

# POTATO PULP, WHEAT BRAN EVALUATED FOR SWINE

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The swine industry in North Dakota has been based on barley and oats as the main energy feeds. As long as an abundance of barley and oats is produced in the state and it is available for feeding at reasonable prices, there probably will not be a shift from this practice. However, there are some by-products of food processing produced in the state that could complement the standard grains if those by-products could be used efficiently in swine rations. Two of these by-products are potato pulp and wheat bran.

North Dakota has one potato starch plant which processes cull and other unmarketable potatoes. Potato pulp is the residue remaining after the starch has been extracted from the potato.

Wheat bran is officially defined as the coarse outer covering of the wheat kernel, as separated from cleaned and scoured wheat in the usual process of commercial milling. When wheat is milled, the bran yield is approximately 12 to 15 per cent of the total weight (Deyoe, et al. 1967).

The majority of previous research conducted with swine on the utilization of bulky or fibrous feeds, a classification in which potato pulp and wheat bran fall, has been concerned primarily with the energy diluting effect of this type of feeds. Considerably less research has been conducted to evaluate fibrous or bulky feeds as a potential energy source. These experiments were therefore designed to evaluate potato pulp and wheat bran as an energy source in practical pelleted swine rations.

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## Procedure

Three experiments involving a total of 142 animals were conducted to measure the performance of swine fed rations containing three levels of potato pulp (0, 20 and 30 per cent) and three levels of wheat bran (0, 15 and 20 per cent).

The pigs were fed rations calculated to contain 14 per cent protein from an approximate initial weight of 50 pounds to a final liveweight of 200 pounds. However, upon analysis the barley available for the first experiment had a crude protein content of only 8.8 per cent instead of the normal of approximately 12 per cent. Consequently,

the rations used in the first experiment had an average protein content of only 11.77 per cent instead of the planned 14 per cent.

The rations for the next two experiments were then calculated on the basis of the analysis of the available barley. Shortly after the start of these experiments, barley from another source was used which had a protein content of 11.9 per cent. This resulted in rations with a protein content of 15.6 to 16.0 per cent.

Barley with a protein content as low as 8.8 is not generally found in North Dakota. However, it tends to emphasize one reason why livestock may perform differently on supposedly the same feeds.

One digestion experiment was conducted with rats on the three rations containing potato pulp.

**Table 1. Ration Formulation and Composition. Experiment 136.**

	Lots 1 & 5	Lots 2 & 6	Lots 3 & 7	Lots 4 & 8
Barley	895	768	636	550
Wheat Bran	—	150	300	—
Potato Pulp	—	—	—	300
SBOM	80	58	40	125
Dicalcium Phosphate	8	—	—	8
Limestone	10	17	17	10
Vitamin Premix	2	2	2	2
T.M. Salt	5	5	5	5
Total pounds	1000	1000	1000	1000
Calculated				
Protein, %	14.04	13.96	13.94	13.91
Analyzed				
Protein, %	11.24	11.87	11.99	11.98
Acid Detergent				
Fiber, %	7.16	7.50	7.98	9.15
Estimated T.D.N., %	73.13	70.50	67.80	72.20
Estimated Cost/cwt., Dollar	2.46	2.34	2.26	2.50

**Table 2. Summary of Results, Experiment 136.**

	Barley	15% Bran	30% Bran	30% Potato Pulp
Lot	1 & 5	2 & 6	3 & 7	4 & 8
No. Per Lot	12	11	11	12
Initial Wt., Lb.	50	51	52	51
Final Wt., Lb.	196	198	194	192
Av. Da. Gain, Lb.	1.40	1.41	1.35	1.35
Feed/cwt. Gain, Lb.	324	339	357	326
Av. Da. Feed				
Offered, Lb.	4.52	4.75	4.79	4.38
Lb. Gain/Lb. Feed, Lb.	0.31	0.30	0.29	0.31
T.D.N./Lb. Gain, Lb.	2.37	2.40	2.41	2.35
T.D.N./Lb.				
Gain Only, Lb. <sup>1</sup>	1.29	1.35	1.36	1.31
Backfat, Inches <sup>2</sup>	1.13	1.16	1.17	1.16

<sup>1</sup>Corrected for maintenance requirements.  
<sup>2</sup>Three heaviest hogs per lot.

