Long-term consumption of polysaccharide gel from durian fruit-hulls in mice

Sunanta Pongsamart\textsuperscript{1}, Achara Tawatsin\textsuperscript{3}, and Suchada Sukrong\textsuperscript{2}

Abstract

Pongsamart, S., Tawatsin, A. and Sukrong, S.
Long-term consumption of polysaccharide gel from durian fruit-hulls in mice

Consumptive safety studies of durian polysaccharide gel were performed in mice. The polysaccharide gel, DF\textsubscript{II} and DF\textsubscript{I}, were given orally for 60 and 100 days to male and female groups, respectively. The oral doses of 0.25 g/kg/d of DF\textsubscript{II} or DF\textsubscript{I} or standard polysaccharide pectin or a high dose of 0.5 g/kg/d of DF\textsubscript{II}, were given to test groups. Food and water were given ad libitum. The results indicated that no toxic effect was induced in treated mice. Relative body weight gain profile in treated mice was not different (p>0.05) from its control. However, the lowest mean values of relative weight gain were obtained at finale in male and female groups treated with 0.5 g/kg/d of DF\textsubscript{II}. Other pathological effects were examined by clinical analysis of animal blood and serum. Normal hematologic results and clinical data of glucose, cholesterol, creatinine and BUN in treated groups were found and was not significantly different (p>0.05) from those of control and/or standard groups. However, mean values of serum cholesterol in DF\textsubscript{II} and DF\textsubscript{I} treated groups were rather low in comparison to their control and standard. The serum enzymes ALP, AST (SGOT) and ALT (SGPT) were examined for detection of any pathological changes of the liver. No significant elevation of these enzymes (p>0.05) in DF\textsubscript{II} and DF\textsubscript{I} treated groups was observed in comparison

\textsuperscript{1}Ph.D. (Medicinal Chemistry), Assoc. Prof., \textsuperscript{2}M.Sc. (Pharmacognosy), Department of Biochemistry, Faculty of Pharmaceutical Sciences, \textsuperscript{3}M.S. (Microbiology), Asst. Prof., Department of Veterinary Medicine, Faculty of Veterinary Sciences, Chulalongkorn University, Phaya Thai, Bangkok 10330 Thailand.

Corresponding e-mail : sunanta.Po@chula.ac.th

Received, 28 April 2001 Accepted, 21 May 2002
Consumption of polysaccharide gel from durian in mice
Pongsamart, S., et al.

Key words: consumptive safety, toxic effects, durian polysaccharide gel, Durio zibethinus

Subchronic toxicity in this study suggests that polysaccharide gel from fruit-hulls of durian at oral doses of 0.25 and 0.5 g/kg/d could be consumed safely for a long period of 60-100 days in male and female mice.

uptight

Subchronic toxicity in this study suggests that polysaccharide gel from fruit-hulls of durian at oral doses of 0.25 and 0.5 g/kg/d could be consumed safely for a long period of 60-100 days in male and female mice.

Key words: consumptive safety, toxic effects, durian polysaccharide gel, Durio zibethinus

Subchronic toxicity in this study suggests that polysaccharide gel from fruit-hulls of durian at oral doses of 0.25 and 0.5 g/kg/d could be consumed safely for a long period of 60-100 days in male and female mice.

Key words: consumptive safety, toxic effects, durian polysaccharide gel, Durio zibethinus

Subchronic toxicity in this study suggests that polysaccharide gel from fruit-hulls of durian at oral doses of 0.25 and 0.5 g/kg/d could be consumed safely for a long period of 60-100 days in male and female mice.

Key words: consumptive safety, toxic effects, durian polysaccharide gel, Durio zibethinus

Subchronic toxicity in this study suggests that polysaccharide gel from fruit-hulls of durian at oral doses of 0.25 and 0.5 g/kg/d could be consumed safely for a long period of 60-100 days in male and female mice.

