highly significant difference in degree of unsaturation of the fat as shown by the higher iodine number of the fat from pigs fed cooked soybeans. This was also indicated in the fatty acid analysis which showed significant differences in content of oleic and linoleic acid.

This research indicates that properly cooked whole soybeans are of excellent nutritional value and equal to soybean meal in swine rations. Although feeding cooked, whole soybeans causes softer carcasses lacking in firmness, this does not appear to affect the acceptability of the pork produced. The decision regarding their use is primarily one of economics. The relative prices of meal and beans, cooking costs and estimated feed efficiency must be considered. It has been estimated that total costs of cooking soybeans may be in excess of $10 per ton if less than 1,000 hogs are fed per year and about $5 per ton if 2,000 head are produced yearly.

## Summary

Growing-finishing pigs fed diets containing soybean meal or cooked soybeans grew at similar rates, but those pigs fed the cooked soybeans required about 6% less feed per unit of gain and had a higher dressing percentage. Carcasses from pigs fed cooked soybeans were less firm and had a higher percentage of polyunsaturated fatty acids. There were no differences in carcass characteristics, chemical content, shear value, color, marbling, cooking losses, tenderness, flavor or juiciness of pork loin chops from pigs fed cooked soybean or soybean meal diets. Supplemental lysine and methionine did not improve the performance of pigs fed cooked soybeans.

Table 1. Composition of Rations (Percent)

| Diet | To 115 lb. | | | | 115 to 205 lb. | | | |
|---|---|---|---|---|---|---|---|---|
| | A | B | C | D | A | B | C | D |
| Ground yellow corn | 79.9 | 77.75 | 75.5 | 75.5 | 88.3 | 87.2 | 86.0 | 86.0 |
| Soybean meal (45%) | 17.5 | 9.0 | -- | -- | 9.3 | 4.7 | -- | -- |
| Cooked soybeans (38%) | -- | 10.7 | 22.0 | 21.65 | -- | 5.7 | 11.6 | 11.25 |
| Ground limestone | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 |
| Dicalcium phosphate | 1.4 | 1.35 | 1.3 | 1.3 | 1.2 | 1.2 | 1.2 | 1.2 |
| Trace mineral salt | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| Vitamin-antibiotic | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| L-lysine | -- | -- | -- | 0.1 | -- | -- | -- | 0.1 |
| DL-methionine | -- | -- | -- | 0.25 | -- | -- | -- | 0.25 |
| Calculated protein, % | 15.1 | | | | 12.1 | | | |
| Calculated calcium, % | 0.62 | | | | 0.56 | | | |
| Calculated phosphorus, % | 0.58 | | | | 0.52 | | | |

[a] Provided per lb. of ration: 1,500 I.U. vitamin A, 150 I.U. vitamin D, 2 mg. riboflavin, 4 mg. calcium pantothenate, 9 mg. niacin, 10 mg. choline chloride, 5 mcg. vitamin $B_{12}$, 10 mg. aureomycin to 115 lb. and 5 mg. aureomycin 115 to 205 lb.

Table 2. Pig Performance and Carcass Characteristics of Pigs Fed Soybean Meal or Cooked Soybeans

| | Soybean meal | Soybean meal and cooked soybeans | Cooked soybeans | Cooked soybeans, lysine and methionine |
|---|---|---|---|---|
| No. of pigs | 18 | 18 | 18 | 18 |
| Avg. initial wt., lb. | 65.3 | 65.2 | 64.8 | 65.3 |
| Avg. final wt., lb. | 206.5 | 200.6 | 202.2 | 206.6 |
| Avg. daily gain, lb. | 1.85 | 1.80 | 1.88 | 1.86 |
| Avg. daily feed, lb. | 6.24* | 5.73 | 5.90 | 5.81 |
| Feed per lb. gain, lb. | 3.36 | 3.23 | 3.15 | 3.16 |
| Carcass data[a] | | | | |
| Dressing percent | 70.38** | 71.91 | 72.39 | 72.63 |
| Backfat, in. | 1.27 | 1.24 | 1.30 | 1.34 |
| Length, in. | 29.9 | 29.8 | 30.1 | 30.1 |
| Loin eye area, sq. in. | 4.45 | 4.40 | 4.59 | 4.58 |
| Ham and loin, % | 37.31 | 38.54 | 38.12 | 38.32 |

[a] Nine barrows slaughtered per treatment.
* Significant $P < .05$.
** Significant $P < .005$.

Table 3. Chemical, Physical, Taste Panel and Cooking Characteristics of Pork Loins

| Traits | Diet A | B | C | D |
|---|---|---|---|---|
| Water, % | 71.29 | 72.83 | 70.62 | 71.81 |
| Fat, % | 5.33 | 5.31 | 5.78 | 3.81 |
| Protein, % | 22.30 | 21.26 | 22.30 | 23.48 |
| Marbling[a] | 3.44 | 3.44 | 3.22 | 2.67 |
| Color[b] | 3.11 | 2.78 | 2.67 | 3.11 |
| Cooking loss, % | 15.33 | 15.78 | 15.22 | 13.83 |
| Tenderness[c] | 3.58 | 3.34 | 3.03 | 3.68 |
| Flavor[c] | 3.09 | 3.04 | 3.10 | 3.22 |
| Juiciness[c] | 2.89 | 3.12 | 3.48 | 3.43 |
| Shear, lb.[d] | 16.92 | 14.51 | 14.33 | 17.14 |

[a] Based on a 1 to 5 scale, 1 = trace to 5 = abundant.
[b] Based on a 1 to 5 scale, 1 = pale to 5 = dark.
[c] Based on a 1 to 8 scale, 1 = extremely desirable to 8 = extremely undesirable.
[d] Pounds of force to shear a one inch core.

Table 4. Fatty Acid Content and Iodine Number of Fat Samples

| | Diet A | B | C | D |
|---|---|---|---|---|
| Iodine number | 63.0** | 68.9 | 70.5 | 70.4 |
| Myristic acid, % | 1.09 | 1.13 | 1.28 | 1.18 |
| Palmitic acid, % | 29.68 | 29.46 | 28.41 | 28.72 |
| Stearic acid, % | 10.07 | 8.86 | 8.78 | 9.41 |
| Palmitoleic acid, % | 1.64 | 1.63 | 1.62 | 1.51 |
| Oleic acid, % | 49.28* | 46.26 | 44.96 | 45.01 |
| Linoleic acid, % | 8.57** | 12.74 | 14.96 | 14.13 |

* Significant $P < .025$.
** Significant $P < .01$.