Influence of Method of Pelleting on Utilization of Energy from Corn, Wheat Shorts, and Bran

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ABSTRACT

Two experiments were conducted to investigate the effect of double steam-pelleting and dry- *vs.* steam-pelleting on the nutritive value of corn, wheat, bran, and wheat shorts. Steam-pelleting was definitely superior to dry-pelleting on the basis of growth, feed efficiency, and metabolizable energy value for the bran diets but to a lesser extent for diets containing wheat shorts and corn. The results suggest that in the case of wheat bran a substantial improvement in nutritive value can be obtained if this ingredient is preprocessed by steam-pelleting and grinding prior to inclusion in diets which are to be fed as mash, dry-pelleted and crumbled, or steam-pelleted and crumbled. It would appear to be slightly beneficial to preprocess wheat shorts and corn if these ingredients are to be later used in mash diets.

Large quantities of wheat bran and shorts are available, but owing to their low nutritive value in relation to cereal grains they have been used to only a limited extent in commercial poultry and swine rations. If such feed ingredients are to find a major place in the commercial feeding of monogastric animals, their nutritive value must be improved. Cave *et al.* (1) presented evidence to indicate that commercial steam-pelleting would enhance the metabolizable energy (ME) value of fibrous feeds such as wheat bran and wheat shorts.

Along with their relatively low nutritive value, wheat by-products have also been criticized in that they are hard to handle because of their bulky nature and flow characteristics. Steam-pelleting such ingredients before they are offered to the feed trade would help to overcome some of the above criticisms. The feed manufacturer could regrind the material before he incorporates it into rations, in a manner similar to the way in which much of the alfalfa meal and cereal grass is handled today. By such a process the wheat by-products would in many cases receive a double steam-treatment, which may well further enhance their nutritive value.

The purpose of the present study was to treat corn, wheat bran, and shorts in the above described manner to determine the effect of the double steam-treatment on growth, feed efficiency, and their metabolizable energy values. In an attempt to gain information on the chemical *vs.* the physical effects of pelleting, a complete series of diets was dry-pelleted without the use of steam. It was felt the dry-pelleting would give the physical advantages of pelleting but not the chemical effects brought about by steam-treatment.

MATERIALS AND METHODS

Samples of ground corn, wheat bran, and wheat shorts were each thoroughly mixed and then half of the material was subjected to steam-pelleting and reground into mash. The remaining half of the sample was retained in the original mash form. These ingredients will be referred to as processed and unprocessed materials. All test materials were mixed

TABLE I
COMPOSITION OF BASAL DIET

Diet Ingredients	%		%
Ground yellow corn	40.75	Calcium phosphate (20% P)	2.0
Soybean oil meal (50% protein)	50.0	Iodized salt (0.015% KI)	0.4
Stabilized animal tallow	3.0	Vitamin-mineral mix	1.0
Limestone	2.85		
			100.0

Vitamin-Mineral Mix (g./100 kg. of diet)			
Vitamin A, 10,000 USPU/g.	132	Vitamin B_{12}, 19.8 mg./kg.	26.4
Vitamin D_3, 1,650 ICU/g.	132	Procaine penicillin, 22 g./kg.	13.2
Choline chloride (25%)	132	Ethoxyquin, 50%	49.9
Riboflavin, 52.8 g./kg.	49.9	Manganous oxide (56% Mn)	15.4
d-Calcium pantothenate, 70.4 g./kg.	11.0	Zinc oxide (80% Zn)	13.2
Niacin, feed grade	8.8	Copper sulfate (25% Cu)	6.6
		Finely ground corn (to 1 kilo)	

50:50 with a basal diet (Table I) to make up the experimental rations. The experiment was set up in a factorial arrangement, involving three feed ingredients—corn, wheat bran, and wheat shorts; two processing treatments—unprocessed and processed; and three forms of feed—mash, dry pellets (crumbles), and steamed pellets (crumbles).

Steam pelleting was carried out in a commercial pelleting machine where the temperature in the conditioning chamber was maintained at around 90°C. and the feed required around 3–5 sec. to pass through the chamber. Dry pelleting was carried out with a laboratory-type dry pelleter with no steam attachment.

Two experiments were carried out with four replicates of 10 White Leghorn-type cockerel chicks placed on each dietary treatment at 1 day of age for a 4-week experimental period. The first experiment was a simple growth and feed efficiency trial; the second was a duplicate of the first but with ME values determined for the test ingredients. Although the ingredients for the second test were obtained from the same supplier, they were not from the same original batch of grain and thus the growth and feed utilization values give an indication of the repeatability of the results when different samples of the materials are used.

