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# The Influence of Whole Wheat, Bran and Shorts on Body Weight and Feather Growth in Chicks

F. E. Mussehl

C. W. Ackerson

M. J. Blish

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COLLEGE OF AGRICULTURE      UNIVERSITY OF NEBRASKA  
AGRICULTURAL EXPERIMENT STATION  
RESEARCH BULLETIN 119

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LINCOLN, NEBRASKA  
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# The Influence of Whole Wheat, Bran, and Shorts on Body Weight and Feather Growth in Chicks

F. E. MUSSEHL, C. W. ACKERSON, and M. J. BLISH

Wheat has long been recognized as one of the most valuable feedstuffs for all types of poultry. In the wheat-producing areas much wheat is fed as grain largely because of its availability on the farms and its high palatability. Most of the wheat produced in the United States is, however, grown primarily for the manufacture of flour, and large quantities of milling by-products are available for animal feeding. Approximately 4½ million tons of bran, shorts, and low-grade flour are available each year.

The practical question asked by poultry raisers is, to what extent can these milling by-products be combined successfully in poultry rations? The answer to this question can, of course, be developed only from research work, and the results of certain experiments which should be helpful are presented in this publication.

## COMPOSITION AND NUTRITIVE VALUES

The wheat kernel consists of three rather distinct parts, each of which has characteristic chemical and physical properties. The outer coats, or bran layers, comprise about 16 per cent of the weight of the kernel, the endosperm about 82 per cent, and the germ about 2 per cent.

In modern milling practice, the wheat is first cleaned and moistened to toughen the bran. It then passes between pairs of steel rollers, the first pairs of which are corrugated to increase crushing efficiency. These rollers gradually break the kernels into smaller pieces, flatten the bran layers, and separate them from the middlings. The flour is removed as made available from each grinding by means of bolting cloths.

In the milling process about 72 per cent of the original wheat is converted into flour, about 11 per cent is recovered as bran, 11 per cent as shorts, and 5 per cent as "red dog" flour. The bran and shorts are most commonly used in poultry rations, though low-grade flour is sometimes used in fattening formulas.

Wheat and its products are valued for their protein, vitamins, ash, and energy-producing nutrients. Notwithstanding the common use of wheat and its products in poultry rations, relatively little research work has been done on their biological value in poultry rations.

### Protein Values

Considerable research on the nutritive value of wheat proteins has been done with laboratory animals other than chicks. Osborne and Mendel (6) pioneered in this research with the conclusion that wheat proteins rank well toward the top of cereal products in biological value. Murphy and Jones (4) concluded that wheat-bran proteins are particularly high in the nutritionally essential amino acids: arginine, lysine, tryptophane, tyrosine, and cystine. They state that "When patent wheat flour was used as the

sole source of protein in a similar ration, rats grew during the first 15 to 16 weeks at a rate only one-half to two-thirds of that of the rats receiving bran. Normal reproduction was not, however, obtained on the bran ration."

Jones and Gersdorff (2) studied the amino-acid distribution of the proteins of wheat bran and found them characterized by a high content of the basic amino acids. It is these amino acids which are often the limiting factor when rations made up of certain cereal products are used.

Tully (10) compared red durum wheat with bran and middlings and combinations of these by-products, with the conclusion that ground durum wheat is a satisfactory poultry feedstuff. Equally good results were obtained in rations for mature birds when wheat bran and middlings were used to replace half the wheat. The latter substitutions did not, however, give good results in chick rations. Poley (7) studied the value of common protein concentrates as supplements to wheat and wheat-milling products and concluded that the protein values of wheat and its milling by-products differ significantly.

#### Vitamin Values

Wheat was early recognized as a good source of the antineuritic vitamin B<sub>1</sub> or thiamin. Daniel and Munsell (1) have evaluated all published research work on vitamin B<sub>1</sub> values which they express as follows in international units per 100 grams of material (values for shorts and middlings are not given):

Wheat .....	150
Bran .....	200
Germ .....	1200

Wheat is also known to carry a small amount of carotene, the precursor of vitamin A, and relatively larger amounts of vitamin G. Vitamin G values are expressed by Daniel and Munsell (1) as 80 units per 100 grams for whole wheat and 300 units for wheat germ.

Wheat germ is one of the richest sources of the vitamin E factor. In ordinary milling practice, most of the wheat germ goes into the shorts. Vitamin E requirements for normal growth of chicks have not yet been determined. Wheat-germ oil is available commercially, and is being promoted as a source of the vitamin E factor.

#### Ash Constituents

The ash content of the milling by-products is appreciably higher than that of wheat. Wheat and its products are especially high in phosphorus and the by-products contain appreciable amounts of manganese, an element which has received much attention recently because of its perosis-preventing quality.

