Research Note

Performance of Two Strains of Laying Hens Fed Ground and Whole Barley with and Without Access to Insoluble Grit

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ABSTRACT The live performance from 19 to 43 wk of age of two strains of commercial White Leghorn hens fed two levels of whole barley (0 or 60%) and insoluble grit (0 or 4 g/bird per wk) was compared. The 0 and 60% whole barley diets differed only in feed form and were formulated to the same nutrient specifications. No dilution of nutrients or ingredients occurred. The 0% whole barley diet was fed in mash form. The 60% whole barley diet was fed as whole grain and mash concentrate blended into a complete diet and fed in the same feed trough.

(Key words: whole grain, barley, grit, feed form, laying hen)

INTRODUCTION

In choice feeding trials, laying hens fed whole wheat, oats, or barley have had the same or better egg production and feed efficiency as hens fed mash or pelleted diets (Karunajeewa, 1978; Cowan and Michie, 1979; Kiiskinen, 1987). In these trials, the hens voluntarily consumed 55 to 80% of their feed intake as whole grain. When whole grain and a concentrate have been fed together in one trough instead of being choice fed, the results with laying hens have been mixed. In research where whole wheat or whole barley has comprised 38 to 45% of a complete laying diet, egg production and feed efficiency have been either unchanged or improved by feeding whole grain (Blair et al., 1973; Ouart et al., 1986). In trials where the layer diet contained 70 to 80% whole grain, however, egg production and feed efficiency have decreased and mortality has increased (Robinson, 1985; Al Bustany and Elwinger, 1988). The method of consistently obtaining normal production when feeding whole grain to laying hens has not yet been determined. Milling and grain handling costs could be reduced if it is possible to feed whole grain without a loss in bird performance.

Feeding whole barley reduced egg production, feed efficiency, and egg specific gravity and increased feed intake, egg weight, and body weight gain. Access to insoluble grit had no effect on any of the production variables measured. The two strains of hens responded similarly to whole barley but differed in feed intake, feed efficiency, egg weight, egg specific gravity, and body weight gain. Feeding whole barley combined with a mash concentrate depressed hen performance compared to birds fed a similar diet in mash form. Strain of hen and access to insoluble grit did not alter the response to feeding whole barley.

In the present study, a diet containing 60% whole barley was fed to laying hens to determine its effect on egg production, feed intake, feed efficiency, egg weight, egg specific gravity, body weight gain, and mortality. The response of two strains of laying hens to whole barley was determined, and the possible benefit of supplying insoluble grit when feeding high levels of whole grain was investigated.

MATERIALS AND METHODS

Bird Management

Two strains of day-old Single Comb White leghorn pullets3 were placed in litter floor pens and reared using standard procedures for temperature and ventilation control. Pullets were beak trimmed at 10 d of age. The birds were fed starter and grower diets in mash form from 0 to 6 wk and 6 to 17 wk of age, respectively. The prelay diet contained 2,750 kcal/kg ME, 16% CP, and 2.25% Ca and was fed from 17 to 19 wk of age. The birds that were fed 0% whole barley in the laying diet received the prelay diet in mash form, and the birds fed 60% whole barley in the layer diet received a prelay diet comprised of 10% whole barley blended with a mash concentrate. No insoluble grit was fed. Pullets were sample weighed weekly starting at

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TABLE 1. Ingredient composition of 0 and 60% whole barley-laying hen diets fed from 19 to 43 wk

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>0% Whole barley</th>
<th>60% Whole barley</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole barley</td>
<td>0.00</td>
<td>60.00</td>
</tr>
<tr>
<td>Ground barley</td>
<td>60.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Soybean meal</td>
<td>23.53</td>
<td>23.53</td>
</tr>
<tr>
<td>Canola oil</td>
<td>3.67</td>
<td>3.67</td>
</tr>
<tr>
<td>Ground limestone</td>
<td>9.79</td>
<td>9.79</td>
</tr>
<tr>
<td>Dicalcium phosphate</td>
<td>0.36</td>
<td>0.36</td>
</tr>
<tr>
<td>Vitamin and mineral premix</td>
<td>2.00</td>
<td>2.00</td>
</tr>
<tr>
<td>Salt</td>
<td>0.42</td>
<td>0.42</td>
</tr>
<tr>
<td>DL-Methionine</td>
<td>0.13</td>
<td>0.13</td>
</tr>
<tr>
<td>Avizyme 1100</td>
<td>0.10</td>
<td>0.10</td>
</tr>
</tbody>
</table>

1On a calculated basis, the diets contained ME, 2,600 kcal/kg; CP, 18.1%; calcium, 4.2%; available phosphorus, 0.45%; sodium, 0.18%; methionine, 0.42%; methionine plus cystine, 0.72%; lysine, 0.99%.