Fecal collections were made every other day during the last 6 days of the second experiment. The feces were immediately placd in a freezer at −29°C. upon collection and then freeze-dried, and the samples for the three collection periods were pooled before being analyzed. Feed and feces samples were analyzed for nitrogen, moisture and gross energy in order that nitrogen corrected ME values could be determined.

To calculate ME for the various test materials for the three forms of feed, the basal diet was fed as mash and as steamed and dry crumbles. It was assumed in calculating the ME values of the test materials that the changes in ME caused by pelleting the basal diets alone were the same as when they were diluted with the test ingredients.

RESULTS AND DISCUSSION

The growth and feed efficiency results in Table II indicate that for wheat bran, steam-pelleting was superior to dry-pelleting, and diets made with processed bran were superior to those made with unprocessed bran. There appeared to be only a slight advantage for steam-pelleting over dry-pelleting of corn and shorts. Little or no change could be attributed to the double steam-pelleting treatment as compared to single steam-pelleting any of the materials on the basis of these criteria.

TABLE II

EFFECT OF DRY- AND STEAM-PELLETING AND DOUBLE PELLETING ON THE UTILIZATION OF WHEAT BRAN, WHEAT SHORTS, AND CORN

		Average Weight		Feed/Gain	
		Unprocessed	Processed	Unprocessed	Processed
		g.	g.		
Bran	Mash	246± 7.4[a]	291±10.3	2.82±0.04	2.62±0.12
	Dry-pelleted	309± 6.1	334± 9.2	2.33±0.03	2.15±0.07
	Steam-pelleted	335± 5.7	336± 5.7	2.09±0.06	2.07±0.03
Shorts	Mash	277±10.6	291±11.0	2.39±0.09	2.41±0.01
	Dry-pelleted	329± 5.2	339± 5.1	2.00±0.04	1.97±0.02
	Steam-pelleted	338± 4.6	343± 5.5	2.03±0.01	1.92±0.06
Corn	Mash	276± 5.2	290±12.5	2.24±0.01	2.25±0.04
	Dry-pelleted	294± 9.7	311±10.5	1.85±0.04	1.86±0.04
	Steam-pelleted	309±12.1	328± 5.0	1.82±0.06	1.85±0.04

[a] Standard deviation.

It is well established that there is not necessarily a good correlation between growth and feed efficiency on the one hand and ME on the other. It was therefore decided to repeat the above experiment and include ME determination as an added criterion.

TABLE III

EFFECT OF DRY- AND STEAM-PELLETING AND DOUBLE PELLETING ON GROWTH, FEED EFFICIENCY, AND THE METABOLIZABLE ENERGY VALUE OF WHEAT BRAN, SHORTS, AND CORN

		Average Weight		Feed/Gain		Metabolizable Energy[a] Test Material	
		Unprocessed	Processed	Unprocessed	Processed	Unprocessed	Processed
		g.	g.			kcal./g.	kcal./g.
Bran	M[b]	164± 7.3[c]	259±1.6	2.56±0.08	2.37±0.03	1.46±0.06	1.70±0.03
	DP	288± 8.1	296±5.1	2.30±0.05	2.16±0.14	1.48±0.02	1.85±0.04
	SP	303± 8.7	294±1.3	2.15±0.13	2.09±0.03	2.05±0.05	2.50±0.05
Shorts	M	233±11.3	267±5.0	2.11±0.02	2.01±0.01	2.10±0.09	2.16±0.04
	DP	324± 3.4	318±6.6	2.00±0.08	1.92±0.02	2.09±0.05	2.13±0.03
	SP	303± 6.1	333±8.0	2.06±0.05	2.04±0.03	2.20±0.01	2.21±0.02
Corn	M	231± 4.9	248±5.3	2.02±0.09	2.01±0.03	3.45±0.02	3.51±0.02
	DP	258± 3.7	269±7.0	1.97±0.01	2.01±0.05	3.58±0.02	3.55±0.02
	SP	314±13.4	183±2.1	1.93±0.03	1.96±0.01	3.61±0.01	3.61—0.02

[a] Nitrogen corrected values, dry weight basis.
[b] M = mash; DP = dry-pelleted; SP = steam-pelleted.
[c] Standard deviation.

The weight and feed efficiency data obtained in experiment 2 (Table III) agreed, by and large, with those obtained in the first experiment. Steam-pelleting increased the ME content of the unprocessed bran (1.46 *vs.* 2.05 kcal./g.), but dry-pelleting appeared to have little effect on the ME value (1.46 *vs.* 1.48 kcal./g.). Steam-pelleting the processed bran resulted in a higher ME value than that of the steam-pelleted unprocessed bran (2.50 *vs.* 2.05 kcal./g.). Steam-pelleting resulted in a small increase in the ME of corn and to a lesser extent for wheat shorts. Dry-pelleting had no effect on the ME of wheat shorts but produced marginal improvements with corn.

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Literature Cited

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