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COMPARISON OF SCABBED BARLEY, NORMAL BARLEY, AND YELLOW CORN IN DIETS

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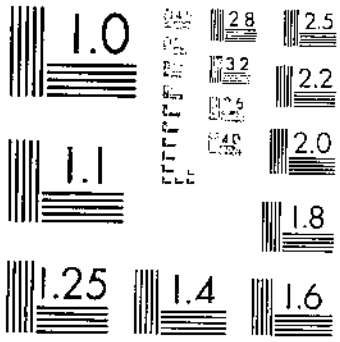

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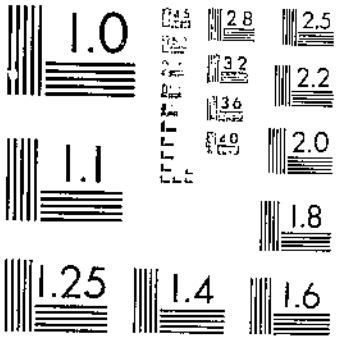

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COMPARISON OF SCABBED BARLEY, NORMAL BARLEY, AND YELLOW CORN IN DIETS FOR LAYING CHICKENS

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INTRODUCTION

After the harvest in years in which an appreciable portion of the barley crop becomes scabbed, there is a demand for information regarding the feeding of this diseased grain to livestock. The experiments herein reported were made with laying chickens, for the purpose of obtaining data on the comparative value of diets containing relatively large quantities, respectively, of scabbed barley, normal barley, and yellow corn.

REVIEW OF LITERATURE

Daugherty, Gossman, and Hendry, as reported by Haring (*3*),[1] compared the palatability of several grains for poultry and found that barley appeared to be much less palatable than wheat, yellow corn, or white yolo (a variety of grain sorghum developed at the California Agricultural Experiment Station), when these grains were fed from hoppers kept open for 2 hours before the chickens went to roost. Rintoul and Rugg (*8*) made a similar comparison of barley with other grains and reported that barley, when fed as "the grain at night", did not give so good results as Algerian oats, wheat, or mixed grains.

Lomax (*4*) compared barley and wheat as constituents of the scratch grain fed to White Leghorn pullets. He found no significant difference between these two grains in their effect on the production or size of eggs. He did find, however, that pullets receiving

[1] Italic numbers in parentheses refer to Literature Cited, p. 9.

barley as a part of their diet ate somewhat more feed and produced a few more eggs than those receiving wheat. Nevertheless, wheat proved to be the more economical, since the feed cost per bird was greater for the barley group than for the wheat group and the return above feed cost was slightly in favor of the latter group.

Moore (*5*, *6*), compared barley and corn as constitutents of both the mash and scratch feed given to laying hens, as well as to chicks. He found that the pullets receiving barley laid eggs with lighter yolks than did those receiving corn but the shell texture of the eggs was not so good. The mortality among the former birds was only about two-thirds that of the latter. Chicks from eggs of the barley-fed hens appeared to be somewhat heavier than those from the other groups when the grains were fed in diets similar in all other ways. Moore's results demonstrate that barley can be safely substituted for corn in a diet for laying chickens, if provision is made for supplying enough vitamin A. Earlier experiments conducted by Hart, Halpin, and Johnson, as reported by Clark (*2*), had previously shown that this applies also to growing chicks.

Morgan (*7*) compared barley and corn as constituents of the mash fed to hens. He found little, if any, difference in the egg production and in the live weights. He did find, on the other hand, that the feed consumption of the hens receiving barley was greater than that of the hens receiving corn and that the feed cost per hen was greater.

Roche and Bohstedt (*9*) studied the effect of scabbed barley and scabbed oats on several classes of livestock and found that chicks fed scabbed barley did just as well as those fed normal barley. These investigators also report that scabbed barley fed to pullets, both in the mash and as a scratch feed, proved to be just as good as the undiseased grain, on the basis of live weight and number and weight of eggs produced.