Key words: consumptive safety, toxic effects, durian polysaccharide gel, Durio zibethinus

Subchronic toxicity in this study suggests that polysaccharide gel from fruit-hulls of durian at oral doses of 0.25 and 0.5 g/kg/d could be consumed safely for a long period of 60-100 days in male and female mice.

Key words: consumptive safety, toxic effects, durian polysaccharide gel, Durio zibethinus

Subchronic toxicity in this study suggests that polysaccharide gel from fruit-hulls of durian at oral doses of 0.25 and 0.5 g/kg/d could be consumed safely for a long period of 60-100 days in male and female mice.

Key words: consumptive safety, toxic effects, durian polysaccharide gel, Durio zibethinus

Subchronic toxicity in this study suggests that polysaccharide gel from fruit-hulls of durian at oral doses of 0.25 and 0.5 g/kg/d could be consumed safely for a long period of 60-100 days in male and female mice.

Key words: consumptive safety, toxic effects, durian polysaccharide gel, Durio zibethinus

Subchronic toxicity in this study suggests that polysaccharide gel from fruit-hulls of durian at oral doses of 0.25 and 0.5 g/kg/d could be consumed safely for a long period of 60-100 days in male and female mice.

Key words: consumptive safety, toxic effects, durian polysaccharide gel, Durio zibethinus

Subchronic toxicity in this study suggests that polysaccharide gel from fruit-hulls of durian at oral doses of 0.25 and 0.5 g/kg/d could be consumed safely for a long period of 60-100 days in male and female mice.

Key words: consumptive safety, toxic effects, durian polysaccharide gel, Durio zibethinus

Subchronic toxicity in this study suggests that polysaccharide gel from fruit-hulls of durian at oral doses of 0.25 and 0.5 g/kg/d could be consumed safely for a long period of 60-100 days in male and female mice.

Key words: consumptive safety, toxic effects, durian polysaccharide gel, Durio zibethinus

Subchronic toxicity in this study suggests that polysaccharide gel from fruit-hulls of durian at oral doses of 0.25 and 0.5 g/kg/d could be consumed safely for a long period of 60-100 days in male and female mice.

Key words: consumptive safety, toxic effects, durian polysaccharide gel, Durio zibethinus

Subchronic toxicity in this study suggests that polysaccharide gel from fruit-hulls of durian at oral doses of 0.25 and 0.5 g/kg/d could be consumed safely for a long period of 60-100 days in male and female mice.

Key words: consumptive safety, toxic effects, durian polysaccharide gel, Durio zibethinus

Subchronic toxicity in this study suggests that polysaccharide gel from fruit-hulls of durian at oral doses of 0.25 and 0.5 g/kg/d could be consumed safely for a long period of 60-100 days in male and female mice.

Key words: consumptive safety, toxic effects, durian polysaccharide gel, Durio zibethinus

Subchronic toxicity in this study suggests that polysaccharide gel from fruit-hulls of durian at oral doses of 0.25 and 0.5 g/kg/d could be consumed safely for a long period of 60-100 days in male and female mice.

Key words: consumptive safety, toxic effects, durian polysaccharide gel, Durio zibethinus

Subchronic toxicity in this study suggests that polysaccharide gel from fruit-hulls of durian at oral doses of 0.25 and 0.5 g/kg/d could be consumed safely for a long period of 60-100 days in male and female mice.

Key words: consumptive safety, toxic effects, durian polysaccharide gel, Durio zibethinus

Subchronic toxicity in this study suggests that polysaccharide gel from fruit-hulls of durian at oral doses of 0.25 and 0.5 g/kg/d could be consumed safely for a long period of 60-100 days in male and female mice.

Key words: consumptive safety, toxic effects, durian polysaccharide gel, Durio zibethinus

Subchronic toxicity in this study suggests that polysaccharide gel from fruit-hulls of durian at oral doses of 0.25 and 0.5 g/kg/d could be consumed safely for a long period of 60-100 days in male and female mice.