Sherwood and Couch (8) reported that the substitution of 20 per cent of gray shorts of wheat for a like amount of corn or kafir was effective in reducing perosis or slipped-tension disorder. Skinner and Peterson (9) report manganese values in parts per million for representative wheat products as follows: wheat, 54.5; bran, 140.4; standard middlings, 155.8.

EXPERIMENTAL RESULTS

As a basal ration for our experiments we used feedstuffs which are commonly used with wheat products in poultry rations. Details of the rations are listed in Figures 1, 2, 3, and 4. The chemical composition of the wheat and milling by-products used in our experiments are given in Table 1.

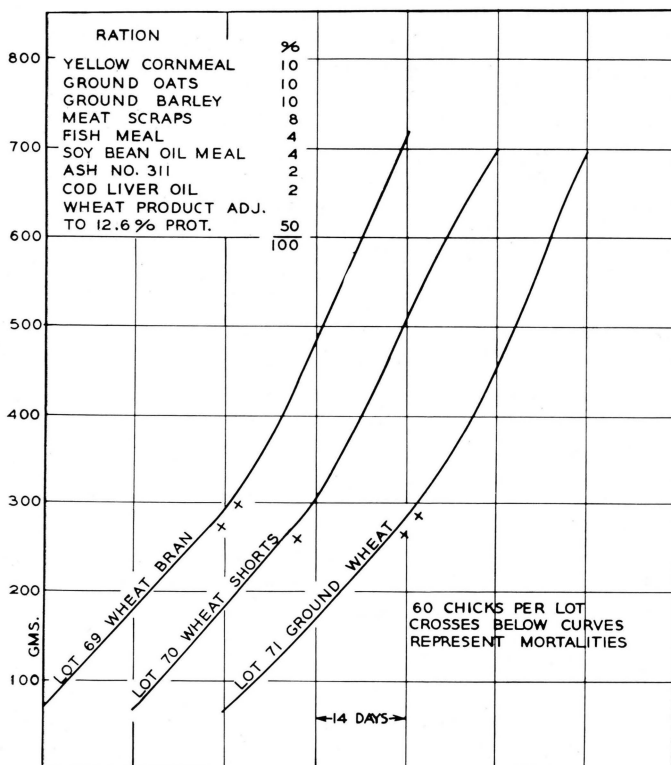


FIGURE 1

TABLE 1.—Chemical composition of wheat and milling by-products as used in our experiments.

	Protein	Fiber	Fat	N-Free extract	Ash	Water
	%	%	%	%	%	%
Wheat	12.3	2.4	2.1	70.3	2.0	10.9
Bran	15.2	9.4	4.8	53.9	6.0	10.7
Shorts	16.6	6.4	4.6	56.6	4.6	11.0