No instances were found in which the all-mash system of feeding had been used or in which an experiment had been made to compare scabbed barley, normal barley, and yellow corn. In experimental work the all-mash system of feeding is to be preferred to the mash-and-scratch system because the former offers the chickens much less opportunity to select certain feeding stuffs than does the latter.

MATERIAL AND PLAN OF EXPERIMENT

The present comparison of the feeding value of diets containing relatively large quantites, respectively, of scabbed barley, normal barley, and yellow corn was made at the United States Animal Husbandry Experiment Farm, Beltsville, Md. Two feeding experiments were conducted, one for 100 weeks with Rhode Island Red pullets, and the other for 48 weeks with Single-Comb White Leghorn pullets. The first experiment was begun September 6, 1929, and the second 52 weeks later, September 5, 1930; both were continued until August 7, 1931.

At the beginning of each experiment strong, healthy pullets were obtained from the rearing range and were distributed, on the basis of live weight, among 4 pens, until each pen contained 22 pullets. Pens 1, 2, 3, and 4 contained Rhode Island Red pullets; pens 1–a, 2–a,

3–a, and 4–a, White Leghorn pullets. The birds in each pen were housed in a small colony laying house. Approximately 6,000 square feet of well-sodded grass range surrounded each house. At all times the birds had access to this range.

Four lots of scabbed barley [2] were fed. Lots 1 and 2 were moderately scabbed; the former contained no other grains, and the latter contained approximately 22.4 percent of other grains.[3] Lot 3 was slightly scabbed and contained approximately 2.1 percent of other grains. Lot 4 was very badly scabbed and contained approximately 13.8 percent of other grains. In all the scabbed-barley lots, nearly all the other grains consisted of oats. Lots 1 and 2 were fed until November 15, 1930, when they were exhausted, after which lots 3 and 4 were fed.

The composition of the diets is shown in table 1.

TABLE 1.—*Composition of all-mash feed mixtures fed to Rhode Island Red pullets during the first 52 weeks, Sept. 6, 1929–Sept. 5, 1930, and to the birds in both experiments during the last 48 weeks, Sept. 5, 1930–Aug. 7, 1931*

RHODE ISLAND REDS, FIRST 52 WEEKS

Ingredient	Pen 1	Pen 2	Pen 3	Pen 4
	Percent	*Percent*	*Percent*	*Percent*
Ground yellow corn	30.00			
Ground normal barley		30.00		
Ground scabbed barley (lot 1)			30.00	
Ground scabbed barley (lot 2)				30.00
Ground wheat	20.00	20.00	20.00	20.00
Rolled oats (feeding)	15.00	15.00	15.00	15.00
Wheat middlings	10.00	10.00	10.00	10.00
Dried buttermilk	6.00	6.00	6.00	6.00
Meat scrap (55 percent protein)	5.50	5.50	5.50	5.50
White fish meal	5.50	5.50	5.50	5.50
Alfalfa-leaf meal	3.50	3.50	3.50	3.50
Steamed bone meal	1.45	1.45	1.45	1.45
Ground limestone	1.45	1.45	1.45	1.45
Common salt	.72	.72	.72	.72
Anhydrous sodium sulphate	.55	.55	.55	.55
Flowers of sulphur	.22	.22	.22	.22
Anhydrous sodium thiosulphate	.11	.11	.11	.11
Total	100.00	100.00	100.00	100.00

BIRDS IN BOTH EXPERIMENTS, LAST 48 WEEKS

Ingredient	Pens 1 and 1-a	Pens 2 and 2-a	Pens 3 and 3-a	Pens 4 and 4-a
	Percent	*Percent*	*Percent*	*Percent*
Ground yellow corn	38.27			
Ground normal barley		38.27		
Ground scabbed barley (lots 1 and 3)[1]			38.27	
Ground scabbed barley (lots 2 and 4)[1]				38.27
Wheat bran	18.74	18.74	18.74	18.74
Rolled oats (feeding)	11.48	11.48	11.48	11.48
Meat scrap (55 percent protein)	7.76	7.76	7.76	7.76
White fish meal	6.79	6.79	6.79	6.79
Dried buttermilk	4.85	4.85	4.85	4.85
Alfalfa-leaf meal	4.21	4.21	4.21	4.21
Ground calcite	6.90	6.90	6.90	6.90
Anhydrous sodium sulphate	.50	.50	.50	.50
Common salt	.50	.50	.50	.50
Total	100.00	100.00	100.00	100.00

[1] Lots 1 and 2 were fed until Nov. 15, 1930, when they were exhausted, after which lots 3 and 4 were fed.