Key words: consumptive safety, toxic effects, durian polysaccharide gel, Durio zibethinus

Subchronic toxicity in this study suggests that polysaccharide gel from fruit-hulls of durian at oral doses of 0.25 and 0.5 g/kg/d could be consumed safely for a long period of 60-100 days in male and female mice.
Polysaccharide gel isolated from fruit-hulls of durian (*Durio zibethinus* L.) has been found to be useful in preparation of jellies and jams, (Pongsamart et al., 1989 a), and as excipient in pharmaceutical preparations such as tablet, suspension and emulsion (Umprayn et al., 1990 abc; Pongsamart, 1989). The chemical composition and sugar components of polysaccharides in form of DFI (crude) and DF II (partially purified) were previously described (Pongsamart and Panmaung, 1998). Toxic effects of a high oral dose of polysaccharide gel were also investigated in mice and rats, with the results indicating that polysaccharide gel did not induce acute toxicity in mice and rats (Pongsamart et al., 2001). Toxic effects did not occurred in subacute treatment at doses of 0.125, 0.25 and 0.5 g/kg/day for 10 days when compared with water and pectin which were used as a control and a standard polysaccharide, respectively (Pongsamart et al., 1989 b). The purpose of this study was to determine in more detail the consumptive safety after long-term treatment in male and female mice with a dose of 0.25 g/kg/day of DFI and DF II and pectin (a standard polysaccharide) as well as with a high dose of 0.5 g/kg/d of DF II. The pathological changes were characterized by observing the increment of the relative weight of internal organs especially liver weight and high levels of biochemical compositions in blood. The sign of liver damage was also characterized by the high levels of some enzymes in serum such as alkaline phosphatase (ALP) aspartate aminotransferase (AST; SGOT) and alanine aminotransferase (ALT; SGPT) (Fauci et al., 1998).

**Materials and Methods**

**Animals**

Female and male Swiss Albino mice, age 30-35 days (20-25 g) were obtained from the National Laboratory Animal Center, Mahidol University at Salaya. All animals were weighed and placed in individual stainless steel cages (8 × 10 in.). The animals were acclimatized for at least 3 days prior to the initiation of experiments in an experimental room with a controlled temperature (25±1°C) and 50-60 % humidity. Animals were maintained on a commercial pellet diet (from F.E. Zuellig Co.) and tap water *ad libitum*. Animal weights were recorded every morning at 8-10 am. throughout the experimental period.

**Polysaccharide gel extracts**

The polysaccharide gel isolated from fruit-hulls of durian includes DF I, a crude extract, and DF II, a partially purified form of DF I. The method of isolation of DF I and DF II, and its properties were previously described (Pongsamart and Panmaung, 1998). A 5% polysaccharide gel in water was freshly prepared before use. Oral feeding with stainless steel stomach needle was performed at a volume of 10 ml/kg body weight. The dose of 0.25 g/kg of DF I and DF II was given in test groups. A high dose of 0.5 g/kg of DF II was also performed in test groups of female and male mice.

**Experimental protocol**

Mice were housed singly in stainless steel cages, and given food and water *ad libitum*. Initial body weight of animals was recorded at day 0, the day on which experiment started. Two preparations of polysaccharide gel, DF I and DF II (0.25 g/kg/d) were given to the treated groups whereas pectin (0.25 g/kg/d) and water (10 ml/kg/d) were given to the standard and control groups, respectively. A high dose of DF II (0.5g/kg/d) was also given to female and male test groups. Each group of 14-15 male or 8 female mice received polysaccharide gel and pectin everyday for 60 and 100 days, respectively. Each animal was weighed before feeding every morning, food and water intake was also observed through out the experimental period. After 4 weeks of treatment, the treated females were housed with normal untreated male for mating. The pregnancy rate, litter size, number of offspring, offspring growth rate and animal weight were determined for the following 70 days of treatment. Offspring weight was recorded every
day after birth for 4 weeks.

