UNIVERSITY OF IDAHO
College of Agriculture

BARLEY

A Valuable Feed for Egg Production

C. F. Petersen and C. E. Lampman

IDAHO Agricultural Experiment Station

Bulletin No. 238
July 1955

Pointers on the Use of Barley as a Poultry Feed

EXPERIMENTS were conducted over a 3-year period to determine the value of ground barley in laying rations. The Idaho Experiment Station strain of Single Comb White Leghorn pullets was used in all trials. Based on the data obtained during the 3 years, it is concluded that:

1. High levels of barley can be used successfully in rations for egg production without reducing palatability.

2. Barley can be used more successfully at high levels in the mash portion of the feed because it is not neccessary to accustom the birds to it.

3. A laying mash which contained only barley (63 percent) as the grain portion was equal to various combinations of grains including rations in which corn supplied over one-half the grain supplement.

4. The high barley mash promoted excellent egg production, egg size, body weight, and feed efficiency.

5. Since barley contains 6 percent or more fiber, an all-barley mash cannot be considered a high-energy ration.

6. Barley could be used to a greater extent in laying mashes since it results in lower feed and production costs.

BARLEY

A Valuable Feed for Egg Production

C. F. PETERSEN AND C. E. LAMPMAN*

BARLEY is produced in considerable volume in Idaho and other western states and is generally available to the feed and poultry industries at a cost somewhat below that of other grains. The information obtained in these studies should, therefore, prove of definite benefit. Barley can be used to advantage in compounding laying rations to take advantage of locally produced feed. This will result in reduced feed costs, decreased egg costs and a greater opportunity for profitable egg production, especially during years of narrow profit margin.

Barley is generally considered of lower feeding value than other grains for poultry. It is also more difficult to encourage birds to consume whole barley readily. Yet the average composition of barley does not differ greatly from that of other grains. This is noted in Table 1, in which is listed the approximate composition of barley, corn, wheat, and oats. The major differences are that oats contains a very high level of fiber compared to the other three grains and the fiber level of barley is approximately three times that of corn. Corn also differs in that it contains carotene, a source of vitamin A.

The difference in fiber content is primarily responsible for the variability of one nutritional requirement which, until recent years, has received little attention in poultry nutrition. This requirement is for energy which is supplied primarily by carbohydrates and fats and by surplus proteins. The more fiber a feed contains, the less energy present in that feed. Recent data from the Texas Experiment Station by Fraps (1) give energy values for the various grains as follows: corn, 1145 calories per pound; wheat, 1024 calories per pound; barley, 811 calories per pound; and oats, 760 calories per pound.

* Associate Poultry Husbandman and Head, Department of Poultry Husbandry, respectively.

Table 1. Approximate composition of common grains

Nutrient	Barley	Corn	Wheat	Oats
Protein (percent)	9.7	8.9	9.9	9.0
Fat (percent)	2.2	3.9	2.0	5.4
Fiber (percent)	6.2	2.0	2.7	11.0
N. F. E. (percent)	68.7	68.9	72.7	61.1
Ash (percent)	2.2	1.3	1.9	3.7
Calcium (percent)	0.06	0.02	0.05	0.09
Phosphorus (percent)	0.41	0.27	0.29	0.43
Iron (percent)	0.0068	0.0020	0.0069	0.0080
Manganese (mg. per lb.)	7.8	2.3	27.7	19.2
Copper (mg. per lb.)	5.0	0.9	4.4	2.4
Carotene (mg. per lb.)	.....	1.33	.....	.....
Thiamin (mg. per lb.)	1.8	1.7	2.2	2.9
Niacin (mg. per lb.)	20.0	9.8	26.8	8.2
Riboflavin (mg. per lb.)	0.6	0.5	0.5	0.4
Pantothenic acid (mg. per lb.)	3.3	2.6	5.2	6.8
Productive energy (calories per lb.)	811	1145	1024	760

Titus and Godfrey (2) found that both scab barley and normal barley were equal to corn when fed at levels of 30 and 38 percent of all-mash rations as measured by body weight, livability, and egg production. The ration containing corn resulted in more efficient production of eggs. When fed to Rhode Island Reds, only 87 percent as much feed was required with the corn ration as with barley to produce a dozen eggs. Ten percent less feed was required with corn when fed to Single Comb White Leghorns.