## Results

The addition of 15 per cent wheat bran to pelleted barley rations had no effect on average daily gains made by the pigs. In each experiment the gains were almost identical. The pigs fed the 15 per cent bran ration did require about 10 pounds (three per cent) more feed per hundred pounds gain than those on straight barley. They ate 0.18 pounds or 3.5 per cent more feed per day.

The addition of 30 per cent bran to the barley ration resulted in no significant difference in average daily gains. However, there were indications of a downward trend in gains with the 30 per cent bran rations. Averaging the three experiments resulted in daily gains of 1.52 pounds per day for the animals on the basal ration as compared to 1.45 pounds per day for those fed 30 per cent bran in the ration. Feed requirements increased by 10 per cent for those animals fed the high level of bran, which was an increase of 33 pounds for the bran fed pigs (334 lbs. for barley vs. 367 lbs. for 30 per cent bran per hundredweight gain).

The pigs fed 30 per cent bran ate considerably more feed per day than those fed the basal ration. This increase amounted to an average of 0.3 pounds per day for the experimental period. There was a small amount of feed wastage by the lots on the 30 per cent bran rations. This was especially true if the pellets were not well formed and firm, giving the pigs an opportunity to break the pellet and sort out the bran.

The addition of potato pulp to the rations produced a marked reduction in average daily gains. When the three rations containing potato pulp were compared to the three rations not containing potato pulp, gains obtained on the pulp rations were significantly less in these experiments. When the data from the two experiments involving the six treatments were combined, the pigs fed potato pulp as 20 per cent of their ration gained 0.17 pounds less per day than those fed rations not containing potato pulp (1.56 vs. 1.39).

The least desirable results were obtained when 20 per cent potato pulp was combined with 15 per cent wheat bran. In the third experiment this combination resulted in gains significantly lower ( $P .05$ ) than those of other treatments.

The feed efficiency of the pigs fed potato pulp was comparable to the efficiency of pigs fed the barley rations. Those fed potato pulp required only three per cent more feed per hundred pounds of gain than the control lots. The major portion of this small increase can be accounted for as wastage in the second experiment. The pigs fed bran in

**Table 3. Ration Formulation and Composition Experiments 138 and 139.**

	Lots 1 & 7	Lots 2 & 8	Lots 3 & 9	Lots 4 & 10	Lots 5 & 11	Lots 6 & 12
Barley	835	715	590	617	496	376
Wheat Bran	—	150	300	—	150	300
Potato Pulp	—	—	—	200	200	200
SBOM	140	111	86	158	130	100
Dicalcium Phosphate	8	3	3	8	3	3
Limestone	10	14	14	10	14	14
T.M. Salt	5	5	5	5	5	5
Vitamin Premix	2	2	2	2	2	2
Total, Pounds	1000	1000	1000	1000	1000	1000
Calculated Protein, %	13.93	13.91	14.04	13.98	14.01	13.96
Analyzed Protein, %	15.71	15.49	16.28	15.59	15.36	15.20
Acid Detergent Fiber, %	6.87	7.66	8.52	8.63	10.32	11.39
Estimated T.D.N., %	73.13	70.51	67.80	72.53	69.90	67.20
Estimated Cost/cwt., Dollars	2.72	2.57	2.47	2.69	2.55	2.43

**Table 4. Summary of Results, Experiment 138.**

	Barley	15% Wheat Bran	15% Wheat Bran	20% Potato Pulp	15% Wheat Bran 20% Potato Pulp	15% Wheat Bran 20% Potato Pulp
Lot	1	2	3	4	5	6
No. Per Lot	5	5	4	4 <sup>1</sup>	5	5
Initial Wt., Lb.	53	50	52	51	55	50
Final Wt., Lb.	204	202	197	203	195	192
Days on Feed	98	98	98	112	112	112
Av. Daily Gain, Lb.	1.54	1.54	1.48	1.34	1.25	1.27
Feed/cwt. Gain, Lb.	346	350	376	377	376	384
Av. Da. Feed Offered, Lb.	5.30	5.40	5.56	5.05	5.24	4.86
Lb. Gain/Lb. Feed, Lb.	0.29	0.29	0.27	0.27	0.27	0.26
T.D.N./Lb. Gain, Lb.	2.53	2.47	2.55	2.73	1.63	2.58
T.D.N./Lb. Gain Only, Lb. <sup>2</sup>	1.62	1.58	1.64	1.74	1.54	1.56
Backfat, Inches	1.19	1.04	1.04	1.19	1.18	1.07

<sup>1</sup>One animal recovered, not due to treatment.

