Note

Increasing Effect of Dietary Taurine on the Serum HDL-cholesterol Concentration in Rats

Hideki MOCHIZUKI, Hiroaki ODA,* and Hidehiko YOKOGOSHI

School of Food and Nutritional Sciences, The University of Shizuoka, 52-1 Yada, Shizuoka 422-8526, Japan
*Department of Applied Biological Sciences, Nagoya University, Nagoya 464-8601, Japan

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Taurine, 2-amino ethanesulfonic acid, is the major free intracellular amino acid present in many tissues and plays an important role in lipid metabolism such as that of bile acid conjugation for fat absorption. The effect of taurine on the serum cholesterol level in normal rats was investigated. Taurine enhanced the serum HDL-cholesterol concentration in a dose-dependent manner without any change in total cholesterol.

Key words: taurine; serum cholesterol; HDL-cholesterol; normal rat

Taurine has various biological and physiological functions, including cell membrane stabilization, antioxidation,1) detoxification,2) osmoregulation, neuromodulation,3) and brain and retinal development.4) It is also known that taurine is an essential nutrient for cats,5) and that formula-fed preterm infants were unable to maintain normal plasma and urinary taurine levels without any apparent functional impairment.6,7) Besides lipid metabolism, taurine plays a crucial role in the production of bile acid conjugates in the liver. Taurine causes an increase in the utilization of bile acid which is the degrading metabolite of cholesterol and participates in fat absorption.7) A number of studies concerned with the effect of taurine on cholesterol metabolism have been conducted, but almost all experiments were carried out on animals with hypercholesterolemia that had been induced by feeding a high cholesterol diet.8,9) There have been few studies with normal rat on the relationship between taurine and serum cholesterol.10,11)

In this paper, the effects of various levels of taurine on cholesterol in the serum and liver are reported.

Young male rats of the Wistar strain weighing about 60 g (Japan SLC, Hamamatsu, Japan) were maintained at 24°C with a 12-hr light (7:00-19:00 hr) and dark cycle. To accustom the rats to the experimental conditions, they were initially fed ad libitum for 2 days with a 20% casein diet (basal diet), before being divided into groups. The composition of the basal diet was (in weight percent): casein, 20; mineral mixture (AIN-93G; Nihon Nosan, Yokohama, Japan), 5.0; corn oil, 5.0; vitamin mixture (AIN-7612); Nihon Nosan); choline chloride, 0.15; and a mixture of sucrose and corn starch (1:2) to 100%. In the experimental diets, taurine was supplemented at levels of 0.5%, 1%, 3%, and 5% to the basal diet at the expense of carbohydrate. The animals were individually housed and given free access to the experimental diets and water for 12 days (experiment 1) or for 14 days (experiment 2). The rats were killed by decapitation at around 10:00 a.m. after 16 hr of fasting on the last day of the experiment, and blood was collected from the cervical wound. The total lipids in the liver were extracted by the method of Folch et al.13) and were determined gravimetrically. The serum lipids (total cholesterol and HDL-cholesterol) and liver cholesterol were measured enzymatically with kits (cholesterol C-test and HDL-cholesterol-test; Wako Pure Chemicals, Osaka, Japan). The experimental procedures used in this study met the guidelines of the Animal Care and Use Committee of the University of Shizuoka. Experimental data were statistically analyzed by a one-way analysis of variance (ANOVA) and then by Duncan’s multiple-range test.14)

In our previous experiments, the concentration of serum HDL-cholesterol in rats fed on a 5% taurine-containing diet was significantly elevated as compared with that in rats fed on the basal diet (basal diet group vs taurine-diet group; 48.1 ± 3.0 vs 66.8 ± 3.9, 31.9 ± 2.2 vs 40.7 ± 1.8, 32.3 ± 2.4 vs 41.8 ± 2.2, 19.1 ± 2.8 vs 30.4 ± 2.3 mg/dl, respectively, in experiments where the test diets were provided for different periods). Therefore, the dose-dependent effects of taurine on serum cholesterol were investigated in the first experiment (Table 1). The addition of taurine had little or no influence on the food intake, body weight gain and liver weight. Although the serum total cholesterol concentration and hepatic lipids content were unaltered by taurine supplementation, the HDL-cholesterol level was significantly increased by taurine in a dose-dependent manner. The liver cholesterol content did not change or tended to decrease with taurine supplementation. It is well known that taurine can diminish the degree of increase in the serum cholesterol concentration induced by feeding a diet containing a large amount of cholesterol.15) In the second experiment to compare with the effect of feeding the basal diet, taurine increased serum HDL-