[2] Scabbiness caused by the fungus *Gibberella saubinetii*.

[3] Boerner, in the Handbook of Official Grain Standards of the U.S. Department of Agriculture (*1, p. 47*), defines the term "barley" as follows: "Barley shall be any grain which consists of 50 percent or more of barley, and contains not more than 25 percent of cereal grains of a kind or kinds other than barley."

The average composition of the yellow corn, normal barley, and scabbed barley used in these experiments is given in table 2.

TABLE 2.—*Composition of the yellow corn, normal barley, and scabbed barley used in experiments*

FIRST 52 WEEKS (RHODE ISLAND RED PENS)

Feed	Water	Crude protein (N×6.25)	Crude ash	Ether extract	Crude fiber	Nitrogen-free extract
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Yellow corn	12.80	8.00	1.20	3.81	2.11	72.08
Normal barley	12.73	11.40	2.53	2.08	5.46	65.80
Scabbed barley:						
Lot 1	12.95	12.25	2.94	2.17	6.22	63.47
Lot 2	12.42	13.81	2.03	1.86	6.55	62.43
LAST 48 WEEKS [1] (ALL PENS)						
Yellow corn	13.24	8.44	1.22	3.04	2.03	71.13
Normal barley	11.55	11.54	2.70	2.07	5.49	66.65
Scabbed barley:						
Lot 3	11.40	11.33	3.17	2.05	6.44	65.61
Lot 4	11.17	12.73	3.24	2.19	7.31	63.36

[1] Lots 1 and 2 of scabbed barley were used during the first 10 weeks of this 48-week period, and lots 3 and 4 the remaining 38 weeks.

In addition to feed-consumption, live-weight, and egg-production data, complete mortality records were kept as a basis for deciding whether mortality seriously affected the results. Records were kept of the total number of deaths which occurred during the experiment and the actual number of bird days for each pen.

EXPERIMENTAL RESULTS

The mortality data are given in table 3. The total number of possible bird days for 22 birds between September 6, 1929, and September 5, 1930, was 8,008, and for the same number of birds between September 5, 1930, and August 7, 1931, it was 7,392. However, attention is called to the fact that in the case of the Rhode Island Reds there was not the same number of birds in each pen at the beginning of the period between September 5, 1930, and August 7, 1931, since the number of deaths during the preceding period had not been the same in all the pens.

TABLE 3.—*Number of deaths and bird days in each pen during periods indicated, each pen initially containing 22 birds*

DEATHS

Rhode Island Reds				White Leghorns	
Pen no.	Sept. 6, 1929, to Sept. 5, 1930	Sept. 5, 1930, to Aug. 7, 1931	Total	Pen no.	Sept. 5, 1930, to Aug. 7, 1931
1	2	1	3	1-a	2
2	2	3	5	2-a	1
3	4	1	5	3-a	2
4	3	0	3	4-a	2

TABLE 3.—*Number of deaths and bird days in each pen during periods indicated, each pen initially containing 22 birds*—Continued

	BIRD DAYS				
1	7,763	6,690	14,453	1-a	6,865
2	7,903	6,373	14,276	2-a	7,090
3	7,800	5,878	13,684	3-a	7,288
4	7,773	6,384	14,157	4-a	7,020

The feed-consumption, live-weight, and egg-production data are presented in graphic form in figures 1, 2, and 3, respectively.

