Effect of Dietary Stevia (Stevia rebaudiana) Extract on Gizzard Erosion and Ulceration Induced by Dietary Histamine in Broiler Chicks

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An experiment was conducted to determine if dietary Stevia (Stevia rebaudiana) extract prevents gizzard erosion and ulceration of chicks induced by dietary histamine. Day old broiler chicks were fed on a basal diet, a diet with 0.4% histamine or a diet containing 0.2% Stevia extract (on dry matter basis) + 0.4% histamine for 14 days. Dietary histamine reduced growth and caused occurrence of gizzard erosion and ulceration as previously reported. Feeding of Stevia extract containing diet partly prevented retardation of growth and occurrence of gizzard erosion and ulceration caused by histamine. The result shows that the Stevia extract contains active substance(s) that attenuates histaminic action.

Key words: Stevia extract, growth, gizzard erosion, broiler

Introduction

Stevia, a perennial plant with the scientific name of Stevia rebaudiana is known as a sweetening substance that is used for refreshing drinks and various foods in Japan. It has been reported that Stevia and its related compounds have some physiological functions including antioxidant properties. Sato and Takeuchi (1996) showed that antioxidant activity of Stevia stem extract was much higher than Stevia leaf extract or green tea extract in vitro and in vivo studies.

Harry et al. (1975) observed that addition of histamine to normal feed resulted in growth depression and occasional death in chicks. Thus histamine is a factor occurring gastric erosion and ulceration in young chicks. Das and Banerjee (1993) showed that lipid peroxidation of gastric tissue and an occurrence of gastric ulceration were positively correlated with increase in histamine secretion in rats. Therefore, antioxidant property of Stevia extract might be anticipated to protect chicks from some disturbance occurred by excess histamine production or stress. In this preliminary experiment, an experiment was conducted to determine if dietary Stevia extract prevents gizzard erosion and ulceration and growth depression of chicks induced by dietary histamine...
histamine.

**Materials and Methods**

Thirty-six male broiler chicks (day old, Ross strain) were divided into 3 dietary groups of 12 chicks each and were kept at two chicks per cage. A grounded commercial broiler starter diet (CP 20% and ME 3,000 kcal/kg) was used as a basal diet. Birds were given either the basal diet, a diet containing 0.4% histamine (histamine diet) or a diet containing 0.2% Stevia extract + 0.4% histamine (Stevia diet) from a day old to 14 days of age *ad libitum*. Room and cage temperature were set on the conventional temperature cited by Sulistiyanto et al. (1999). Briefly, day old chicks were allocated to electrically heated cages at 36°C and the temperature gradually lowered to 26°C at 10 days of age and the temperature was kept at constant (24°C) until the end of experiment. Water was provided *ad libitum*. Light was provided 24 hours a day through the experimental period. At 7 days of age, ten out of 12 chicks in each dietary group were selected to eliminate poor growth chicks.

Stevia extracts was obtained from JJB Stevia Laboratory Ltd, (Urawa, Japan), which is made mainly of Stevia stem (20% leaf and 80% stem). They were prepared by following procedures: Stevia leaf and stem was extracted in boiling water and concentrated and thereafter fermented. The extract contained 20% (W/V) of dry matters. The extract in 100 ml contained 23 μg beta-carotene, 13 IU vitamin A, 6.3 μg biotin, 0.21 mg vitamin B2, 2.4 mg niacin, 0.98 mg pantothenic acid, 120 mg calcium, 1.3 mg iron, 2.2 g potassium, 20 mg phosphorus, 22 mg sodium and 47 kcal of gross energy (Sato and Takeuchi, 1996).

At the end of the experiment, the proventriculus and gizzard of 10 chicks in each dietary group were removed. After dissecting and washing them free of feed residue, intensity of gizzard erosion and ulceration (GE) were scored on an arbitrary scale by the method of Horaguchi et al. (1980). Briefly, intensity 0 is that no abnormality is observed in a kerationoid layer, and the degree of roughening and erosion is very slight. Intensity 1 is that slight changes in roughening and a disorder in the alignment of folds are observed. Intensity 2 is that deficiency is more clearly observed in a kerationoid layer and intensity 3 is that ulceration of the gizzard is significant that a perforation reaches the abdominal cavity. Intensity 2 and 3 of GE score were considered as occurrences of severe gastric erosion and ulceration. Data were subjected to one-way analysis of variance in General Linear Model of SAS (SAS Institute, Cary, NC, USA). Duncan's multiple range tests were used to detect differences among treatment means in growth performance. Fisher test was applied for occurrence of severe gastric erosion and ulceration.