On the final day of treatment, treated animals were weighed and then anesthetized with diethyl ether, and blood withdrawn immediately from the inferior vena cava using a heparinized hematocrit tube and syringe. Serum was obtained following centrifugation at $3,000 \times g$, 5 min, and used for biochemical and clinical analyses. Immediately following collection of the blood sample, liver, heart, lung and kidneys were rapidly removed and weighed. The internal organs were examined grossly.

Assessment of clinical parameters

Hematological parameters of blood samples were analyzed for hematocrit and hemoglobin. Blood count of red blood cells, white blood cells and lymphocytes were examined (Dacie and Lewis, 1975). Clinical pathology was assessed according to biochemical analysis, i.e. the increment of serum concentrations of glucose, cholesterol, creatinine and blood urea nitrogen (BUN) by using spectrophotometric assay. The elevation of enzyme levels of alkaline phosphatase (ALP), aspartate aminotransferase (AST or SGOT), and alanine aminotransferase (ALT or SGPT) was determined to assess toxic liver injury and biological toxicity.

Statistical method

Results are expressed as group mean values ± SD in tables; graphs were constructed using SigmaPlot Scientific Graphing Software for Windows, symbols and bars on graphs represent mean ± SD. Means not having superscripts in common are statistically different ($p<0.05$). Multiple means of the treatment, standard and control groups were examined by using SPSS for MS Windows program, and analysis undertaken using analysis of variance followed by Duncan's multiple range test or Post Hoc Tests to evaluate significant differences between groups. The limit for statistical significance ($\alpha$) was set at 0.05. Relative weight gain mean values were compared cross groups treated with different amounts and types of food at 10-day intervals for 60 and 100 days in male and female groups, respectively, and at 7-day intervals for 30 days in groups of offspring.

Results and Discussion

In a previous study, investigation of a high oral single dose (2 g/kg) of polysaccharide gel from fruit-hulls of durian indicated that no acute toxic effect was induced in mice and rats. Long-term treatment in mice with an oral dose of 0.25g/kg/d of $DF_i$ and $DF_{II}$ was performed in this study; pectin and water were used as a standard polysaccharide and control, respectively. A high dose of $DF_{II}$ (0.5 g/kg/d) was also assessed. These doses were about 5-10 times or more than 20 times which would be consumed in the recipe of food or drug formula, respectively. Normal behavior of animals was observed. Food and water were taken normally in treated groups as well as in the control group. Soft feces were excreted normally in treated group as well as in the groups of control and standard. However, at the first 1-2 weeks of treatment, some animals of the treated groups excreted very soft feces. This result may suggest a mild laxative property of polysaccharide fiber (Spiller, et al., 1979).

Effect of polysaccharide gel on body weight and internal organ weight

Initial body weight and relative weight gain in test male and female mice are illustrated in Figure 1 and Figure 2, respectively. Final body weights in test male and female are demonstrated in Table 1 and 2, respectively. Average body weights (Table 1) and the average weight gain profile in male groups (Figure 1) were not significantly different ($p>0.05$) from that of their control. However, the $DF_{II}$ at 0.5 g/kg/d treated group at final period of experiment showed the lowest average body weight. Figure 2 shows the profile of relative weight gain in female mice. The average weight gains of treated and control groups were not significantly different ($p>0.05$) at day 10 to 30 of treatment before mating period and at day 80 to 100 of treatment after lactation.
Figure 1. Relative weight gain in male mice during 60 days treatment with DF₁ and DF₂. Each bar represents mean (sd). Mean values of treated groups at time illustrated are not significantly different from that of control (p > 0.05). Control male mice were fed with water 10 ml/kg/d. Standard male mice were fed with pectin 0.25 g/kg/d, M = male, n = number of mice.

Figure 2. Relative weight gain in female mice during 100 days treatment with DF₁ and DF₂. Each bar represents mean (sd). Mean values of treated groups at time illustrated are not significantly different from control (p > 0.05). Control female mice were fed with water 10 ml/kg/d. Standard female mice were fed with pectin 0.25g/kg/d, F = treated female, n = number of mice.
Table 1. Relative internal organ weight in test male mice after 60 days treatment with DF₁ and DF₁₀. NS = no significant difference between groups (p> 0.05),  a, b = significant difference between groups (p< 0.05), M = male, n = number of mice.