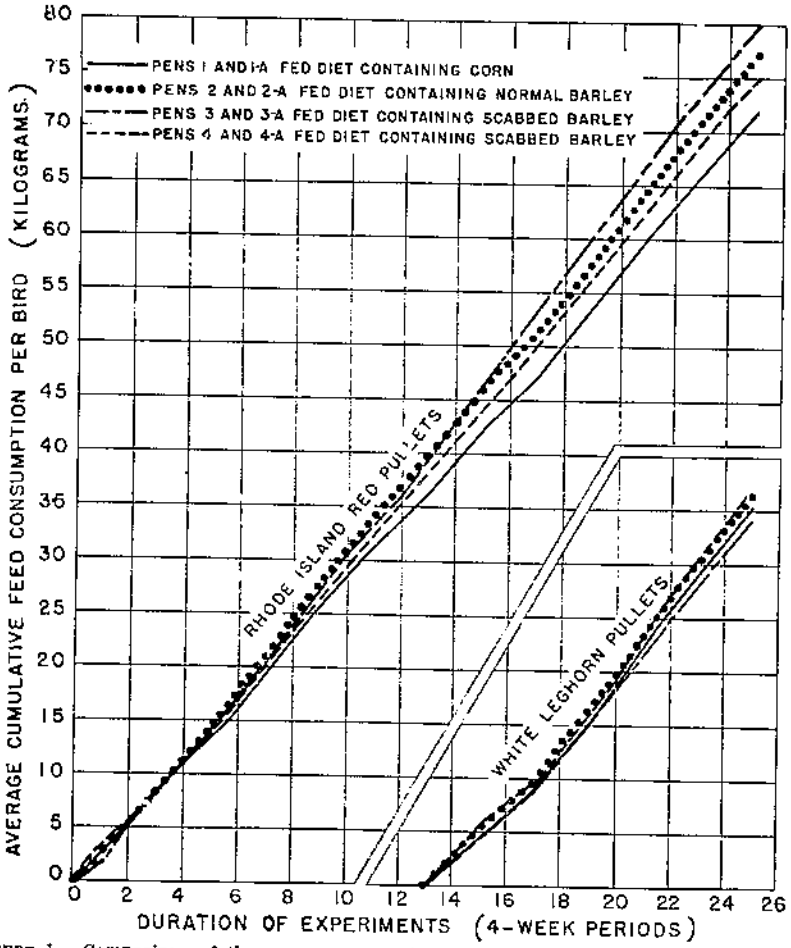

FIGURE 1.—Comparison of the average cumulative feed consumption per bird in the pens receiving the different diets.

DISCUSSION

One of the major nutritive differences between yellow corn and barley is that the former is a fair source of vitamin A, whereas the latter is a poor source. It is, therefore, logical to assume that one would obtain very similar results with these two grains, if the vita-

min A requirements of the chickens are adequately provided for. Although the chickens in the several pens received no cod-liver oil, they nevertheless were supplied adequately with vitamin A and vitamin D by the grass range and the sunlight, respectively.

A comparison of the data presented in table 3 shows that there were only slight differences in mortality among the comparable pens. It is clear, therefore, that the experimental results were not seriously affected by mortality. The data in this table also furnishes evidence that none of the diets, when fed to birds on range,

