In Ovo Peptide YY Administration Improves Growth and Feed Conversion Ratios in Week-Old Broiler Chicks

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ABSTRACT The effects of in ovo Peptide YY (PYY) administration on growth and feed conversion ratios in a commercial broiler line were investigated. Six hundred Ross male × Cobb female eggs were administered either 0.9% saline (control) or 600 µg/kg egg weight PYY in ovo at Day 18 of incubation. On day of hatching, 210 birds from each treatment group were randomly placed by sex into pens. Body weights at placement were not different between treatment groups. Average chick body weight and adjusted pen feed conversion ratios were improved by PYY in ovo treatment at 7 d posthatch (165.7 vs 170.2 g, P < 0.02; and 1.55 vs 1.49, P < 0.04, respectively). No significant differences between treatments were noted for these parameters at 21 or 42 d of age. These results suggest that in ovo treatment of broiler chicken eggs with gastrointestinal hormones that increase intestinal nutrient absorption, such as PYY, may enhance chick performance.

(Key words: peptide YY, chick, in ovo injection, feed conversion)

INTRODUCTION

Previous studies have demonstrated that digestive processes are not fully developed at hatch in chicks and turkey poults (Krogdahl and Sell, 1989; Nir et al., 1993). The failure of the intestinal tract of hatchlings to fully digest and absorb feed may contribute to increased post-hatch mortality and subsequent decreases in performance (Nitsan et al., 1991; O’Sullivan et al., 1992; Nir et al., 1993).

Peptide YY (PYY), a member of the regulatory peptide family that includes neuropeptide Y and pancreatic polypeptide, is present in endocrine cells of the lower intestine and the pancreas of vertebrates (Larhammar, 1996). Peptide YY is a gastrointestinal hormone that can be released by the presence of free fatty acids in the lumen of the distal small intestine (Hallden and Aponte, 1997). Peptide YY has been isolated from chicken intestine and was found to contain 37 amino acid residues rather than the 36 residues found in all other vertebrate pancreatic peptide family members (Conlon and O’Harte, 1992).

Although no data are available concerning the effects of PYY on intestinal nutrient absorption by the broiler chicken, it is possible that in ovo administration of PYY may enhance the intestinal absorptive capacity of hatching broiler chicks, resulting in subsequent improvements in performance. This study was conducted to determine whether in ovo administration of PYY results in increased growth and improved feed conversion ratios in broiler chickens.

MATERIALS AND METHODS

Six hundred Ross × Cobb eggs were obtained from Embrex, Inc. and treated in accordance with the guidelines of the North Carolina State University Institutional Animal Care and Use Committee. Eggs were randomly divided into two groups. One group was administered 0.9% saline (0.1 mL) and the other 600 µg human recombinant PYY3/kg egg weight dissolved in 0.1 mL of saline into the egg air space on Day 18 of incubation. At hatching, 420 chicks were vent-sexed, wing-banded, weighed, and placed randomly by treatment and sex into 60 pens of 7 chicks each. Pens were located within five adjacent rooms with 12 pens per room. Pens were equipped with nipple drinkers and feeders. Room temperatures were maintained at 30 to 32 C for the 1st wk and then decreased.

Received for publication January 8, 1999.
Accepted for publication May 2, 1999.

†Salaries and research support provided by state and federal funds appropriated to the North Carolina Agricultural Research Service, North Carolina State University. The use of trade names in this publication does not imply endorsement by the North Carolina Agricultural Research Service, nor criticism of similar products not mentioned.

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Abbreviation Key: AFCR = adjusted feed conversion ratios; FCR = feed conversion ratio; PYY = peptide YY.
Peptide YY has biological activity in the chicken embryo, particularly in mammals and chickens (Larhammar et al., 1993). Chicken PYY displays more variability than neuropeptide Y sequences, that of the human (Larhammar et al., 1993). Chicken PYY is approximated 70% homologous to the human (Larhammar et al., 1993). The results of the present study suggest that human recombinant PYY has biological activity in the chicken embryo.

**RESULTS**

Although there were significant sex differences for body weight and AFCR, there were no sex by treatment interactions; hence, data from both sexes were pooled by treatment groups. Mortality was 2.86% (6/210) for birds treated with saline from PYY and 0.96% (2/210) for birds treated with PYY. The mean body weights of hatchlings at placement (43.72 ± 0.15 g for control and 43.82 ± 0.20 g for PYY, respectively; Table 1). At 7 d, hatchlings from PYY-treated eggs were 2.6% heavier than hatchlings from saline-treated eggs. This difference in body weight did not persist beyond the 1st wk after hatching. Similarly, AFCR (Table 1) was 3.87% lower at 7 d (1.55 ± 0.77 for control and PYY, respectively) but not at 21 or 42 d for chicks from PYY-treated eggs.

