INCREASED DIETARY CALCIUM FOR BROILER BREEDER HENS ON WIRE AND LITTER

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Primary Audience: Nutritionists, Broiler Producers, Researchers

SUMMARY

Three experiments were conducted to study the eggshell quality of Arbor Acres Classic broiler breeder hens maintained on wire and fed a diet containing 2.54% Ca. Because the time of feeding seems to influence this diet, a daily feed allowance of 156 g/hen given at 08:00 hr supplied 3.96 g of Ca/hen/day. In Experiment 1, eggshell quality significantly decreased when hens were moved to wire-floored pens. Increasing the Ca content of the diet to 4% by adding 1.46% Ca from granular limestone in Experiment 2 did not affect shell quality of eggs from hens kept on wire or litter floor pens. In Experiment 3, 1.46% of the Ca was supplied by pellet-size limestone, which did not affect eggshell quality. Egg weight and egg production were not affected in any of the three experiments. However, in all three experiments eggshell quality declined when hens were moved from floor pens with litter to pens with wire floors.

Key words: Broiler breeder, calcium requirement, eggshell quality

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DESCRIPTION OF PROBLEM

Egg specific gravity (ESG) has been associated with hatchability of broiler breeder eggs. McDaniel and Roland [1] reported that eggs with lowest ESG had the greatest weight loss, highest early embryonic mortality, and lowest hatchability. They also stated that egg specific gravity above 1.080 did not affect hatchability. Several workers [2, 3, 4, 5] have since confirmed that eggs with a specific gravity below 1.080 do not hatch as well as those with an ESG above 1.080.

It has recently been reported [6] that scattering coarse limestone (2 g/bird/day) on the litter at 15:30 hr (to allow for afternoon ingestion and digestion) resulted in significantly increased ESG (1.0802 vs. 1.0809). The use of the large particles did not reduce egg weight loss, but increased hatchability (79.39 vs. 82.66%). Moving the time of feeding broiler breeders from morning to afternoon has been shown to influence ESG [7]. The improvement of ESG by moving feed time to afternoon was later confirmed [8]. However, the improvement was not as large as previously reported [7].

Interest in keeping broiler breeders in cages prompted research on eggshell quality [9]. These workers found that ESG declined

1 Florida Agricultural Experiment Station, Journal Series No. 5974.
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within 1 day after broiler breeders were moved from litter to wire floors. Also, ESG recovered when hens had access to litter. The finding that coarse limestone spread in the litter improved eggshell quality [6] prompted further research to improve the eggshell quality of eggs from hens maintained on wire floors. These experiments were conducted to further investigate ways to improve shell quality of eggs from broiler breeders kept on wire.

**MATERIALS AND METHODS**

**EXPERIMENT 1**

One hundred ninety-two Arbor Acres Classic hens, 55 wk of age, were used in this experiment. They were randomized into 24 pens, each containing eight hens. Pine shavings were used as litter. Hens had previously been fed 156 g of feed/day containing 2.54% calcium (Table 1) at 08:00 hr. Raised wire floors were placed in 12 of the pens, preventing access to the litter and fecal matter. Hens on the litter or wire floors continued receiving the control diet (Table 1) during the experiment.

Eggs were collected daily and weighed. The eggs were then broken and the shells were washed and allowed to air dry. The shells were then weighed and the egg weight and shell weight were used to calculate shell percentage. The experiment was conducted for 14 days.

A one-way analysis of variance was used according to the procedure of SAS [10]. Significant differences between means were determined by Duncan’s multiple range test [11].

**EXPERIMENT 2**

At the end of Experiment 1, each treatment group was randomly sorted into two groups of six pens. One group of six pens of hens on litter and one group of six pens of hens on wire continued to receive the same diet as in Experiment 1 (the control diet). The other group of six pens of hens on litter and six pens on wire received a diet containing 4% calcium with the Ca supplied by pulverized limestone. These diets were fed for 1 wk. Eggs were collected and broken out in the same manner as in Experiment 1. Data were summarized the same as in Experiment 1 and a two-way analysis of variance was used.

**EXPERIMENT 3**

Experiment 3 was initiated at the end of Experiment 2. Six pens of hens on litter and six pens of hens on wire continued to receive the control diet. A portion of the pulverized limestone (3.81% or 1.46% Ca) in the diet of the other hens was replaced with pullet-sized limestone. The procedures for collecting, summarizing, and analyzing data were the same as in Experiment 2. The experiment was conducted for 10 days.