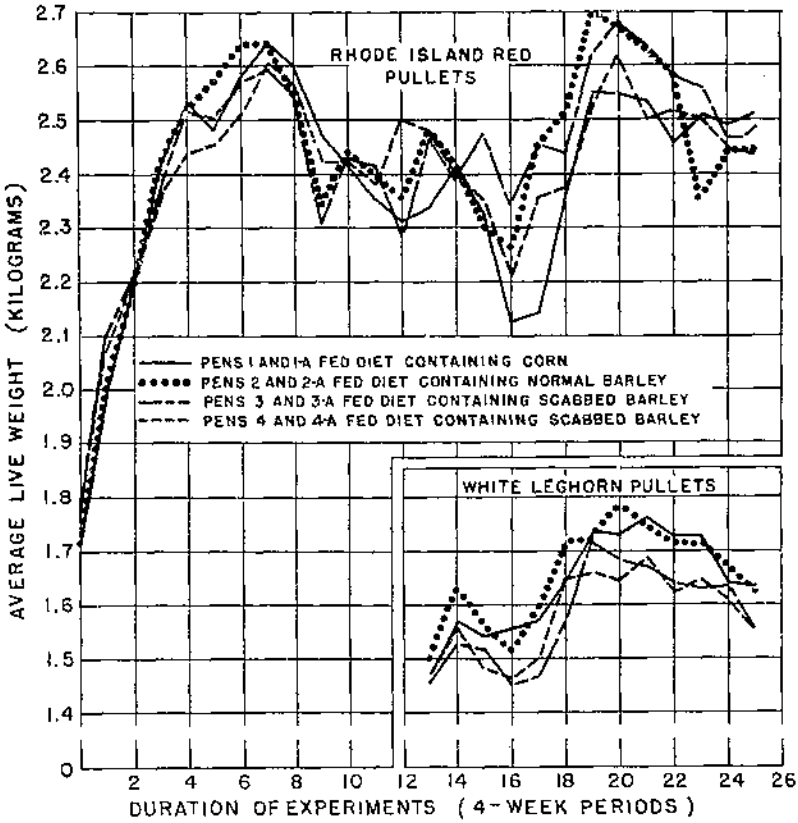

FIGURE 2.—Comparison of the average live weight per bird in the pens receiving the different diets.

was deficient in the several factors necessary for maintaining life.

In general, the birds ate more of the diets containing barley than they did of those containing corn. This is clearly shown in figure 1.

There were no significant differences in the quantities consumed, per head, of the three diets containing barley. During the first 60 weeks the maximum difference was between the two diets containing the scabbed barleys. This difference was approximately 1.7 kg (3.75 pounds) or about 4 percent of the feed consumed, and hence was less than is commonly found when two pens of chickens are placed on the same diet. A difference in feed consumption of

5 percent is commonly observed between duplicate pens of the size used in these experiments.

At the beginning of the sixty-third week new lots of scabbed barley were fed to pens 3 and 3-a, and to pens 4 and 4-a, respectively. In the first two pens the moderately scabbed barley was replaced by a lot of slightly scabbed barley, and in the last two pens the moderately scabbed barley was replaced by badly scabbed barley. Soon after these changes the rate of feed consumption in pen 3 increased slightly and that in pen 4 decreased to an equal, or slightly greater,