A more recent comparison of corn and barley in an all-mash feeding program has been reported by Peterson and Zweigart (3). A high-energy ration containing corn as the only grain addition was compared to a similar diet in which the grain portion was supplied by an equal amount (68 percent) of ground barley. The barley ration was fed as regular mash and also as pellets. The egg production obtained during a 24-week period was the same for the barley and corn rations which were fed as loose mash. The pelleted barley ration permitted slightly higher production. Feed efficiency, as measured by pounds of feed to produce one dozen eggs, was similar for all groups.

Purpose

The purpose of the experiments reported here was to determine the effectiveness of high intake levels of barley in the diet of hens for egg production and whether or not a mash containing barley as the only grain addition would prove satisfactory from the standpoint of palatability and performance.

Barley and Oats Compared

This study was conducted during the 1951-1952 laying year to determine the effectiveness for egg production of laying mashes containing either 50 percent ground barley or 50 percent ground oats. Wheat bran at 15 percent completed the grain portion of the two mashes. These two rations were compared to one ration containing 25 percent ground yellow corn and 25 percent ground barley and another mash composed of a mixture of five grain, or grain by-product, sources. The various mashes contained approximately 20 percent protein and were fed with equal parts whole scratch grain composed of wheat 50, oats 25, and barley 25 percent. The scratch feeds were fed in separate hoppers once each day in late afternoon. The experimental rations used in this and subsequent experiments are given in Table 2.

Each ration was fed to duplicate pens of 70 Single Comb White Leghorn pullets. No culling was done during the course of the experiment but all dead or emaciated birds were removed and posted to determine cause of death. The experiment was started on October 1, 1951 when the pullets were about 6 months of age, and continued for a period of 10 calendar months. All pens were in one insulated building which was equipped with both fan and gravity ventilation. The temperatures during the winter months ranged from 45° to 50° F. in pens

Table 2. Composition of experimental rations

Year	1951-52				1952-53				1953-54			
Ration No.	1	2	3	4	1	2	3	4	1	2	3	4
Pen No.	2-7	3-8	1-6	4-9	1-6	2-7	3-8	4-9	1-6	2-7	3-8	4-9
Ingredient %												
Wheat bran	15.0	15.0	15.0	15.0	15.0	.....	15.0	.....	15.0	15.0	15.0	.....
Wheat shorts	.....	.....	.....	12.0	.....	.....	.....	.....	.....	.....	.....	.....
Ground oats	50.0	.....	.....	10.0	15.0	.....	.....	.....	15.0	15.0	15.0	.....
Ground oat hulls	.....	.....	.....	.....	.....	12.0	.....	.....	.....	.....	.....	.....
Ground corn	.....	.....	25.0	20.0	18.0	.....	.....	.....	16.7	.....	33.5	.....
Ground barley	.....	50.0	25.0	10.0	15.0	50.0	48.0	63.0	16.8	33.5	.....	63.2
Dehydrated alfalfa meal	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Herring fish meal	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Meat meal	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	7.5	7.5	7.5	7.5
Soybean oil meal	17.0	17.0	17.5	16.0	18.0	20.0	18.0	18.0	15.0	15.0	15.0	15.0
Oyster shell flour	2.5	2.5	2.5	2.5	2.5	1.5	2.5	1.5	2.0	2.0	2.0	1.3
Steamed bone meal	1.0	1.0	1.0	1.0	2.0	3.0	2.0	3.0	2.0	2.0	2.0	3.0
Iodized salt	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Riboflavin concentrate	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
A and D oil	0.3	0.3	0.3	0.3	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Manganese	+	+	+	+	+	+	+	+	+	+	+	+
Calories per pound	642	668	755	728	714	622	661	714	712	656	768	714
Percent protein	19.5	19.5	19.5	19.6	19.9	19.8	20.0	19.7	19.9	20.1	19.7	19.7
Percent fiber	9.4	6.7	5.9	6.8	7.1	9.6	7.2	6.7	6.7	7.4	6.0	6.1
Percent calcium	2.26	2.28	2.31	2.25	2.33	2.25	2.33	2.24	2.27	2.27	2.26	2.27
Percent phosphorus	1.12	1.09	1.16	1.18	1.12	1.14	1.15	1.14	1.16	1.17	1.14	1.19