**RESULTS AND DISCUSSION**

**EXPERIMENT 1**

As Table 2 shows, moving broiler breeder hens from litter to wire floors did not affect egg production (EP) or egg weight (EW). However, eggshell weight (ESW) and percentage shell (PS) were significantly lowered. These observations agree with previous findings [9].
EXPERIMENT 2

Egg production and EW were not significantly affected with hens in floor pens with litter or on wire floors (Table 3) or with 4% dietary calcium with the use of pulverized limestone. The increase in dietary calcium resulted in a non-significant increase in ESW both with hens on the litter and on wire floors. The ESW from the hens on the litter and receiving the diet with 4% calcium was not as heavy as the ESW from hens receiving the 2.5% calcium when on litter. Percentage eggshell was not affected by feeding the diet with 4% calcium. The ESW and PS were significantly lower for hens on wire than for hens on litter. The interaction of floor type and dietary Ca level was not significant for any measurement.

EXPERIMENT 3

Egg production and EW were not different for hens maintained on litter or wire floors (Table 4). Also the use of pullet-size limestone did not affect these measurements. Eggshell percentage was not affected when pullet-size limestone was used with hens on the litter or wire floor. However, the ESW was significantly lowered by feeding pullet limestone both with hens kept on litter or wire as compared to hens fed the diet with 2.5% Ca. The failure of pullet-size limestone to improve eggshell weight does not agree with previous data from commercial layers [12]. However, in a previous report [6] the pullet-size limestone was spread in the litter, whereas it was included in the feed in the present experiment.

In all three experiments eggshell quality was reduced when hens were moved from floor pens with litter to pens with wire floors. Increasing the Ca content of the diet did not prevent this decline in eggshell quality. Apparently hens need to recycle feces since eggshell quality has been shown to prevent the decline [9].

### TABLE 3. Performance of broiler breeder hens maintained in pens with litter or wire floors and fed two levels of calcium (Experiment 2)

<table>
<thead>
<tr>
<th>FLOOR TYPE</th>
<th>DIETARY Ca (%)</th>
<th>DIETARY Ca (%)</th>
<th>EGG PRODUCTION (%)</th>
<th>EGG PRODUCTION (%)</th>
<th>EGGWEIGHT (g)</th>
<th>EGGWEIGHT (g)</th>
<th>PERCENT SHELL (%)</th>
<th>PERCENT SHELL (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2.5</td>
<td>4.0</td>
<td>Average</td>
<td>2.5</td>
<td>4.0</td>
<td>Average</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Litter</td>
<td>67.5a</td>
<td>72.3a</td>
<td>69.9a</td>
<td>62.1a</td>
<td>62.7a</td>
<td>62.4a</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wire</td>
<td>75.3b</td>
<td>72.5b</td>
<td>73.9b</td>
<td>61.9b</td>
<td>62.7b</td>
<td>62.3b</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>71.4a</td>
<td>72.4a</td>
<td>72.4a</td>
<td>62.0a</td>
<td>62.2a</td>
<td>62.3a</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:**
- a,b Means within a row with no common superscript differ significantly (P < .05).
- x,y Means within a row or column and within a measurement with no common superscript differ significantly (P < .05).
TABLE 4. Performance of broiler breeder hens maintained in pens with litter or wire floors and fed diets with and without large particles of limestone (Experiment 3)

<table>
<thead>
<tr>
<th>FLOOR TYPE</th>
<th>DIETARY Ca (%)</th>
<th>DIETARY Ca (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2.5</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>2.5</td>
<td>4.0</td>
</tr>
<tr>
<td>Litter</td>
<td>69.4&lt;sup&gt;a&lt;/sup&gt;</td>
<td>68.4&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Wire</td>
<td>70.2&lt;sup&gt;b&lt;/sup&gt;</td>
<td>63.5&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Average</td>
<td>69.8&lt;sup&gt;a&lt;/sup&gt;</td>
<td>66.0&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

EGG PRODUCTION (%)

| Litter     | 5.63<sup>a</sup>| 5.51<sup>b</sup>| 5.57<sup>a</sup>| 8.87<sup>a</sup>| 8.81<sup>a</sup>| 8.84<sup>a</sup>|
| Wire       | 5.51<sup>b</sup>| 5.24<sup>c</sup>| 5.38<sup>b</sup>| 8.51<sup>b</sup>| 8.44<sup>b</sup>| 8.48<sup>b</sup>|
| Average    | 5.57<sup>a</sup>| 5.38<sup>b</sup>| 8.69<sup>a</sup>| 8.63<sup>a</sup>

*Pullet-size limestone used in these diets.

*Means within a row and within a measurement with no common superscript differ significantly (P < .05).

<sup>x</sup>Means within a row or column and within a measurement with no common superscript differ significantly (P < .05).

CONCLUSIONS AND APPLICATIONS

1. Hens maintained on wire floors had poorer eggshell quality than did hens kept on litter.
2. Increasing the level of dietary calcium from 2.5% to 4.0% with ground limestone or pullet-size limestone did not improve the eggshell quality of hens on wire or litter.

REFERENCES AND NOTES