<sup>2</sup>Corrected to maintenance requirements.

**Table 5. Summary of Results, Experiment 139.**

	Barley	15% Wheat Bran	15% Wheat Bran	20% Potato Pulp	15% Wheat Bran 20% Potato Pulp	15% Wheat Bran 20% Potato Pulp
Lot	1 & 7	2 & 8	3 & 9	4 & 10	5 & 11	6 & 12
No. Per Lot	12	12	12	12	12	12
Initial Wt., Lb.	58	56	56	55	55	55
Final Wt., Lb.	217	216	208	204	188	204
Days on Feed	98	98	98	98	98	98
Av. Da. Gain, Lb.	1.62	1.63	1.55	1.52	1.36	1.52
Feed/cwt., Gain, Lb.	332	343	368	327	348	350
Av. Da. Feed Offered, Lb.	5.39	5.60	5.72	4.95	4.73	5.30
Lb. Gain/Lb. Feed, Lb.	0.31	0.29	0.27	0.31	0.29	0.29
T.D.N./Lb. Gain, Lb.	2.42	2.42	2.50	2.37	2.44	2.36
T.D.N./Lb. Gain Only, Lb. <sup>1</sup>	1.52	1.55	1.59	1.46	1.47	1.45
Backfat, Inches	1.03	1.07	1.07	1.06	1.02	1.09

<sup>1</sup>Corrected for maintenance requirements.

combination with potato pulp required on the average seven and eight per cent more feed per hundred pounds gain for the 15 and 30 per cent bran rations, respectively, when compared to the barley ration.

#### Less Feed Eaten

The most striking aspect of these experiments was the reduction in daily feed consumption by the pigs fed the potato pulp rations. Those lots fed rations containing 20 per cent potato pulp or potato pulp plus 15 per cent bran ate an average of 0.3 pounds of feed per day less than those fed the barley rations. The pigs fed 30 per cent bran in addition to the potato pulp ate only slightly more. When the pulp-bran lots were compared to the lots receiving only bran, the difference in daily intake became even more pronounced. The difference then increased to more than 0.5 pounds per day less feed intake for the pulp-bran lots (5.50 vs. 4.99 and 5.64 vs. 5.08 for the 15 and 30 per cent bran lots, respectively). The animals fed only bran in the ration compensated for the lower energy value by increasing consumption. This effect was not observed with those fed potato pulp. The mean value for T.D.N. per pound gain only, (corrected for maintenance needs) in these experiments was 1.56 pounds. With this value an extra 0.5 pounds of a 70 per cent T.D.N. ration would furnish enough energy for an additional 0.22 pound of gain.

The total digestible nutrient content of the rations were determined by using the average T.D.N. values of 75, 75 and 57 per cent for barley, soybean oil meal and wheat bran, respectively (NRC, 1964; Morrison, 1959). The potato pulp was assigned the value of 72 per cent T.D.N. for balancing rations and calculating efficiencies. The data shows that the T.D.N. required per pound of gain was very similar for all treatments. This requirement for the three rations containing ingredients of known energy value was 2.49 pounds of T.D.N. per pound of gain (maintenance plus gain). The energy required for the three rations containing potato pulp was 2.52 pounds of T.D.N. per pound of gain. This indicated that the assigned value of 72 per cent total digestible nutrients for the potato pulp was approximately the actual value in these experiments.

This energy value was then calculated by using the requirement per pound of gain of the barley ration as the standard. If barley has a T.D.N. value of 75 per cent, potato pulp has a calculated T.D.N. value of  $72.64 \pm 8.07$  per cent. In using this method of determination the assumption was made that the barley had a constant energy value of 75 per cent and that this does not change when used in

different proportions and combinations. Also, all feed that was offered was assumed to have been consumed. If there had been a considerable wastage of feed, this would be reflected as a lower energy value of the calculated ingredient.