Abbreviations: HDL, high-density lipoprotein; Apo A-I, apolipoprotein A-I; mRNA, messenger ribonucleic acid
cholesterol without an accompanying elevation of total cholesterol (Table II). Apo A-I is the principal apolipoprotein consisting of HDL-cholesterol, so the content of Apo A-I may be related to the synthesis of HDL-cholesterol in the liver and to the concentration of serum HDL-cholesterol as well. In our first experiment, the concentration of hepatic Apo A-I mRNA tended to be greater in those rats fed on a test diet containing 5% taurine (1.9, 1.6, 1.5, 1.1- or 1.0-fold increase according to the period of feeding the test diets).

Therefore, taurine may have been responsible for the increase of HDL-cholesterol synthesis in the liver or may have modified the balance of each serum lipoprotein containing cholesterol.

References

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**Table I.** Effect of Dietary Taurine on Body Weight Gain, Liver Weight, and Lipids in the Serum and Liver (experiment 1)

<table>
<thead>
<tr>
<th>Dietary level of taurine</th>
<th>Body weight gain</th>
<th>Liver weight</th>
<th>Serum total cholesterol</th>
<th>Serum HDL-cholesterol</th>
<th>Liver total lipids</th>
<th>Liver cholesterol</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>g/12 days</td>
<td>% of body weight</td>
<td>mg/dl</td>
<td>mg/dl</td>
<td>mg/g of liver</td>
<td>mg/g of liver</td>
</tr>
<tr>
<td>0</td>
<td>51.4±1.5</td>
<td>2.97±0.14b</td>
<td>76.5±3.5b</td>
<td>32.8±2.0b</td>
<td>54.7±0.5</td>
<td>3.05±0.17b</td>
</tr>
<tr>
<td>0.5</td>
<td>51.8±2.2</td>
<td>3.06±0.06ab</td>
<td>68.9±3.1ab</td>
<td>38.5±1.3b</td>
<td>50.7±1.6</td>
<td>3.03±0.04ab</td>
</tr>
<tr>
<td>1.0</td>
<td>56.8±1.0</td>
<td>3.25±0.09b</td>
<td>64.9±3.5b</td>
<td>43.7±1.0f</td>
<td>50.5±1.4</td>
<td>3.11±0.08b</td>
</tr>
<tr>
<td>3.0</td>
<td>56.1±3.5</td>
<td>3.21±0.07b</td>
<td>83.4±8.3f</td>
<td>44.0±1.5f</td>
<td>48.3±1.5</td>
<td>2.80±0.11ab</td>
</tr>
<tr>
<td>5.0</td>
<td>53.4±1.2</td>
<td>3.11±0.06ab</td>
<td>80.3±5.5f</td>
<td>44.5±2.1f</td>
<td>56.0±10</td>
<td>2.72±0.10f</td>
</tr>
</tbody>
</table>

Rats were fed on the test diets for 12 days. Each value is the mean±SEM for 5 rats. Within a column, values with different superscripts are significantly different (p<0.05).

**Table II.** Effect of Dietary Taurine on Body Weight Gain, Liver Weight, and Serum Cholesterol (experiment 2)

<table>
<thead>
<tr>
<th>Dietary level of taurine</th>
<th>Body weight gain</th>
<th>Liver weight</th>
<th>Serum total cholesterol</th>
<th>Serum HDL-cholesterol</th>
</tr>
</thead>
<tbody>
<tr>
<td>%</td>
<td>g/14 days</td>
<td>% of body weight</td>
<td>mg/dl</td>
<td>mg/dl</td>
</tr>
<tr>
<td>0</td>
<td>56.9±2.3</td>
<td>3.59±0.12</td>
<td>119±5.8</td>
<td>32.3±2.4</td>
</tr>
<tr>
<td>5.0</td>
<td>54.4±1.6</td>
<td>3.57±0.08</td>
<td>123±4.9</td>
<td>41.8±2.2</td>
</tr>
</tbody>
</table>

Rats were fed on the test diets for 14 days. Each value is the mean±SEM for 8 rats. Within a column, values with different superscripts are significantly different (p<0.05).