**Results and Discussion**

The results in the present experiment (Tables 1 and 2) confirmed the previous findings by Shifrine et al. (1959), Harry et al. (1975) and Watanabe et al. (1987) that histamine developed gastric erosion and ulceration, and growth depression. Dietary Stevia up to 0.085% did not cause any disturbance in growth performances in broilers...
Table 1. Effect of histamine and Stevia extracts on growth performance in broiler chicks

<table>
<thead>
<tr>
<th>Dietary group</th>
<th>Feed intake(^1) (g)</th>
<th>Body weight gain(^2) (g)</th>
<th>Feed efficiency(^1) (g/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>331±5(^a)</td>
<td>231±12(^a)</td>
<td>0.693±0.015(^a)</td>
</tr>
<tr>
<td>0.4% histamine</td>
<td>255±6(^b)</td>
<td>147±11(^b)</td>
<td>0.627±0.013(^b)</td>
</tr>
<tr>
<td>0.4% histamine + 0.2% Stevia</td>
<td>267±6(^b)</td>
<td>177±9(^a)</td>
<td>0.661±0.007(^b)</td>
</tr>
</tbody>
</table>

\(^1\) Values are means±SE for 5 observations.
\(^2\) Values are means±SE for 10 observations.

Values in a column with different superscript letters are significantly different (P < 0.05).

Table 2. Effect of histamine and Stevia extracts on intensity and severity of gizzard erosion and ulceration (GE) in broiler chicks

<table>
<thead>
<tr>
<th>Dietary group</th>
<th>GE intensity(^d) and number involved</th>
<th>GE score(^d)</th>
<th>Occurrence of severe GE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>0 1 2 3</td>
<td>0 5</td>
<td>0/10</td>
</tr>
<tr>
<td>0.4% histamine</td>
<td>1 3 3 3</td>
<td>3 18</td>
<td>6/10*</td>
</tr>
<tr>
<td>0.4% histamine + 0.2% Stevia</td>
<td>4 3 2 1</td>
<td>10</td>
<td>3/10</td>
</tr>
</tbody>
</table>

\(^*\) Significantly different relative to the control (P<0.05).
\(^d\) intensity 0: no abnormality is observed in a keratinoid layer, and the degree of roughening and erosion is very slight. Intensity 1: slight changes in roughening and a disorder in the alignment of folds are observed. Intensity 2: deficiency is more clearly observed in a keratinoid layer. Intensity 3: ulceration of the gizzard is significant that a perforation reaches the abdominal cavity. GE intensity.

\(^d\) GE score=GE intensity×number of chicks involved.

under the conventional breeding condition (Wood et al., 1996). In this experiment, an addition of Stevia extract to histamine-contained diet partially prevented the growth depression and gastric erosion by histamine. Stevia extract used in the present study was prepared mainly from stem of Stevia, which contained less stevioside and rebaudioside A. The extract from Stevia stem has been shown to present higher anti-oxidizing activity than that of Stevia leaf or green tea extract known as antioxidants (Sato and Takeuchi, 1996). Das and Banerjee (1993) showed that cold-restraint stress in rats caused an increase in gastric histamine and pepsin contents with progress of ulceration, and that increased tissue lipid peroxidation due to generation of reactive oxygen species such as hydrogen peroxide and reactive hydroxyl radical. Therefore, a favorable effect of the Stevia extract obtained in this experiment is possibly due to anti-oxidizing activity of the extract. Since many factors were involved in inducing gastric erosion and ulceration, and growth depression following histamine secretion (Masumura et al., 1985; Miyazaki and Umemura, 1987), the other possible explana-
tions might be given for the anti-histamine effect of the Stevia extract. The extract inhibits of histamine incorporation from intestine, activates histamine catabolism, blocks of H2-histamine receptor, depresses gastric secretion (inhibition of H+/K+ -ATPase) and/or inhibits peptic activity.

Yamada et al. (1985) indicated that Stevia extract had no chronic toxicity in rats. Tomita et al. (1997) showed that the Stevia extract has strong bactericidal activity against a wide range of food-borne pathogenic bacteria without activity of Bifidobacteria and Lactobacilli suggesting that the extract from Stevia stem has potential to maintain desirable intestinal microbiota. Thus an addition of the Stevia extract to poultry feed may be beneficial to maintain or enhance poultry performance under certain stressful conditions.

References