Potato pulp, on this basis of determination, was worth 97 per cent of the value of barley when used as an energy source to provide not over 30 per cent of the ration and preferably at 20 per cent or less of the ration.

Using the same method of calculation for bran, it was determined that this feed had a T.D.N. content of  $57.65 \pm 8.06$  per cent as used in these experiments. This agrees very closely with the reported value of 57 per cent (NRC, 1964).

In these experiments neither potato pulp nor wheat bran at the levels fed had a significant effect upon backfat deposition. However, most of the pigs used in these experiments finished with a backfat depth slightly in excess of one inch at 200 pounds liveweight.

#### SUMMARY

These experiments indicate that the addition of 15 per cent wheat bran to pelleted barley rations had no effect on average daily gains, but the pigs did require about 3 per cent more feed per hundred pounds of gain than the control groups. Thirty per cent bran only slightly reduced gains, but increased feed requirements per unit of gain by 10 per cent.

The pigs fed rations containing potato pulp gained 0.17 pounds less per day than those fed no potato pulp. Feed efficiency was similar to that of the basal lots but the pigs ate 0.25 to 0.30 pounds less feed per day.

The pigs fed bran at levels of 15 and 30 per cent of the ration ate more feed per day to compensate for the lower energy value of the ration. This

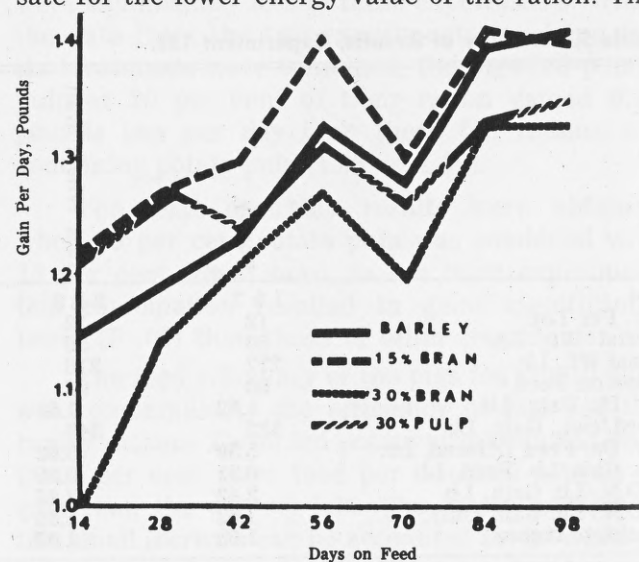


Figure 1. Average Daily Gains, Experiment 136.

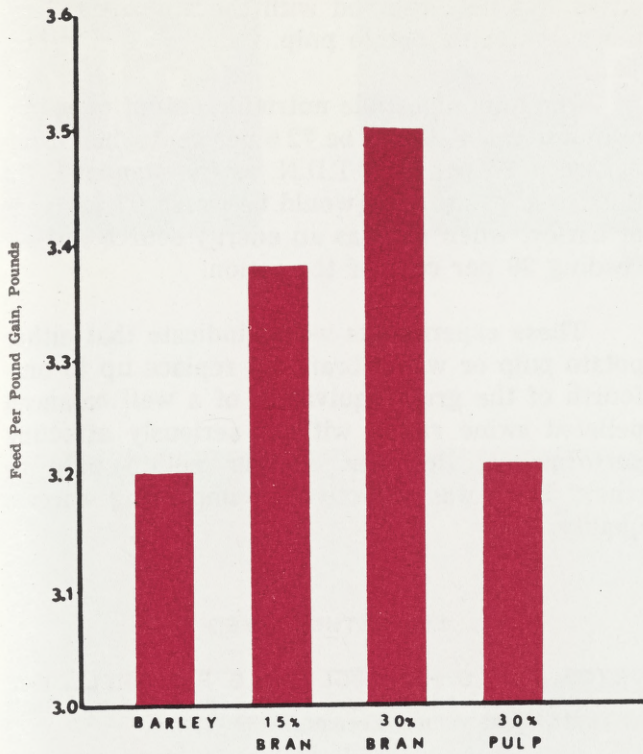


Figure 2. Feed Per Pound Gain, Experiment 136.