<table>
<thead>
<tr>
<th>Test animals (mice)</th>
<th>n, Sex</th>
<th>Weight (g) Mean ± SD</th>
<th>Internal organ wt. (g)/100 g. body wt. Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Liver NS</td>
<td>Heart NS</td>
</tr>
<tr>
<td>Control group water 10 ml/kg/d</td>
<td>14,M</td>
<td>37.4±2.9</td>
<td>5.07±0.52</td>
</tr>
<tr>
<td>Standard group pectin 0.25g/kg/d</td>
<td>15,M</td>
<td>38.4±2.9</td>
<td>4.72±0.31</td>
</tr>
<tr>
<td>Test group DF₁ DF₁₀ 0.5g/kg/d</td>
<td>15,M</td>
<td>36.6±1.8</td>
<td>4.39±0.21</td>
</tr>
<tr>
<td>Test group DF₁ DF₁₀ 0.25g/kg/d</td>
<td>14,M</td>
<td>38.2±3.1</td>
<td>4.89±0.76</td>
</tr>
<tr>
<td>Test group DFI DFII 0.25g/kg/d</td>
<td>13,M</td>
<td>38.8±2.8</td>
<td>5.15±0.45</td>
</tr>
</tbody>
</table>

Table 2. Relative internal organ weight in test female mice after 100 days treatment with DF₁ and DF₁₀. NS = no significant difference between groups (p> 0.05), a, b = significant difference between groups (p< 0.05), F = female, n = number of mice.

<table>
<thead>
<tr>
<th>Test animals (mice)</th>
<th>n, Sex</th>
<th>Weight (g) Mean ± SD</th>
<th>Internal organ wt. (g)/100 g. body wt. Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Liver NS</td>
<td>Heart NS</td>
</tr>
<tr>
<td>Control group water 10 ml/kg/d</td>
<td>8,F</td>
<td>31.4±2.7</td>
<td>a</td>
</tr>
<tr>
<td>Standard group pectin 0.25g/kg/d</td>
<td>8,F</td>
<td>29.7±2.8</td>
<td>abc</td>
</tr>
<tr>
<td>Test group DF₁ DF₁₀ 0.5g/kg/d</td>
<td>8,F</td>
<td>29.7±5.6</td>
<td>cd</td>
</tr>
<tr>
<td>Test group DF₁ DF₁₀ 0.25g/kg/d</td>
<td>8,F</td>
<td>31.1±2.6</td>
<td>bcd</td>
</tr>
<tr>
<td>Test group DFI DFII 0.25g/kg/d</td>
<td>8,F</td>
<td>33.3±1.6</td>
<td>d</td>
</tr>
</tbody>
</table>

ended. In this experiment, normal untreated male mice was housed with test females on day 28-42 (14 days). The average relative weight gain during pregnancy period is not shown. Most of test female mice in treated and control groups became pregnant and gave birth by day 50-56.
The high relative weight gain profile on day 50-70 as shown in Figure 2 was observed during the lactation period. However, the average relative weight gain appeared to be the lowest in the DFII (0.5 g/kg/d) treated female group (Figure 2) on days 80-100 towards the end of the experiment and the lowest final body weight was also appeared in the DFII (0.5 g/kg) treated group as well as standard group (Table 2). These results suggest that long term feeding of DFII at an oral dose of 0.5 g/kg/d has potential to reduce weight gain in male and female mice.

The relative weights of liver, heart, lung and kidneys was determined at the end of the experiment in male and female mice. The results are shown in Table 1 and 2, respectively. Final body weight of the animals is also demonstrated. In the male groups (Table 1) the relative weights of internal organs were not significantly different (p>0.05) from those of control groups, except for the lung and the left kidney; but these relative weights were not different (p>0.05) from that of the standard group. Among females (Table 2) the relative weight of liver in treated groups was lower (p<0.05) than that of the control group; but not significantly different (p>0.05) from that of the standard group. Enlargement of liver was not observed in treated groups.