Table 3. The influence of different grains in laying mashes upon egg production, egg size, body weight, livability, feed consumption and feed efficiency 1951-1952

Ration No.	1			2			3			4		
Pen No.	2	7	Av.	3	8	Av.	1	6	Av.	4	9	Av.
Percent barley	.....	.....	.....	50	50	50	25	25	25	10	10	10
Percent corn	.....	.....	.....	.....	.....	.....	25	25	25	20	20	20
Percent oats	50	50	50	.....	.....	.....	.....	.....	.....	10	10	10
Percent bran	15	15	15	15	15	15	15	15	15	15	15	15
Original number birds	70	70	140	70	70	140	70	70	140	70	70	140
[1]Av. percent egg production	62.5	65.0	63.7	65.2	64.2	64.7	65.2	62.5	63.8	66.8	64.2	65.5
Av No. eggs per bird	189	196	192	197	194	195	197	189	193	202	194	198
Av. egg weight (oz. per dozen)	25.2	25.3	25.3	24.9	25.0	24.9	25.1	25.5	25.3	25.2	25.2	25.2
Av. hen weight—lb.—October	4.3	4.2	4.2	4.2	4.2	4.2	4.2	4.1	4.2	4.2	4.1	4.2
July	4.8	4.9	4.9	4.7	4.9	4.8	4.8	4.8	4.8	4.8	4.8	4.8
Percent mortality	10.0	18.6	14.3	8.6	12.9	10.7	22.9	17.1	20.0	11.4	15.7	13.6
Percent mortality less leukosis	5.7	15.7	10.7	4.3	11.4	7.9	15.7	11.4	13.6	2.9	11.4	7.1
Total feed per bird (lb)	85.6	91.1	88.3	87.2	86.1	86.6	86.3	84.5	85.4	87.9	85.7	86.8
Percent mash consumed	52	49	50	54	50	52	49	51	50	53	52	53
[2]Percent scratch consumed	48	51	50	46	50	48	51	49	50	47	48	47
Av. actual caloric intake (calories per lb.)	773	773	773	781	781	781	829	829	829	811	811	811
Percent barley consumed of total ration	12.1	12.8	12.4	38.4	37.5	38.0	25.0	25.0	25.0	17.0	17.2	17.1
Av. lbs. feed per dozen eggs	5.4	5.6	5.5	5.3	5.3	5.3	5.3	5.4	5.3	5.2	5.3	5.3

[1]There was no significant difference in egg production as determined by analysis of variance. F = 0.77. The significance levels for F were 4.06 and 2.73 at the 1 and 5 percent levels respectively.

[2]Scratch mixture: wheat 50, oats 25, barley 25.

equipped with fan ventilation. Pens equipped with gravity ventilation fluctuated slightly more. The minimum temperature recorded for these pens was 35° F. when the outside temperature was 19° below zero. Built-up floor litter was started in September and removed at the completion of the experiment. The birds were trapnested on a 3-day per week basis to determine egg production for individual hens. Average feed consumption data of hens by individual pens were obtained at monthly intervals and body weight and average egg weight for individual birds obtained during the months of October, December, March, and June.

The summarized data for this experiment are presented in Table 3. The various sources of grains in the mash did not influence egg production, egg size, body weight, or livability. Ration 1 (50 percent oats) and ration 2 (50 percent barley) were equally as effective as ration 3 with 25 percent corn and 25 percent barley or ration 4 which contained a mixture of barley, corn, oats, wheat bran, and wheat shorts. As summarized in the foot note of Table 3, a statistical analysis of egg production data indicates that the differences which occurred were not significant.

Ration 1, which contained a high percentage of oats, was the least efficient. It required an average of 5.5 pounds feed to produce one dozen eggs compared to 5.3 pounds for the other 3 rations. Since oats contain a high percentage of fiber (average 11.0 percent), it would be expected to be less efficient than the other diets. Also, as noted in Table 2 of ration compositions, ration 1 contained an average of only 642 calories per pound of feed. The barley ration (No. 2) was only slightly higher, containing 668 calories. All birds were fed the same scratch whole grain mixture of 50 parts wheat, 25 parts barley, and 25 parts oats. This grain mixture contains 905 calories per pound, which is somewhat higher than any of mash formulas used. Considering this, the average actual caloric intake of the 4 rations was 773 (ration 1), 780 (ration 2), 830 (ration 3), and 811 (ration 4) per pound of feed consumed. These differences are not great and are all lower than what is accepted at the present time as an adequate caloric intake level of 900 per pound. Had the experimental birds been subjected to extreme cold weather, it is possible that differences in the energy content may have influenced feed efficiency and egg production. It is also possible that none of the rations would have proven adequate.