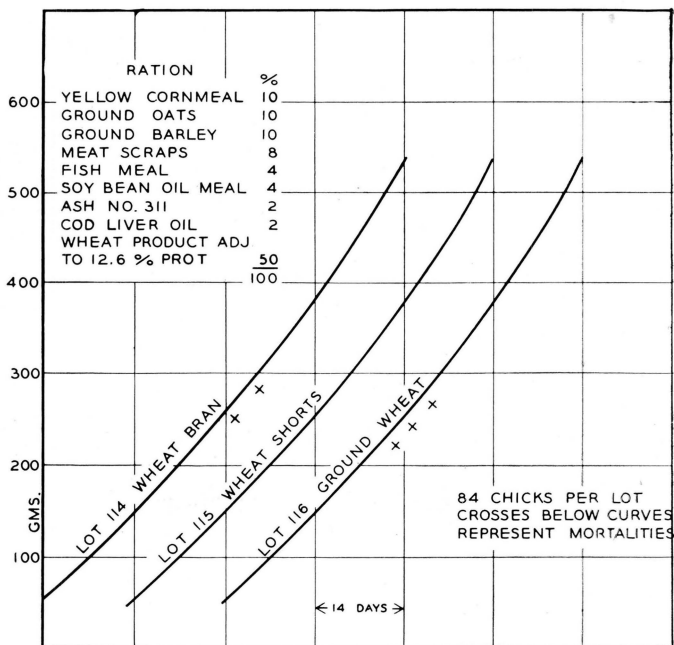


FIGURE 2

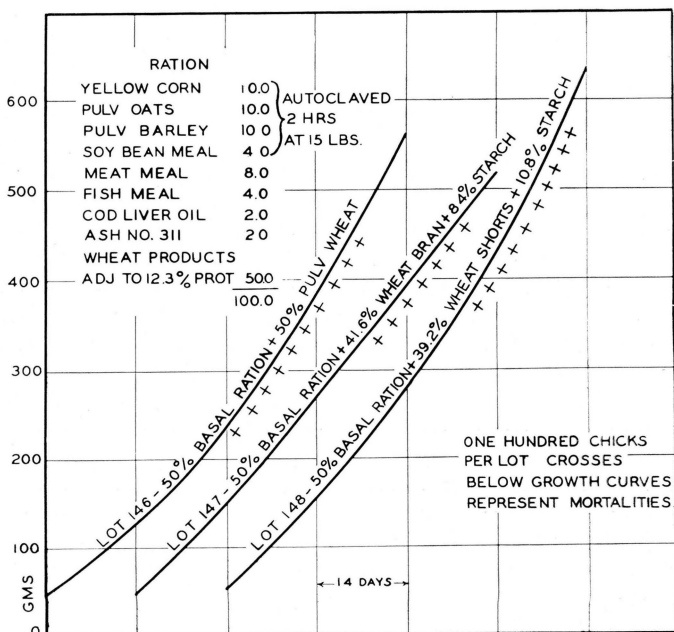


FIGURE 3

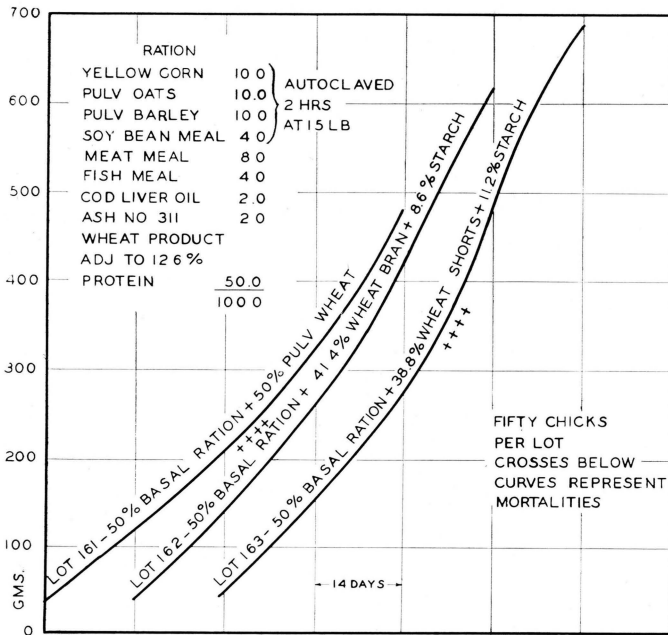


FIGURE 4

Chicks of the same age and general genetic background were used for parallel groups in each experiment. Electric brooders were used to provide suitable temperature conditions, and other environmental factors affecting growth were under good control. To assure selection of normal chicks of inherently good vigor, chicks were selected for the experiment when five or eight days old.

Lots 69, 70, and 71 consisted of White Rocks, which were eight days old at the beginning of the experiment. Lots 114, 115, and 116 were five-day-old White Leghorns. Each chick was identified with a wing band, and sex determinations were made at the end of the experimental period. Rations were kept constantly before the chicks in clean feeders. Tap water was also provided.

The first two series of experiments were planned to answer questions on the relative growth-promoting values of the proteins of whole wheat, bran, and shorts. All of the wheat products used were derived from the same sample of wheat. Adjustments were made with cornstarch so that all the rations in each series contained the same quantity of protein.

The chicks grew satisfactorily, and there was no evidence of protein, vitamin, or mineral deficiencies. Feathering was very satisfactory, and several experienced observers rated the lots as entirely normal.

Differences in the rate of growth of the chicks in the two series of experiments as summarized in Table 2 are due to breed and seasonal factors. Extremely warm weather during the last half of the second experiment (Lots 114, 115, and 116) affected the growth rate, but all lots in each experiment were subject to the same environmental factors.

TABLE 2.—*Growth-rate data for duplicate Experiments I and II (Figs. 1 and 2), comparing bran, shorts, and ground wheat as sources of protein for growing chicks.*

Lot No.	Variable	No. chicks	Deaths	Weight	28-day weight	56-day weight
				at start		
				g.	g.	g.
EXPERIMENT I						
69	Wheat bran	60	2	64	298	717±10
70	Wheat shorts	60	1	64	305	701±10
71	Ground wheat	60	2	65	284	691±8
EXPERIMENT II						
114	Wheat bran	84	2	56	258	534±8
115	Wheat shorts	84	0	56	258	538±7
116	Ground wheat	84	3	57	255	547±7

These duplicated experiments with relatively large numbers of chicks in each lot indicate no significant difference in the utilization of the proteins of ground wheat, bran, and shorts when used to contribute 29 per cent of the protein of the ration.