2Vitamin and mineral premix provided per kilogram of complete diet: vitamin A, 10,000 IU; vitamin D, 2,500 IU; vitamin E, 25 IU; vitamin K, 1.5 mg; thiamine, 1 mg; riboflavin, 7.5 mg; niacin, 30 mg; vitamin B6, 4 mg; vitamin B12, 0.015 mg; pantothenic acid, 8 mg; folic acid, 0.5 mg; biotin, 0.1 mg; choline, 400 mg; iron, 80 mg; vitamin C, 25 mg; zinc, 80 mg; manganese, 80 mg; copper, 10 mg; iodine, 0.8 mg; cobalt, 0.25 mg; selenium, 0.3 mg; calcium, 3,200 mg; and phosphorous, 2,000 mg.

3Finnfeeds International Ltd., Marlborough, 777 U.K.; beta-glucanase activity of 100 U/g, xylanase activity of 300 U/g and protease activity of 800 U/g.

6 wk of age and BW closely approximated the primary breeder’s recommendations.

At 18 wk of age, the pullets were randomly housed two birds per cage (30.5 × 45.7 cm). The photoperiod length was maintained at 8 h of light each day until the initiation of the experiments at 19 wk of age when it was increased to 14 h of light. Light intensity was maintained at 5 lx during the experiments. Feed and water were available on an ad libitum basis.

**Experimental Design**

The experiment was designed as a 2 × 2 × 2 factorial arrangement with the main effects of level of whole barley in the feed (0 or 60%), access to insoluble grit (0 or 4 g/bird per wk; number 3 layer size, white granite), and strain of laying hen (strain A or B). Each combination of level of barley, access to grit, and strain was replicated nine times with ten hens per replication. When insoluble grit was fed, it was top-dressed on the feed troughs once per week. The composition of the 0 and 60% whole barley-laying hens diets is displayed in Table 1. The two diets were formulated to the same nutrient specifications, and no dilution of nutrients or ingredients occurred. The 0% whole barley diet was fed in mash form, and the 60% whole barley was fed as a blend of whole grain and mash concentrate. The barley in the mash diet was coarsely ground in a hammermill with a 0.64 cm screen. Unlike choice feeding trials, the blended whole grain diet was fed as one ration in one feed trough instead of the whole grain and concentrate being fed in separate feed troughs. The experimental period was from 19 to 43 wk of age.

Egg production was recorded Monday to Friday for the length of the experiment, and the 5-d egg numbers for each week were converted mathematically to 7-d period production by multiplying them by 1.4 prior to statistical analysis. Egg weight and specific gravity measurements were made on all collected eggs produced during 1 d per 28-d period. Eggs were weighed the same day as collected and then stored in a common room over night (6 C). Specific gravity was determined the following morning using graded salt solutions ranging from 1.060 to 1.100 with gradations of 0.005. Mortality was recorded daily.

Data were analyzed as a 2 × 2 × 2 factorial with level of barley, access to insoluble grit, and strain as main effects. SAS Institute (1990) was used for the analysis of variance and treatment effects were considered statistically significant at P < 0.05.

**RESULTS**

Feeding 60% whole barley reduced egg production, feed efficiency, and egg specific gravity and increased feed intake, egg weight, and BW gain (Table 2). Access to insoluble grit had no effect on any of the production variables measured. The two strains of hens responded similarly to whole barley but had different feed intake, feed efficiency, egg weight, egg specific gravity, and BW gain from each other. None of the treatments significantly altered total mortality. Feeding whole barley combined with a mash concentrate depressed hen performance compared to birds fed a similar diet in mash form. Strain of hen and access to insoluble grit did not alter the response to feeding whole barley.

