Effect of Wheat Flour, Bengal Gram Flour and Corn Flour on Lipid Metabolism in Rats

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Summary Male albino rats were fed on respective diets of wheat flour, Bengal gram flour and corn flour for 8 weeks at the 59% level. It was observed that the increase in weight after wheat flour and Bengal gram flour feeding was 6.8 and 12.0% respectively and that the decrease after corn flour feeding was 5.2% as compared to the control animals on sucrose diet. Serum cholesterol and liver cholesterol levels were significantly (p<0.01) decreased after wheat flour, Bengal gram flour and corn flour feeding.

Key Words cholesterol, fecal sterols, flours, rats

Hypercholesterolemia is considered as a major risk factor in the pathogenesis of atherosclerosis (19, 23). It has been observed that cereals and legumes play an important role in decreasing the blood cholesterol level (4, 9, 16, 21). Maclean et al. (15) and Ranhotra et al. (21) have reported that wheat flour reduces serum and liver cholesterol levels. Java et al. (10) and Mathur et al. (17) have found that Bengal gram lowers serum and liver cholesterol levels and increases fecal sterol excretion. Rademyer and Booyens (22) observed that maize decreases serum cholesterol levels and enhances fecal sterol excretion.

This paper deals with the effects of whole wheat flour, Bengal gram flour and corn flour on serum and liver cholesterol and serum glucose levels and total fecal sterol excretion.

MATERIALS AND METHODS

Male albino rats weighing 60–80 g were used in the experiment and fed for 8 weeks on the semipurified diet. The composition of the diet is given in Table 1. Animals were housed in groups of four, each cage having a raised wire floor. The rats were kept for adjustment for a week by the feeding of mouse feed. The experiment was carried out on four groups. To one group a control diet was given...
Table 1. Composition of the control, wheat flour, Bengal gram flour and corn flour diets.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Ingredient</th>
<th>Control (g)</th>
<th>Wheat flour (g)</th>
<th>Bengal flour (g)</th>
<th>Corn flour (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Sucrose</td>
<td>59.0</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>2</td>
<td>Wheat flour</td>
<td>—</td>
<td>59.0</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>3</td>
<td>Bengal gram flour</td>
<td>—</td>
<td>—</td>
<td>59.0</td>
<td>—</td>
</tr>
<tr>
<td>4</td>
<td>Corn flour</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>59.0</td>
</tr>
<tr>
<td>5</td>
<td>Casein (fat and vitamin free)</td>
<td>15.0</td>
<td>15.0</td>
<td>15.0</td>
<td>15.0</td>
</tr>
<tr>
<td>6</td>
<td>Fat (hydrogenated)</td>
<td>20.0</td>
<td>20.0</td>
<td>20.0</td>
<td>20.0</td>
</tr>
<tr>
<td>7</td>
<td>Mineral mixture(^a)</td>
<td>4.0</td>
<td>4.0</td>
<td>4.0</td>
<td>4.0</td>
</tr>
<tr>
<td>8</td>
<td>Vitamin mixture(^b)</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>9</td>
<td>Choline chloride</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>10</td>
<td>Cholesterol</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
</tr>
</tbody>
</table>

\(^a\) Composition of the mineral mixture was the same as in reference (12). \(^b\) Composition of the vitamin mixture was the same as in reference (14).

while to the other three, wheat flour, Bengal gram flour and corn flour diets were supplied. To each group, food and water were supplied ad libitum. The experiment was carried out at a temperature of 18–20°C. The weight of each group of animals was recorded at the start as well as at the end of the experiment. During the final week the feces of each group were collected over 48 h. The rats were fasted overnight and anesthetized with ether. The blood was drawn by heart puncture with a disposable syringe and the blood was transferred to dried test tubes. Serum was obtained by centrifuging at 2,500 rpm for 10 min (5). Feces were dried in an oven at 60–70°C overnight and lipids were extracted from the feces with a chloroform–methanol mixture (2:1) v/v. The feces were refluxed at 55°C for 2 h and the mixture was allowed to stand overnight. The mixture was centrifuged and the lipids were recovered. The residue was re-extracted with a chloroform-methanol mixture. The two extracts were combined and the volume was adjusted to a certain level using a chloroform-methanol mixture (1). Lipids were also extracted from a sample of liver with the chloroform-methanol mixture (1). Serum cholesterol, liver cholesterol and total fecal sterols were estimated by King and Wotton’s method (13) and serum glucose was determined by Haury’s method (6).