### Effect of polysaccharide gel on pregnancy and growth of offspring

The polysaccharide gel from fruit-hulls of durian did not affect pregnancy and offspring in treated female mice. The results are shown in Table 3 and Figure 3. Every female mouse in treated groups became pregnant normally after being housed with an untreated male mouse (within 14 days). Most females gave birth 22-28 days later. Table 3 shows that the number of offspring which was 10-11, the ratio of male : female of offspring was 1 : 1. The average weight at birth (day 1) of offspring in treated groups was not different from that of control group. The average weight of offspring during 1-4 weeks is also demonstrated in Table 3. The relative weight gain profile of offspring is illustrated in Figure 3. The average relative weight gain of offspring was determined every week during the suckling period (about 3 weeks), and also the following week. Figure 3 shows that the relative weight gain of offspring from treated mother was not significantly different (p>0.05) from their

### Table 3. Body weight, sex and number of offspring from test female mice treated with DF and DFII

<table>
<thead>
<tr>
<th>Test animals (Mice)</th>
<th>n, Sex</th>
<th>No. of offspring</th>
<th>Offspring average body weight (g), Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean ± SD</td>
<td>Day 1</td>
</tr>
<tr>
<td>Control group</td>
<td>8,F</td>
<td>10±1</td>
<td>1.76±0.20</td>
</tr>
<tr>
<td>water 10 ml/kg/d</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard group</td>
<td>8,F</td>
<td>11±1</td>
<td>1.66±0.07</td>
</tr>
<tr>
<td>pectin 0.25g/kg/d</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test group DFII</td>
<td>8,F</td>
<td>10±1</td>
<td>1.69±0.17</td>
</tr>
<tr>
<td>DFII 0.5g/kg/d</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test group DFII</td>
<td>8,F</td>
<td>11±1</td>
<td>1.63±0.11</td>
</tr>
<tr>
<td>DFII 0.25g/kg/d</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test group DFI</td>
<td>8,F</td>
<td>10±1</td>
<td>1.54±0.22</td>
</tr>
<tr>
<td>DFI 0.25g/kg/d</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 3. Relative weight gain of offspring during 4 weeks after birth from mother treated with DF₁ and DF₂ for 4 weeks before mating and during lactation. Each bar represents mean ± SD * = significantly different from control (p ≤ 0.05). Control = offspring from mother receiving water 10 ml/kg/d. Standard = offspring from mother receiving pectin 0.25 g/kg/d. F = treated female mice. n = number of mice.

control and standard groups, except that of offspring at day 21 and day 28 in group of DF₂ (0.5 g/kg/d) treated mother, which showed higher relative weight gain profile (p<0.05) than that of offspring from control group. The hematological data of offspring of treated and control groups (Table 4) showed normal hematological parameters. These results suggest that polysaccharide gel did not affect the pregnancy and growth of offspring in mice. The growth rate of offspring from treated mothers was not low in comparison to controls.

Biochemical and clinical analyses

Hematological data in Tables 5 and 6 demonstrate normal hematological parameters in treated male and female mice. The percentages of hematocrit, hemoglobin, lymphocytes, red blood cells and white blood cells count between treated and control male and female mice were not significantly different (p>0.05). However, white blood cells count in DF₁ and DF₂ treated (at a dose 0.25 g/kg/d) male mice was significantly higher (p<0.05) than their controls but was not significantly different (p>0.05) from that of their standard group. The results indicate that polysaccharide gel DF₁ and DF₂ at an oral dose of 0.25 g/kg/d and DF₂ at a high dose of 0.5 g/kg/d did not induce hematological changes in treated male and female mice. However, WBC count in treated male (Table 5) was higher than its control (p<0.05) but not significantly different (p>0.05) from standard group.