The average amount of barley consumed per bird varied from 12 percent of total feed with ration 1 to a high of 38 percent with ration 2, in which the mash portion contained 50 percent barley. As noted previously, this level of barley was consumed without reducing egg production or feed efficiency and did not appear to be unpalatable to the birds.

All-Barley Mash Fed in 1952-1953

This experiment was conducted to determine if barley could be used satisfactorily as the only grain addition to a mash and also to determine the effect of additional fiber in a mash containing 50 percent barley. This was accomplished by the addition of 12 percent oat hulls (30 per-

cent fiber) to ration 2 and 15 percent wheat bran to ration 3. The all-barley mash (ration 4) contained 63 percent barley. Ration 1 contained a combinations of wheat bran, oats, barley, and corn. The rations are given in Table 2.

The same strain of White Leghorn birds and the same procedure was used as for the previous year's study. The experiment was conducted for a period of 9 calendar months.

The results of this trial were complicated somewhat by several outbreaks of intestinal coccidiosis in all pens, which resulted in mortality considerably higher than had generally been experienced during recent years with the Experiment Station flock.

As occurred the previous year, there were no marked differences in any production factors irrespective of the amount of barley fed or the fiber content of the various rations. Although there were no significant differences in egg production, highest egg production was obtained with ration 4 containing 63 percent barley in the mash. Production for birds fed ration 1 was below that of rations 2 and 3, primarily because of low production in one of the duplicate pens. The results are summarized in Table 4.

More variation occurred in feed efficiency between diets than other factors. This was due primarily to differences in production since ration 1 contained considerably less fiber and more calories per pound than ration 2, yet was the least efficient. Ration 2, containing 12 percent oat hulls, contained 9.6 percent fiber and only 622 calories per pound. This ration ranked next to ration 1, requiring an average of 5.9 pounds of feed to produce a dozen eggs. Rations 3 and 4, containing either 48 or 63 percent barley, resulted in values of 5.6 pounds of feed per dozen eggs. Mash consumption was slightly low for all pens, due primarily to the disease problems experienced.

The amount of barley consumed by laying hens varied in this experiment from 20.6 percent of the total feed intake to 43.4 percent. The high level occurred when the hens were fed ration 4 in which the mash portion contained 63 percent barley and no other grain. These figures for barley intakes would have been even higher had greater mash consumption been obtained. The high level of fiber present in ration 2, resulting from the addition of 12 percent oat hulls, did not appear to reduce the effectiveness of the ration or make it less palatable.

Results with All-Barley Mash in Third Year

Further comparisons were made with increasing levels of barley in the mash during the third year of this study. The control ration (No. 1) contained approximately equal parts barley, corn, oats, and wheat bran. Ration 2 was supplemented with 33.5 percent barley and 15 percent each of oats and bran. Corn replaced the barley in ration 3. Ration 4 was similar to ration 4 in the previous year's study, containing 63.25 percent barley as the only grain portion of the mash. An attempt was made to increase the proportion of mash consumed to about 60 percent

Table 4. The influence of high levels of barley and varied fiber intake in laying mashes upon egg production egg size, body weight, mortality, and feed consumption 9 months—1952-1953

