Vitamin and Trace Mineral Withdrawal Effects on Broiler Breast Tissue Riboflavin and Thiamin Content

FARZAD DEYHIM,* BARBARA J. STOECKER,+ and ROBERT G. TEETER*1

*Department of Animal Science and †Department of Nutritional Sciences, Oklahoma State University, Stillwater, Oklahoma 74078

ABSTRACT An investigation was carried out to determine whether a Day 28 to 49 dietary vitamin, trace mineral, and vitamin plus trace mineral premix withdrawal would impact Pectoralis major thiamin or riboflavin concentration in chicks reared under thermoneutral (24 C) and heat-stressed (24 to 35 C) conditions. No significant (P > 0.1) environment by nutrient withdrawal interactions were detected. Heat stress and vitamin withdrawal reduced (P < 0.05) P. major thiamin and riboflavin concentration. In contrast, trace mineral withdrawal failed (P > 0.1) to impact either vitamin. In conclusion, results from this study suggest that a 21-d vitamin withdrawal and heat stress exposure have the potential to reduced muscle riboflavin and thiamin concentration.

(Key words: broiler, heat stress, thiamin, riboflavin, vitamin)

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INTRODUCTION Research examining vitamin and trace mineral premix removal from broiler rations has led to variable results. Skinner et al. (1992) reported that a 28- to 49-d vitamin and vitamin plus mineral withdrawal period failed to impact performance. In contrast, Deyhim and Teeter (1993) detected reduced performance for several live and carcass variables when the same withdrawal period was examined. Weight gain was reduced by a mean of 2.9% in both studies, which suggests that changes in tissue vitamin concentration may have occurred. Because poultry products provide an estimated 2 and 8.3% of the recommended dietary allowance (RDA) for thiamin and riboflavin (Combs, 1993), it is important that the impact of dietary vitamin and trace mineral withdrawal on poultry meat be defined.

MATERIALS AND METHODS

Eleven-hundred-fifty-two Cobb x Cobb male broilers were initially reared in a common pen covered with rice hull litter until Day 26 posthatching. The chicks received a starter diet supplemented with vitamin (V) plus trace elements (TM) until 28 d of age. On Day 26 posthatching, chicks were transferred at random to grower battery compartments housed within either thermoneutral (TN; 24 C) and cycling heat distress (HD; 24-35-24 C) environmental chambers for a 3-wk experimental period. Days 26 through 28 posthatch ambient temperatures were maintained at 24 C to allow chicks a chamber adjustment. At 28 d of age, the ambient temperature of birds designated for HD was increased by 3.6 C daily, such that by Day 32 the chamber provided 12 h of 24 C, 3 h of 24 to 35 C, 6 h of 35 C, and 3 h of 35 to 24 C. Relative humidity was maintained at 50% ± 5%. Dietary treatments administered within either environment, beginning at 28 d of age, included: 1) the basal ration with no supplemental V or TM; 2) the basal ration fortified with TM only; 3) the basal ration fortified with TM only; 3) the basal ration fortified with V only; and 4) the basal ration fortified with V and TM (V + TM). Detailed dietary composition have been discussed elsewhere (Deyhim and Teeter, 1993). Diets containing V and/or TM met National Research Council recommended concentration (NRC, 1984). Feed and water were available for ad libitum consumption. Treatment replication consisted of 32 blocked replicates of six chicks per replicate within the HD environment and sixteen blocked replicates of six chicks per replicate within the TN environment.

Upon completion of the experimental period (Day 49), one bird per replicate was selected at random, killed, and the Pectoralis major extracted for thiamin and riboflavin analysis. Breast muscle vitamin determinations were made according to the Association of Official Analytical Chemists (1990).

Data were subjected to ANOVA using the General Linear Models (GLM) procedure of SAS® (SAS Institute, 1985). When a significant F (P < 0.05) statistic was indicated for treatment, environment, or interactions,
means were separated using Duncan's multiple range test (Steel and Torrie,
1960).

RESULTS AND DISCUSSION

Live performance and general carcass variables have been reported elsewhere
(Deyhim and Teeter, 1993). In the present study, no significant (P > 0.1) two- or three-
way interactions were detected between environment and premix withdrawal on breast muscle thiamin or
riboflavin concentration (Table 1).

Environmental effects upon P. major vitamin concentration were marked (P < 0.05), with both thiamin and
riboflavin being reduced by 23 and 37%, respectively (Table 2). These results suggest that chicks may require
additional vitamin fortification during heat exposure to maintain tissue vitamin concentration. Work reported by
Ferket and Qureshi (1992), in which drinking water fortified with a vitamin pack was observed to increase
performance of heat-stressed birds, is consistent with the data reported herein.

The 21-d vitamin withdrawal period markedly reduced (P < 0.05) P. muscle concentration of thiamin (45%)
and riboflavin (31%; Table 2). Previous research has indicated that increased dietary fortification with
pantothenic acid elevated (P < 0.05) Pectoralis muscle pantothenic acid concentration (Deyhim et al., 1992). In
contrast, trace mineral withdrawal from the grower ration failed to affect (P > 0.1) either thiamin or
riboflavin concentration (Table 2).

In summary, utilization of vitamin withdrawal peri-
ods, especially during heat stress, has the potential to
affect the thiamin, riboflavin, and pantothenic acid
concentration in poultry meat. Such effects have the
potential to impact consumer perception of poultry meat
wholesomeness and should be considered when vitamin
withdrawal is being contemplated. Consequently, the
main effects of environment and premix are presented
separately (Table 2).

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<table>
<thead>
<tr>
<th>Variables</th>
<th>Basal diet</th>
<th>V withdrawal</th>
<th>TM withdrawal</th>
<th>Basal diet + V + TM</th>
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<tr>
<td>Vitamin (V)</td>
<td>Basal diet</td>
<td>V withdrawal</td>
<td>TM withdrawal</td>
<td>Basal diet + V + TM</td>
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<td>Thiamin</td>
<td>0.71 ± 0.14</td>
<td>0.67 ± 0.13</td>
<td>1.40 ± 0.14</td>
<td>1.36 ± 0.18</td>
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<td>Riboflavin</td>
<td>0.52 ± 0.14</td>
<td>0.62 ± 0.13</td>
<td>1.06 ± 0.18</td>
<td>0.94 ± 0.16</td>
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</table>

TABLE 1. Vitamin (V) and trace mineral (TM) withdrawal effects (µg ± SEM) on skinless boneless breast thiamin and riboflavin concentrations of broilers reared in thermoneutral and heat stress environment.

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Thiamin (µg/g)</th>
<th>Riboflavin (µg/g)</th>
</tr>
</thead>
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<tr>
<td>Ambient temperature</td>
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<tr>
<td>Thermoneutral</td>
<td>1.04 ± 0.07</td>
<td>0.90 ± 0.09</td>
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<td>Heat stress</td>
<td>0.79 ± 0.07</td>
<td>0.57 ± 0.09</td>
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<tr>
<td>V withdrawal</td>
<td>1.19 ± 0.08</td>
<td>0.87 ± 0.09</td>
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<tr>
<td>+ vitamin</td>
<td>0.64 ± 0.07</td>
<td>0.60 ± 0.09</td>
</tr>
<tr>
<td>TM withdrawal</td>
<td>0.90 ± 0.07</td>
<td>0.71 ± 0.09</td>
</tr>
<tr>
<td>+ Trace mineral</td>
<td>0.92 ± 0.07</td>
<td>0.76 ± 0.09</td>
</tr>
</tbody>
</table>

| a,b | Means ± SEM within a treatment and column with no common superscript differ significantly (P < 0.05). |