**DISCUSSION**

Although PYY immunoreactive cells have been identified in the duodenum and jejunum of the mature chicken, its biological activity in the chicken is poorly understood (El Salhy et al., 1982). Peptide YY amino acid sequence displays more variability than neuropeptide Y sequences, particularly in mammals and chickens (Larhammar et al., 1993). Chicken PYY is approximated 70% homologous to that of the human (Larhammar et al., 1993). The results of the present study suggest that human recombinant PYY has biological activity in the chicken embryo.

Peptide YY seems to modify the digestive processes to ensure efficient utilization of ingested food (Hallden and Aponte, 1997). The biological activities of PYY include inhibition of gut motility and gastrointestinal and pancreatic secretions (Savage et al., 1987; Hallden and Aponte, 1997), and stimulation of jejunal absorption of glucose in mice (Bird et al., 1996). Although nutrient uptake of hatching broiler chicks was not measured in the present study, enhanced nutrient absorption by the intestinal tract of hatching chicks is one possible explanation for the observed increased growth rates and improved AFCR during the 1st wk of life (Table 1).

Moran (1985) reported the average turnover of avian intestinal epithelial cells averages 2 d. Hence, the cessation of enhanced growth and the efficiency of FCR after 1 wk posthatch would coincide with the complete turnover of the embryonic epithelial cells affected after in ovo administration of PYY. In the present study, PYY was administered on Day 18 of incubation 3 d prior to hatching. We presume that PYY was absorbed by the embryonic membranes of the egg and systemically transferred to the embryo. Peptide YY is known to exert effects on the intestinal tract when administered systemically (Bird et al., 1996) and luminally (Hallden and Aponte, 1997).

Kuenzel et al. (1987) reported that PYY administered intracerebroventricularly in broiler chicks markedly increased feed intake compared to that of saline-injected control birds. In the present study, however, no differences in feed intake were noted (Table 1). Hence, it is unlikely that the observed differences in chick weight and AFCR at 7 d of age is attributable to differences in nutrient consumption associated with PYY administration. The results presented herein support indirectly the hypothesis that intestinal absorption may limit growth and performance of the modern broiler chicken (Obst and Diamond, 1992; Croom et al., 1998). These conclusions are tentative, however, because no direct measurements of intestinal nutrient uptake were made during the course of the study. We cannot discount the possibility of other undescribed biological effects of PYY that could account for the observed posthatch increase in growth and improvement of performance. Further experimentation, including the posthatch administration of PYY and concomitant measurement of nutrient absorption during a 6-wk growth trial, is needed to fully evaluate the role.

**TABLE 1. Effect of in ovo (± SEM) peptide YY (PYY) administration at Day 18 of incubation on BW, feed intake, and adjusted feed conversion ratio (AFCR) in broiler chicks**

<table>
<thead>
<tr>
<th>Age (d)</th>
<th>BW (g)</th>
<th>Feed intake</th>
<th>AFCR (g/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>PYY</td>
<td>Control</td>
<td>PYY</td>
</tr>
<tr>
<td>1</td>
<td>43.72 ± 0.15</td>
<td>43.82 ± 0.20</td>
<td>0.68</td>
</tr>
<tr>
<td>7</td>
<td>165.73 ± 1.47</td>
<td>170.17 ± 1.39</td>
<td>0.02</td>
</tr>
<tr>
<td>21</td>
<td>641.10 ± 5.18</td>
<td>645.06 ± 4.94</td>
<td>0.57</td>
</tr>
<tr>
<td>42</td>
<td>2,345.22 ± 34.09</td>
<td>2,374.85 ± 30.97</td>
<td>0.20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1.32 ± 0.01</td>
<td>1.31 ± 0.02</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5.62 ± 0.07</td>
<td>5.69 ± 0.06</td>
</tr>
<tr>
<td></td>
<td></td>
<td>22.55 ± 0.41</td>
<td>22.51 ± 0.43</td>
</tr>
<tr>
<td>7</td>
<td>1.55 ± 0.02</td>
<td>1.49 ± 0.02</td>
<td>0.04</td>
</tr>
<tr>
<td>21</td>
<td>1.37 ± 0.01</td>
<td>1.38 ± 0.01</td>
<td>0.77</td>
</tr>
<tr>
<td>42</td>
<td>1.88 ± 0.02</td>
<td>1.87 ± 0.02</td>
<td>0.58</td>
</tr>
</tbody>
</table>

1 n = 210/treatment. 2 t = Time of placement.
of PYY in beneficially altering intestinal function and its subsequent effects on performance.

REFERENCES