Ration No.	1			2			3			4		
Pen No.	1	6	Av.	2	7	Av.	3	8	Av.	4	9	Av.
Percent barley	15.0	15.0	15.0	50.0	50.0	50.0	48.0	48.0	48.0	63.0	63.0	63.0
Percent oat hulls	.....	.....	.....	12.0	12.0	12.0	.....	.....	.....	.....	.....	.....
Percent bran	15.0	15.0	15.0	.....	.....	.....	15.0	15.0	15.0	.....	.....	.....
Percent oats	15.0	15.0	15.0	.....	.....	.....	.....	.....	.....	.....	.....	.....
Percent corn	18.0	18.0	18.0	.....	.....	.....	.....	.....	.....	.....	.....	.....
Original No. birds	70	70	140	70	70	140	70	70	140	70	70	140
[1]Av. percent egg production	48.5	56.6	52.3	55.3	55.3	55.3	57.4	56.2	56.8	60.3	58.0	59.2
Av. No. eggs per bird	132	154	143	151	151	151	157	153	155	165	159	162
Av. egg weight (oz. per dozen)	24.9	25.6	25.3	25.1	25.1	25.1	25.2	24.9	25.0	25.2	25.4	25.3
Av. hen weight—lb.—October	4.4	4.5	4.4	4.4	4.4	4.4	4.3	4.4	4.4	4.4	4.4	4.4
July	4.8	5.0	4.9	4.9	5.0	5.0	4.7	4.9	4.8	5.0	5.0	5.0
Percent mortality	37.1	45.7	41.4	28.6	30.0	29.3	30.0	31.4	30.7	35.7	42.9	39.3
Percent mortality less leukosis	32.9	35.7	34.3	21.4	21.4	21.4	27.1	22.9	25.0	24.3	37.1	30.7
Total feed per bird (lb)	74.5	79.2	76.7	76.5	76.5	76.5	72.6	73.9	73.3	77.2	76.7	76.9
Percent mash consumed	44	44	44	48	50	49	46	44	45	48	46	47
[2]Percent starch consumed	56	56	56	52	50	51	54	56	55	52	54	53
Av. actual caloric intake (calories per lb.)	820	820	820	767	767	767	795	795	795	816	816	816
Percent barley consumed of total ration	20.6	20.6	20.6	37.0	37.5	37.2	35.5	35.1	35.3	43.5	43.3	43.4
Av. lbs. feed per dozen eggs	6.4	5.9	6.1	5.9	5.9	5.9	5.4	5.8	5.6	5.5	5.7	5.6

[1]There was no significant difference in egg production as determined by analysis of variance. F = 0.49. The significance levels for F were 4.06 and 2.73 at the 1 and 5 per cent levels, respectively.

[2]Scratch mixture: wheat 50, oats 25, barley 25.

Table 5. The influence of high levels of barley in laying mashes upon egg production, egg size, body weight, livability, and feed consumption
6 months—1953-1954

Ration No.	1			2			3			4		
Pen No.	1	6	Av.	2	7	Av.	3	8	Av.	4	9	Av.
Percent barley	16.8	16.8	16.8	33.5	33.5	33.5	.....	.....	.....	63.2	63.2	63.2
Percent corn	16.7	16.7	16.7	.....	.....	.....	33.5	33.5	33.5	.....	.....	.....
Percent oats	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	.....	.....	.....
Percent bran	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	15.0	.....	.....	.....
Original number birds	68	68	136	68	68	136	68	68	136	68	68	136
[1]Av. percent egg production	64.1	65.2	64.6	65.9	65.8	65.8	65.8	59.7	62.8	65.2	68.5	66.8
Av. No. eggs per bird	117	119	118	120	120	120	120	109	114	119	125	122
Av. egg wt. (oz. per dozen)	25.5	25.7	25.6	25.8	25.8	25.8	25.6	25.9	25.8	25.9	26.0	26.0
Av. hen weight—lb.—October	4.3	4.3	4.3	4.3	4.4	4.4	4.3	4.5	4.4	4.3	4.5	4.4
April	4.9	4.8	4.8	4.9	5.0	4.9	5.0	4.9	5.0	4.8	5.0	4.9
Percent mortality	17.6	19.1	18.4	10.3	19.1	14.7	5.9	20.6	13.2	23.5	14.7	19.1
Percent mortality less leukosis	14.7	19.1	16.9	10.3	19.1	14.7	4.4	16.2	10.3	20.6	10.3	15.4
Total feed per bird (lb.)	48.6	48.7	48.6	48.6	50.3	49.4	48.0	47.6	47.8	47.8	50.0	48.9
Percent mash consumed	57	58	57	59	60	59	60	56	58	56	59	58
[2]Percent scratch consumed	43	42	43	41	40	41	40	44	42	44	41	42
Av. actual caloric intake (calories per lb.)	795	795	795	758	758	758	825	825	825	794	794	794
Percent barley consumed of total ration	20.3	20.2	20.3	30.0	30.1	30.1	10.0	10.9	10.4	46.6	47.6	47.1
Av. lbs. feed per dozen eggs	5.0	4.9	5.0	4.9	4.9	4.9	4.8	5.3	5.0	4.8	4.8	4.8

[1]There was no significant difference in egg production as determined by analysis of variance. F = 1.08. The significance levels for F were 4.06 and 2.73 at the 1 and 5 percent levels, respectively.