RESULTS AND DISCUSSION

Weight gain

In this experiment wheat flour, Bengal gram flour and corn flour were fed to rats for 8 weeks at the 59% level. The results are given in Table 2. When compared to the controls, weight gain was higher after feeding of wheat flour and Bengal gram.
Table 2. Effects of wheat flour, Bengal gram flour and corn flour on serum cholesterol, liver cholesterol, serum glucose levels and fecal sterol excretion in albino rats.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Control</th>
<th>Whole wheat flour</th>
<th>Bengal gram flour</th>
<th>Corn flour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gain in weight (g)</td>
<td>160.0 ± 15.4</td>
<td>170.9 ± 15.4</td>
<td>179.5 ± 17.5</td>
<td>159.2 ± 11.5</td>
</tr>
<tr>
<td>Liver weight (g)</td>
<td>7.6 ± 0.93</td>
<td>6.9 ± 0.64</td>
<td>6.6 ± 0.5</td>
<td>5.2 ± 0.4</td>
</tr>
<tr>
<td>Serum cholesterol (mg/dl)</td>
<td>260.2 ± 21.5</td>
<td>197.1 ± 21.7</td>
<td>187.1 ± 19.1</td>
<td>163.5 ± 20.4</td>
</tr>
<tr>
<td>Liver cholesterol (mg/100 g)</td>
<td>363.3 ± 18.7</td>
<td>320.1 ± 15.4</td>
<td>217.3 ± 9.0</td>
<td>261.2 ± 11.4</td>
</tr>
<tr>
<td>Serum glucose (mg/dl)</td>
<td>145.3 ± 9.3</td>
<td>105.7 ± 7.7</td>
<td>91.8 ± 7.6</td>
<td>87.1 ± 4.5</td>
</tr>
<tr>
<td>Fecal sterol excretion</td>
<td>98.5 ± 4.3</td>
<td>210.1 ± 12.7</td>
<td>240.6 ± 18.7</td>
<td>162.2 ± 21.4</td>
</tr>
</tbody>
</table>

Values are mean of four rats and ± SEM. Numbers in parentheses mean percent changes from control, increase being shown by ** and decrease by *.

flour by 6.8 and 12.0% respectively, whereas it was lower after corn flour feeding by 5.2%.

**Concentration of serum cholesterol**

Serum cholesterol concentration was significantly lower in the rats on wheat flour, Bengal gram flour (p < 0.05) and corn flour diets (p < 0.01) than in the control. Differences in the serum cholesterol for level between each flour group and the control averaged 32.0, 39.0 and 59.1% respectively. The results were similar to those of Java et al. (10) who studies the chick pea and green gram in germinated and ungerminated form and showed that both legumes lowered the serum cholesterol level. Ranhotra et al. (21) also observed that substitution of wheat flour reduced the serum cholesterol level. Patent flour was shown to have a greater effect than highly extracted flour. Mathur et al. (16) reported that Bengal gram, a protein-rich legume, was found to have a marked hypocholesterolemic effect. Maclean et al. (15) also showed that when humans consumed whole wheat flour or white flour, the serum cholesterol level was lowered. Rademyer and Booyens (22) found that substitution of maize meal at the expense of glucose greatly decreased the serum cholesterol level.

**Liver cholesterol content**

The liver cholesterol content was significantly (p < 0.05) lower in the rats on wheat flour, Bengal gram flour and corn flour diet as compared to the control. Mean differences of the liver cholesterol level in each flour groups from the control
were 11.8, 67.1 and 28.0%, respectively. The results were comparable to those of Java et al. (10) who observed that legumes lowered the liver cholesterol level. Ranhotra et al. (21) also reported that wheat flour reduced liver cholesterol levels.

Concentration of serum glucose

Serum glucose concentration was significantly lower after wheat flour, Bengal gram flour and corn flour feeding \( (p<0.01) \) as compared to the control. Serum glucose levels were lowered by 27.3, 36.8 and 40.0%, respectively.

Total fecal sterol excretion

Fecal sterol excretion was significantly higher after feeding of wheat flour \( (p<0.05) \), Bengal gram flour \( (p<0.01) \) and corn flour \( (p<0.01) \). It was higher in the groups on wheat flour, Bengal gram flour and corn flour than in the control by 134.1, 144.2 and 64.6% respectively. The results were somewhat similar to those of Mathur et al. (17) who reported that Bengal gram increased fecal sterol excretion. Rademyer and Booyens (22) showed that maize meal enhanced the fecal excretion of cholesterol.

It is thus concluded that the flours used contained unsaturated fatty acids, protein, fibers and plant sterols which were involved in the hypocholesterolemic action.

It has been reported by many investigators that plant proteins are effective in lowering serum cholesterol levels by increasing fecal sterol excretion (2, 15).

This view is also supported by many authors, in that polyunsaturated fatty acids can reduce serum cholesterol levels (7, 8, 18).

Fiber, which was one of the components of the flours used, might influence serum cholesterol by decreasing its level along with increased fecal sterol excretion (1, 11, 23, 24). The plants also contained phytosterol which is considered to be a hypocholesterolemic agent interfering with cholesterol absorption (20).

The decrease of serum cholesterol concentration observed in this experiment might be due to either an inhibition of cholesterol biosynthesis or an increase of total fecal sterol excretion, or both.

REFERENCES


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