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Heat - Extruded Sorghum Grain for Growing - Finishing Swine.[1/]

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This paper is a progress report of a research project initiated this past year designed to study the effects of heat and pressure processing of sorghum grain on the performance of swine.

The theoretical reasoning behind this approach was to increase the utilization of sorghum grain by chemical and/or physical starch damage with the application of certain degrees of heat and pressure during processing. The starch granules, which contain complex forms of chemically stored energy, must be broken-up and reduced into simple units of glucose in the digestive tract of the pig before absorption can occur.

Heat and pressure processing can physically disorganize the semi-crystalline structure of the starch granules in cereal grains. This makes the starch easily attacked by the digestive enzymes.

Thus, it seems conceiveable to assume that any processing method which may hasten and aid in the reduction of the crystallinity of the starch granules, might also enhance the efficiency of utilization of cereal grains by the pig.

The objective of the feeding trial reported in this paper was to evaluate the utilization of cooker - extruder processed sorghum grain at various levels in growing - finishing rations.

Procedure

On April 4, 1968, sixty head of Duroc and crossbred (Hampshire X Yorkshire) pigs weighing approximately 80 pounds each were divided into 2 replications or groups, each group composed of 5 pens of 6 pigs each. The pigs in each group were allotted to their respective pens on the basis of breed, weight, litter and sex. The 5 treatments were randomly assigned to the pens within each group.

The treatments consisted of cooker - extruder processed sorghum grain added to replace 0%, 20%, 40% 60% and 80% of the ground sorghum grain portion of the various rations. The compositions of the five rations are given in Table 1.

1/ Acknowledgement is made to Farmland Industries, Inc., Kansas City, Missouri, for a grant in partial support of this project.

Table I

Ingredient Composition of the Experimental Rations:

Ingredients:	Levels of Cooker-Extruder Processed Sorghum Grain				
	Control-0%	20%	40%	60%	80%
	Pounds/ton				
Ground Sorghum Grain	1320	1056	792	528	264
Ground Processed Sorghum Grain[1]	---	264	528	792	1056
Soybean Meal (44%)	640	640	640	640	640
Ground Limestone	20	20	20	20	20
Dicalcium Phosphate	20	20	20	20	20
Salt	10	10	10	10	10
Tylan 10	2	2	2	2	2
Trace Mineral (2-5)	0.5	0.5	0.5	0.5	0.5
	Grams/ton				
Vitamin A (10,000 I.U./gm.)	300	300	300	300	300
Vitamin D (15,000 I.U./gm.)	20	20	20	20	20
B-Complex Vitamins (Merch 1233)	216	216	216	216	216
Vitamin B_{12} (Proferm 20)	232	232	232	232	232

[1]Appreciation of thanks is expressed to Wenger Mixer Company; Sabetha, Kansas for processing the cooker-extruder processed sorghum grain.

Table II

Chemical Analysis of Experimental Rations:

	Levels of Cooker-Extruder Processed Sorghum Grain				
	0%	20%	40%	60%	80%
Moisture %[1]	13.0	12.83	12.33	11.73	11.43
Crude Protein %	20.85	20.40	19.72	20.23	19.90
Crude Fat %	2.45	2.20	1.93	1.60	1.77
Crude Fiber %	3.30	3.00	3.43	3.03	3.10
Ash %	5.40	5.30	4.88	4.98	4.80

[1]The chemical analysis were conducted by the Department of Grain Science and Industry

The rations were formulated with soybean meal furnishing 16% crude protein in each ration. Soybean meal was added at this level, on basis that if the protein in the sorghum grain was affected by the processing method, the pigs minimum daily requirement for protein would still be provided by the soybean meal in the ration. The chemical analysis of the rations are given in Table II.

All of the sorghum grain used during the duration of this trial was from the same source. Before the sorghum grain was processed, it was ground through a one-sixteenth inch hammer-mill screen. A Wenger continous cooker-extruder was used to process the sorghum grain and the processed grain was reground before being added to the various rations. The processing produced a product in which all the starch was damaged. The rations were mixed and pelleted by the Grain Science and Industry Department, Kansas State University.

The pigs were self-fed their respective rations and were weighed individually every 2 weeks while on test. Individual pigs were removed from the test pens when they weighed 205 pounds or more, and were slaughtered at the Meat Science Laboratory. During the slaughtering, the stomachs were removed and were examined by Dr. D. C. Kelley, Department of Infectious Diseases, Kansas State University, Veterinary College.

Results

The final results from this feeding trial are given in Table III.

Table III

	Levels of Cooker-Extruder Processed Sorghum Grain				
	0	20%	40%	60%	80%
Number of Animals[1]	9	12	11	10	11
Avg. Initial wt. (lbs)	79.7	82.8	84.8	79.4	83.8
Avg. Final Wt. (lbs)	208.7	210.9	211.5	211.5	212.8
Avg. Total Gain (lbs)	129.0	128.1	126.7	132.1	129.0
Avg. Days to Slaughter	81.2	85.5	72.6	79.2	81.4
Avg. Daily Gain (lbs)	1.59	1.50	1.75	1.67	1.59
Avg. Daily Feed Consumption (lbs)	4.61	4.40	5.17	4.90	4.61
Avg. lbs. feed required/lb. gain	2.91	2.93	2.96	2.94	2.91
Carcass Data:					
Avg. Backfat (Inches)	1.18	1.17	1.21	1.16	1.10
Avg. Carcass (Length)	29.00	29.40	29.19	29.40	29.60
Avg. Loin Eye Area (Sq. Inches)	5.60	5.38	5.23	5.17	5.45
Avg. % Ham & Loin	39.60	38.41	37.83	37.59	39.19

[1] The performance data of the following pigs was not used in the calculation of the final results.
2 pigs on the 0% level were removed from the study, 1 with a broken leg and 1 with severely sore feet, and 1 pig on the 80% level was removed with pneumonia. 1 Carcass was condemned at slaughter with extensive pleuritis and pneumonia, as was 1 pig on the 40% level and 2 pigs on the 60% level.