[2]Scratch mixture: wheat 50, oats 25, barley 25.

of the total feed intake by restricting the whole grain portion of the feed to approximately 2 pounds per dozen eggs produced and through increased mash-feeding space made available on the roosting racks. The experimental period was reduced to 6 months because of a severe outbreak of intestinal coccidiosis. The experiment was terminated to allow treatment of the disease with several drugs. Other than the time element, the experimental procedure was the same as for the two previous years.

The results for this trial are presented in Table 5. The egg production of duplicate pens varied from an average of 62.8 to 66.8 percent. The highest production was obtained from the all-barley mash and the lowest from ration 3 containing 33.5 per cent yellow corn. There was no significant difference in egg production between treatments. Egg size and body size did not vary with the different rations. Mortality was quite high with all pens, due primarily to intestinal coccidiosis.

Feed efficiency was approximately the same with all rations, varying from 4.8 to 5.0 pounds of total feed per dozen eggs produced. These uniform values were obtained even though considerable difference existed in the energy values of the different formulas. As noted in Table 2, the caloric content per pound of feed varied from a low of 656 for ration 2 to a high of 768 for ration 3. This difference of 112 calories is reduced 67 calories when the energy content present in the whole grain portion of the feed is included. Either all rations contained adequate energy or the energy differences present were not sufficient to permit evaluation. The possibility also exists that the disease conditions present may have prevented sufficiently high production to permit differences in feed values to be expressed.

The intake of barley of total feed consumed varied from 10 percent with ration 3 containing 33.5 percent corn to a high of 47 percent with ration 4. Barley also constituted 30 percent of the total feed with ration 2. These high barley levels did not appear to reduce the palatability of the mash since no difficulty was encountered in obtaining approximately 60 percent mash consumption.

Discussion

The composition of barley is approximately the same as other grains, being slightly higher in fiber than wheat or corn and lower than oats or millfeeds. Barley and other white grains differ from corn in that they contain no vitamin A. When corn is decreased or eliminated, allowances must be made to supply adequate vitamin A. The caloric or productive energy content of barley is considerably below that of corn or wheat but superior to oats and millfeeds. It should make a desirable addition to a poultry formula in which a "modified" high energy approach is desired. Strictly high energy rations are more efficient for egg production from the standpoint of feed utilization but also result in problems such as feather picking and cannibalism, and may result in increased production costs.

The results of the 3 years' work would indicate that any of the common grains can be used satisfactorily in laying mashes. Barley was

used at levels from 0 to 63 percent of the mash. The high barley level was included in 2 of the 3 years' study and proved equal to other grain combinations including rations in which corn supplied over half of the grain supplement. Egg production, egg size, body weight, and feed efficiency were equally as good with the all-barley mash as with rations containing low levels of barley.

When barley supplied all of the grain in the mash and 25 percent of the whole grain mixture, 43 percent of the total feed was consumed as barley during 1952 and 47 percent in 1953. This is approximately one-half of the total feed consumed and was accomplished without any apparent reduction in feed palatability. Although the experiments were not begun until the experimental birds were about 6 months old, the pullets were accustomed to whole barley in the whole grain at an early date during the growing period. It should be possible to increase the barley intake further by increasing the level in the whole grain to 50 percent or more if the birds are started on higher levels when young. If birds in production have been accustomed to other grains, they will not readily consume whole barley.

References Cited

1. FRAPS, G. S. Composition and production energy of poultry feeds and rations. Texas Agric. Exp. Sta., Bul. No. 678, 1946. 37 pp.

2. TITUS, HARRY W. and A. B. GODFREY. Comparison of scabbed barley, normal barley, and yellow corn in diets for laying hens. U.S.D.A. Technical Bul. No. 435, 1934. 10 pp.

3. PETERSON, D. W. and PHYLLIS A. ZWEIGART. Corn or barley for laying hens. California Agriculture. Vol. 8, No. 3, pp. 15-16, March 1954.