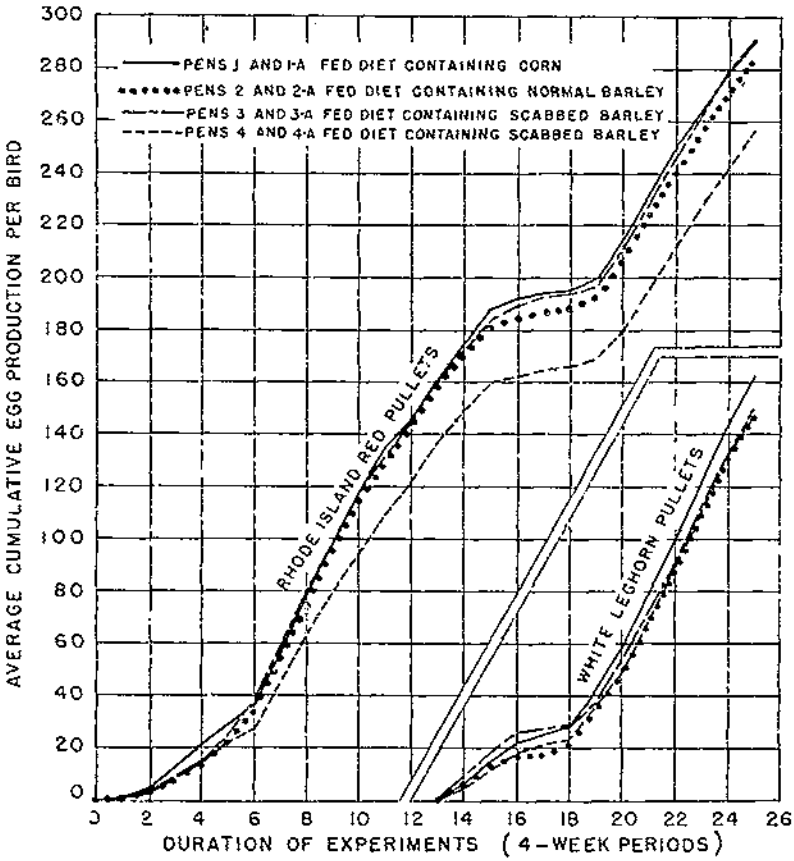

FIGURE 3.—Comparison of the average cumulative egg production per bird in the pens receiving the different diets.

extent; whereas the rate of feed consumption increased more rapidly in pen 4-a than in pen 3-a.

In view of these observations and the fact that all four pens of Leghorns ate nearly the same quantity of feed, it is clear that differences in feed consumption were not consistently due to differences in composition or degree of scabbiness of the several lots of barley.

Figure 2 shows that the average live weights of the birds in the four pens of Rhode Island Reds were remarkably close together throughout the experiment. After the molt the birds receiving corn

recovered their weight more slowly than did the birds receiving barley; however, the corn-fed birds laid practically as many eggs during their second laying year as did any of the others.

The live-weight curves of the White Leghorns also were rather close together throughout the experiment. However, all the Leghorn pullets lost weight some time between the fourth and twelfth week after they were placed on experiment. Incidently, during this same period their rate of feed consumption decreased somewhat, and following the twelfth week their rate of egg production dropped sharply and remained low for nearly 8 weeks. The cause of the decrease in rate of feed consumption, the loss in live weight, and the drop in rate of egg production is not known. However, it is interesting to note that whatever the cause was, the four pens recovered from the effects about equally well.

All but one of the six pens on the barley diets produced fewer eggs than the pens on the comparable corn diets. In this case, one of the pens of Rhode Island Reds receiving scabbed barley produced a few more eggs than the pen receiving corn; this difference in egg production, however, was relatively insignificant.

The most important, as well as consistent, difference between the results obtained with the diets was that the chickens on the corn diets consumed appreciably less feed, for each egg laid, than those on the comparable barley diets. Thus, during the first 52 weeks the Rhode Island Reds consumed only 87 percent as much feed per egg on the corn diet as they did on the barley diets; and during the next 48 weeks they consumed only 90 percent as much. The White Leghorn pullets, in the 48-week experiment conducted with these birds, also consumed only 90 percent as much feed on the former as on the latter diets. These findings agree with those of Morgan (7), who obtained similar results.

SUMMARY AND CONCLUSIONS

Two experiments were conducted for the purpose of comparing the relative value of scabbed barley, normal barley, and yellow corn in diets for laying chickens. In one experiment, which lasted 100 weeks, Rhode Island Red pullets were used; in the other, which lasted 48 weeks, Single-Comb White Leghorn pullets were used.

No significant differences in live weight were observed in either experiment. It was observed, however, that during the molt the Rhode Island Reds which received the diet containing corn lost more weight than birds from any of the other pens. The egg production of the pullets in the comparable pens in each experiment was quite similar, although the pullets in one of the pens of Rhode Island Reds which received scabbed barley did not lay so well as those in the other pens. In both experiments the chickens which received the diets containing corn showed a tendency to produce the most eggs and to eat the least feed. In both experiments the chickens receiving corn produced more eggs per pound of feed than did those receiving either normal or scabbed barley.

It is concluded that: (1) The diets which contained corn were the most efficient, since the pullets receiving them required only 87 to 90 percent as much feed per egg as those receiving the diets containing barley; and (2) scabbed barley whether slightly, mod-

erately, or very badly scabbed, may be expected to give essentially the same results as normal barley so far as maintenance of live weight, egg production, and economy of egg production are concerned.

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