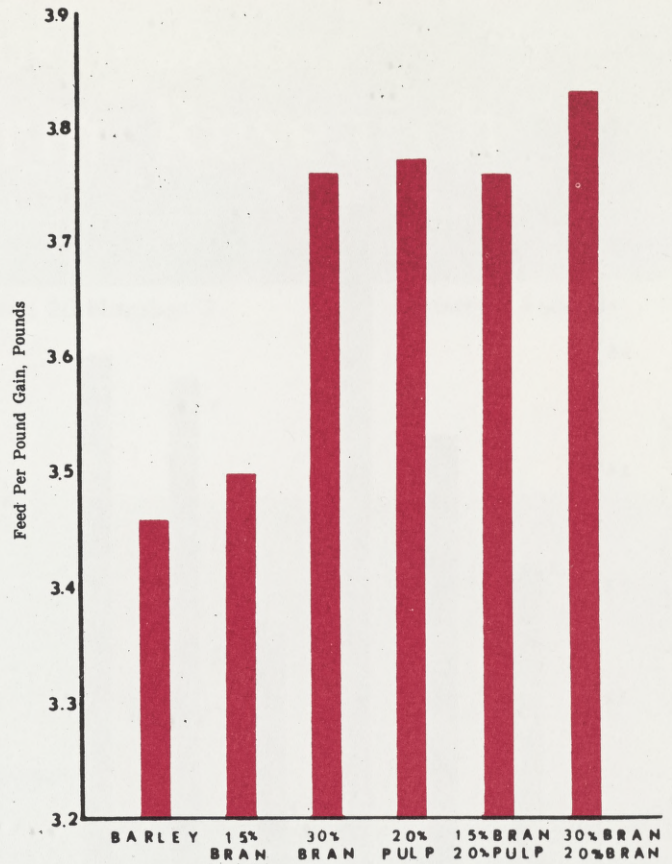


Figure 5. Feed Per Pound Gain, Experiment 138.

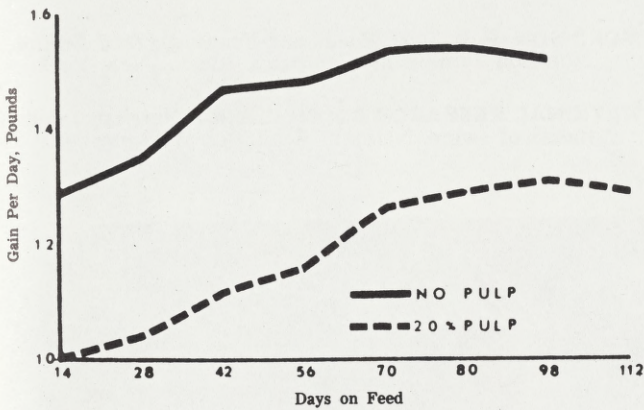


Figure 3. Average Daily Gains, Potato Pulp vs. No Potato Pulp, Experiment 138.

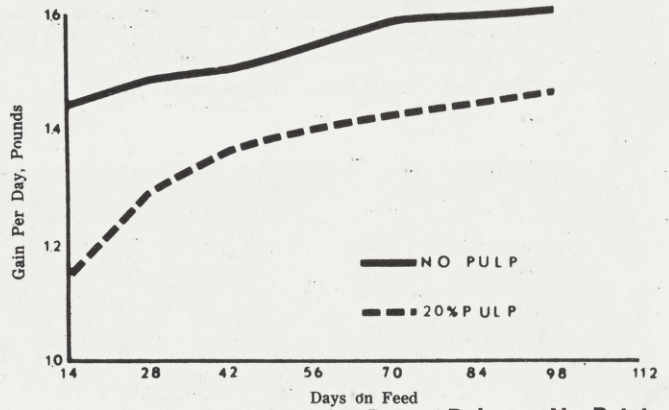


Figure 6. Average Daily Gain, Potato Pulp vs. No Potato Pulp, Experiment 139.