Daniel and Munsell (1) reported differences in vitamin-B values of wheat and its by-products. In the following experiments we investigated some of these differences, using the same basal ration except that the yellow corn, oats, barley, and soybean meal were autoclaved for two hours at 15 pounds of pressure. This treatment quite completely destroys the antineuritic factor ( $B_1$ ) and may reduce or completely destroy other parts of the B complex.

To the autoclaved basal ration were added the wheat products as indicated in Figures 3 and 4. The floors of the brooding units were covered with hardware cloth for this series of experiments to prevent coprophagy, previous experiments in our laboratory having indicated that this is a particular problem when vitamin-B deficient rations are used. To insure a sufficient supply of vitamins A and D, two per cent of U. S. P. cod-liver oil was included in the rations after the basal ration was autoclaved. Direct sunshine was also provided all lots in a sun porch attached to each brooding unit.

In the third and fourth series of experiments very significant differences in the rate of feathering of the chicks in the three lots were observed. The ground-wheat lot (No. 146) was poorly feathered, the shorts lot (No. 148) was intermediate, and the bran lot (No. 147) significantly the best

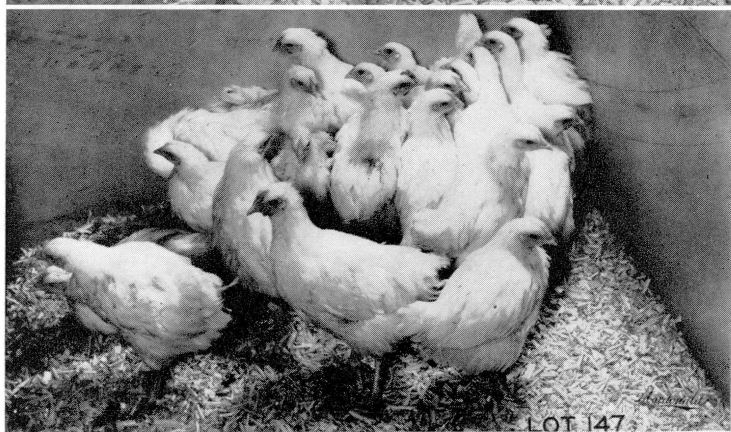


FIG. 5.—Lots 146, 147, 148, at eight weeks of age. Differences in feathering are apparent.

in both experiments. The differences were so striking that photographs were taken when the chicks were eight weeks old. Figure 5 shows Lots 146, 147, and 148 respectively. Lots 161, 162, and 163 showed similar differences.

It is apparent that some factor essential to normal feather growth was destroyed when part of the basal ration was autoclaved. It is not probable that this factor was inorganic, since the original unautoclaved rations failed to express these differences in feather-growth quality. The significant factor was, therefore, apparently organic in nature. It is found in greater concentration in the bran layers than in other parts of the wheat kernel. Chicks receiving wheat shorts grew more rapidly, but feathering was not as normal as in the bran lots. Apparently that part of the wheat kernel which goes to make shorts has a higher concentration of growth-promoting factors, whereas the bran layers are richer in the feather-growth principle. Growth data for Experiments III and IV are given in Table 3.

TABLE 3.—*Growth data for duplicate Experiments III and IV (Figs. 3 and 4), comparing ground wheat, bran, and shorts as sources of protein for growing chicks.*

Lot No.	Variable	No. chicks	Deaths	Weight at start	28-day weight	56-day weight
				g.	g.	g.
EXPERIMENT III						
146	Ground wheat	100	10	55	234	567±13
147	Wheat bran	100	7	56	268	520±12
148	Wheat shorts	100	10	55	283	644±13
EXPERIMENT IV						
161	Ground wheat	50	4	51	204	481±14
162	Wheat bran	50	0	52	262	619±14
163	Wheat shorts	50	4	52	276	699±16

## CONCLUSIONS

The proteins of the entire wheat kernel and of the bran and shorts are apparently utilized with equal efficiency by growing chicks when used with a base of corn, barley, oats, meat scraps, fish meal, and soybean meal. The relatively higher protein levels of bran and shorts, as compared to ground wheat, should be considered by the poultry producer in deciding which product or products can be used with greatest economy.

A good concentration of a feather-growth factor is found in wheat bran. Other common feedstuffs carry the same essential, and the amount of bran which should be used in poultry rations will depend upon price relationships and certain well recognized palatability factors. Our experiments indicate that as much as 40 per cent of bran can be used in chick rations with good results.

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