Summary

1.) Under the conditions of this study, the amount of feed required per pound of gain was approximately the same when 0%, 20%, 40%, 60% and 80% of the processed sorghum grain was used in growing - finishing rations to replace the sorghum grain portion of the rations.

2.) The average daily gains were greater (statistically significant $P < .01$) for the pigs receiving the rations containing the 40% and 60% level of processed sorghum grain.

3.) Further experimental work is needed to determine if economical and nutritional benefits can be derived from cooker-extruder processing of sorghum grain for swine.

Aging and Cookery of Pork

By
Harold J. Tuma, Dorthory L. Harrison and Donald H. Kropf

Why isn't more pork used in hotels and restaurants, in the home, or on the backyard grill? Pork chops are not considered a prestige item by most people, why? Pork is not a difficult meat to process and cook although many chefs and housewives do not present it to its fullest advantage for consumption.

Pork can compete on any menu and for any meal, if processed and cooked properly.

Some of the Myths concerning the use of pork are:

1) It must be cooked to 185° F. (extremely well done) to destroy *Trichinella spiralis*.

2) Pork chops must be cut thin.

3) Pork cannot be handled (cryovaced or aged) the same as beef or lamb.

4) Pork must be cooked by some frying or moist heat methods of cookery.

5) Pork quality is not as important as with some other species.

Research studies here at Kansas State University were designed and conducted to provide answers for the processing and cookery myths concerning pork.

The answer to the first myth is that the *Trichinella spiralis* organism is killed at a temperature of 137° F. (Meat Inspection Division, USDA). Results of studies here at Kansas State indicate that pork cooked to 185° F. internal temperature is less tender, less juicy, has a greater cooking loss, and takes a longer time to cook. The current recommendation for pork cookery temperatures is 160-170° F., final internal temperature. High temperature is not the only way the *Trichinella spiralis* organism can be killed. Freezing, as shown in Table 1, will accomplish the same mission.

Table 1
Required times and Temperatures to kill the Trichinae organism

Temperature °F.	Time Days
+5	30
-10	20
-20	12

Tradition has been the main reason for cutting pork chops thin (½ to 3/4 inch thick). Again research results from here have shown that thin chops are less juicy and less tender with little flavor difference. Tenderness, juiciness, and flavor are the major factors consumers consider in evaluating any cooked red meat product. The objective is to have a tender, juicy and flavorful pork product. Pork chops in the past were cut thin to obtain more chops per package; however, today's consumer is more aware of quality and has purchasing power to buy quality products.

They myth that pork cannot be handled the same as beef or lamb is not well founded. A recent study here indicated that pork could be aged in cryovac (placed in a plastic bag and the air removed) and that there was a slight increase in tenderness during the 12 day aging process (Table 2). The juiciness or flavor characteristics were not enhanced during the aging process. Most of the processing problems are not with pork muscle, per se, but a lack of sanitary processing conditions. The fresh meat from other species is cryovaced and a great deal more fresh pork could be marketed if some of these newer processing methods were used.

The fourth myth concerns the traditional approach to pork cookery. Most cook books suggest moist heat methods (braizing and cooking in liquid) of cookery for pork cuts. Actually the cooking loss was greater and the appearance less desirable when moist heat methods of cookery were used and compared to dry neat methods of cookery. Various pork cuts (pork chops and fresh boneless hams are two good examples) can be broiled, grilled, or roasted the same as beef and lamb and are an excellent product.

The subject of pork quality has been discussed many times and as mentioned previously, today's consumer is more discriminating. Additional Kansas State studies have shown that low quality pork chops had higher cooking losses and were less tender than average quality chops. From a quality aspect pork can have too much marbling (fat within the muscle) which only adds to the calories, but some is necessary for the desirable eating characteristics. There should be just enough so that the little white flecks within the muscle are visible to the eye.

Summary

1. Pork does not need to be cooked to an internal temperature greater than 170° F.; 160° F. to 170° F. is satisfactory.

2. Pork chops for broiling or grilling should be cut at least 1 inch thick.

3. Aging pork 8 to 12 days produced more tender chops than those processed after 1 or 4 days. Processing too fast after slaughter may produce less tender chops.

4. Pork can and should be cooked by a greater variety of methods than traditionally used. For example, roasting and broiling.

5. Pork muscle quality criteria should be a part of any selection or evaluation program.

Table 2
Palatability scores for aged pork chops

Palatability Factor	Aging Time, Days 1	4	8	12
Shear, lb./½ in core[A]	7.7	7.8	6.9	6.8
Flavor score[B]	5.6	5.6	5.6	5.6
Juiciness score[B]	5.6	5.3	5.3	5.4
Tenderness score[B]	5.5	5.6	5.7	5.8

A - the lower the shear value the more desirable

B - the higher the score the more desirable