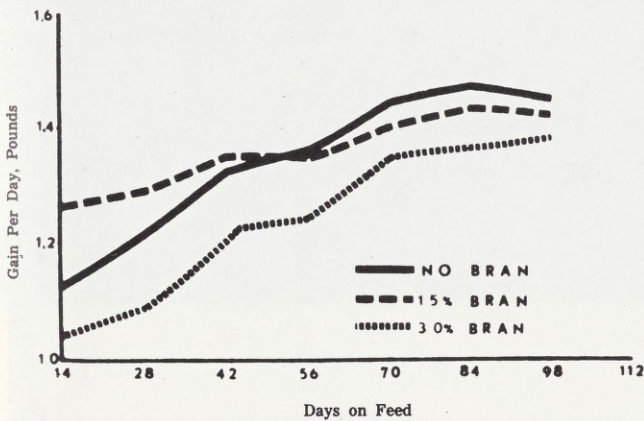


Figure 4. Average Daily Gains, Wheat Bran vs. No Wheat Bran, Experiment 138.

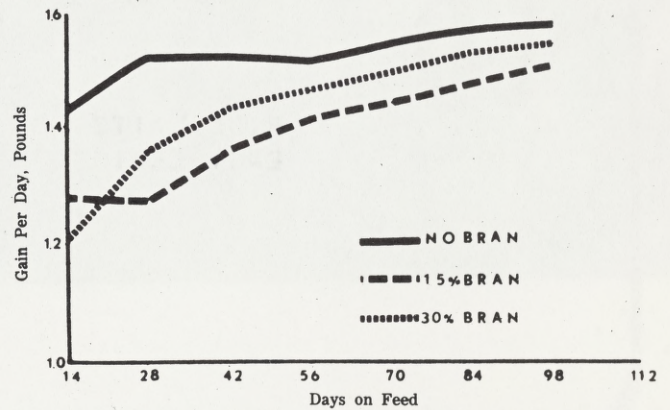


Figure 7. Average Daily Gain, Bran vs. No Bran, Experiment 139.

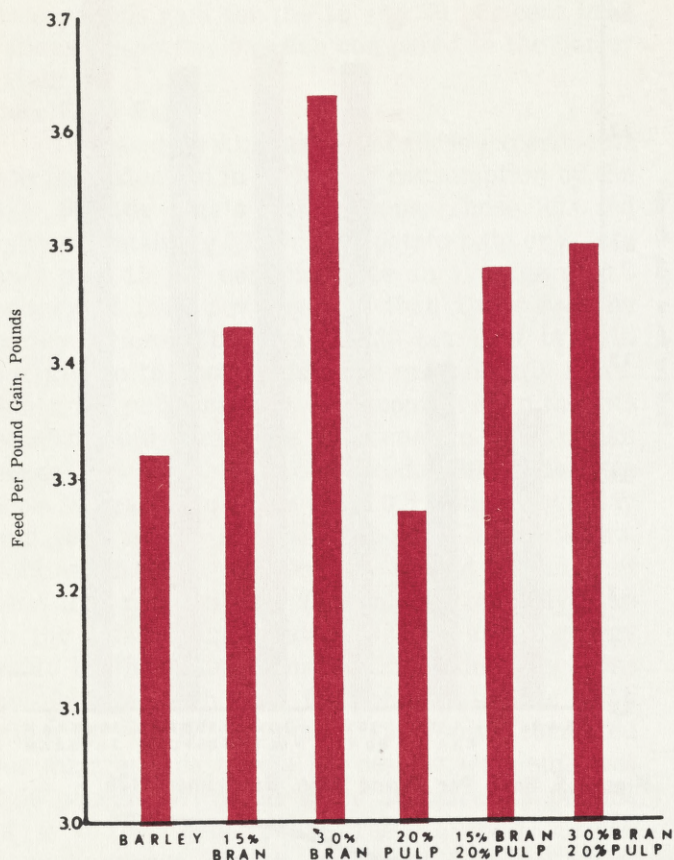


Figure 8. Feed Per Pound Gain, Experiment 139.

effect was not observed with the animals fed rations containing potato pulp.

The total digestible nutrient content of potato pulp was calculated to be 72.6 per cent when using barley at 75 per cent T.D.N. as the standard. On this basis, potato pulp would be worth 97 per cent of barley, when used as an energy source not exceeding 30 per cent of the ration.

These experiments would indicate that either potato pulp or wheat bran can replace up to one-fourth of the grain equivalent of a well balanced pelleted swine ration without seriously affecting performance. However, neither potato pulp or wheat bran was effective in improving carcass quality.

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