**DISCUSSION**

The present study with whole barley agrees with previous research indicating that the egg production and feed efficiency of laying hens was decreased by feeding high levels of whole wheat, barley, or oats blended with mash or pelleted concentrates (Robinson, 1985; Al Bustany and Elwinger, 1988). The decline in shell quality observed here has also been observed by other researchers feeding whole wheat, barley, or oats mixed together with a concentrate into one ration (Ouart et al., 1986; Al Bustany and Elwinger, 1988). The negative response to feeding whole grain when incorporated into a complete diet is in marked contrast to the normal or improved performance in choice feeding trials where laying hens have consumed 55 to 80% of their feed intake as whole wheat, barley, or oats (Karunajeewa, 1978; Cowan and Michie, 1979; Kiiskinen, 1987).

The difference between the choice feeding and blended feeding trials may be that the hens fed blended rations can no longer accurately select whole grain and concentrate to meet their individual nutritional needs. Separation of whole grain and concentrate within a feed trough is another problem that could occur with blended feeds and not in choice feeding systems. Cowan and Michie (1979) observed a decline in egg mass production and concentrate intake when concentrate and whole wheat were layered one on top of the other in the same trough compared to feeding the whole grain and concentrate in separate feed
troughs. Blair et al. (1973) choice fed two types of whole grain (wheat and barley) and concentrate in separate troughs because preliminary research had indicated a drop in production and concentrate consumption when the whole grain and concentrate were blended together. Ouart et al. (1986) attributed a decline in egg specific gravity to hens selectively eating whole wheat instead of the concentrate. After reviewing past research, Forbes and Covasa (1995) questioned the ability of birds to select ingredients to meet their nutritional needs when the ingredients were blended together. The results of the present trial help to confirm the difficulties of feeding high levels of whole grain in a complete ration.

Supplying the hens with insoluble grit did not help the birds to utilize a diet containing a high level of whole barley. Previous research has also failed to demonstrate a benefit to providing insoluble grit when feeding whole grain to chickens and turkeys (O’Neil, 1964; Schwean et al., 1997; Svihus et al., 1997). In contrast, pullets fed whole grain will increase their consumption of insoluble grit when it is available free-choice (Karunajeewa and Tham, 1984). Laying hens fed mash diets and free-choice insoluble grit will consume grit far in excess of what their gizzards will retain without any improvement in live performance (Walter and Aitken, 1961). If the gizzard is unable to thoroughly grind the whole barley, adding insoluble grit to the diet does not appear to solve the problem.

In summary, egg production, feed efficiency, and egg shell quality were reduced by feeding a diet comprised of 60% whole barley blended with mash concentrate. Two strains, differing in live performance, responded similarly to the whole barley diet. Supplying insoluble grit offered no benefit to hens fed whole grain or mash diets.

ACKNOWLEDGMENTS

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REFERENCES


### TABLE 2. Effect of whole barley, insoluble grit, and strain on laying hen performance from 19 to 43 wk of age

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Egg production</th>
<th>Feed:egg ratio</th>
<th>Feed per dozen eggs (kg/dozen)</th>
<th>Body weight gain (kg)</th>
<th>Mortality (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hen-day (%)</td>
<td>Hen-housed (%)</td>
<td>Daily feed intake (g)</td>
<td>Mass ratio (kg/kg)</td>
<td>Specific gravity</td>
<td>NS</td>
</tr>
<tr>
<td>Whole barley (%)</td>
<td>0</td>
<td>87.7</td>
<td>87.3</td>
<td>111.6</td>
<td>2.28</td>
</tr>
<tr>
<td></td>
<td>60</td>
<td>86.1</td>
<td>85.6</td>
<td>117.2</td>
<td>2.38</td>
</tr>
<tr>
<td>Grit (g/bird/wk)</td>
<td>0</td>
<td>87.1</td>
<td>86.7</td>
<td>114.4</td>
<td>2.33</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>86.8</td>
<td>86.1</td>
<td>114.3</td>
<td>2.33</td>
</tr>
<tr>
<td>Strain (A or B)</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>Strain (A or B)</td>
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<td>87.5</td>
<td>86.7</td>
<td>111.9</td>
<td>2.21</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>86.3</td>
<td>86.1</td>
<td>116.8</td>
<td>2.44</td>
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<tr>
<td>SEM</td>
<td>0.32</td>
<td>0.40</td>
<td>0.59</td>
<td>0.018</td>
<td>0.011</td>
</tr>
</tbody>
</table>

1No significant interactions between main effects were observed, P > 0.05.

2P-value of main effect; P > 0.05 (NS).

*P < 0.05.