Serum concentrations of glucose, cholesterol, creatinine and blood urea nitrogen (BUN) in male and female mice are shown in Figures 4 and 6, respectively. The results of serum glucose, cholesterol, creatinine and BUN in treated male and female mice were not significantly different (p>0.05) from those of their standard and control groups. Data were compared among the test, standard and control groups by test for homogeneity of variance (Levene test) using ANOVA followed by Duncan's multiple range test, with
Table 4. Hematological parameters in offspring from test female mice treated with DF\textsubscript{I} and DF\textsubscript{II}. Data are expressed as mean ± SD, M = male, F = female, n = number of test female mice.

<table>
<thead>
<tr>
<th>Test animals (Mice)</th>
<th>n, Sex</th>
<th>No. of offspring Mean ± SD F/M</th>
<th>Hct (%)</th>
<th>Hb (%)</th>
<th>RBC (c×10⁶/mm³)</th>
<th>WBC (c×10³/mm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control group</td>
<td>8,F</td>
<td>10±1 4±1</td>
<td>45.9±2.2</td>
<td>43.6±2.6</td>
<td>13.5±1.0</td>
<td>7.9±0.5</td>
</tr>
<tr>
<td>water 10 ml/kg/d</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard group</td>
<td>8,F</td>
<td>11±1 4±1</td>
<td>43.7±2.1</td>
<td>44.1±1.9</td>
<td>13.1±1.0</td>
<td>7.6±0.7</td>
</tr>
<tr>
<td>pectin 0.25g/kg/d</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test group DF\textsubscript{I}</td>
<td>8,F</td>
<td>10±1 5±1</td>
<td>45.4±2.8</td>
<td>44.3±1.5</td>
<td>13.1±1.2</td>
<td>7.2±0.7</td>
</tr>
<tr>
<td>DF\textsubscript{II} 0.5g/kg/d</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test group DF\textsubscript{II}</td>
<td>8,F</td>
<td>11±1 6±1</td>
<td>44.8±2.5</td>
<td>44.3±2.6</td>
<td>13.2±1.0</td>
<td>7.6±0.7</td>
</tr>
<tr>
<td>DF\textsubscript{II} 0.25g/kg/d</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test group DF\textsubscript{II}</td>
<td>8,F</td>
<td>10±1 5±1</td>
<td>44.3±3.5</td>
<td>44.4±1.8</td>
<td>13.2±1.4</td>
<td>7.8±0.8</td>
</tr>
<tr>
<td>DF\textsubscript{I} 0.25g/kg/d</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5. Hematological parameters in male mice after 60 days treatment with DF\textsubscript{I} and DF\textsubscript{II}. Data are expressed as mean ± SD, NS = no significant difference between groups (p> 0.05), a, b = significant difference between groups (p< 0.05), M = male, n = number of mice.

<table>
<thead>
<tr>
<th>Test animals (mice)</th>
<th>n, Sex</th>
<th>Weight (g) Mean ± SD</th>
<th>Hct % NS</th>
<th>Hb % NS</th>
<th>RBC C×10⁶/mm³</th>
<th>WBC C×10³/mm³</th>
<th>PMN % NS</th>
<th>Band % NS</th>
<th>Lymph % NS</th>
<th>Mon % NS</th>
<th>Eos % NS</th>
<th>Baso % NS</th>
</tr>
</thead>
</table>

Control group water 10 ml/kg/d

Standard group pectin 0.25 g/kg/d

Test group DF\textsubscript{II} DF\textsubscript{II} 0.5 g/kg/d

Test group DF\textsubscript{II} DF\textsubscript{II} 0.25 g/kg/d

Test group DF\textsubscript{I} DF\textsubscript{I} 0.25 g/kg/d

Test group DF\textsubscript{I} DF\textsubscript{I} 0.25 g/kg/d

Test group DF\textsubscript{I} DF\textsubscript{I} 0.25 g/kg/d
Table 6. Hematological parameters in female mice after 100 days treatment with DF

<table>
<thead>
<tr>
<th>Test animals (mice)</th>
<th>n,Sex</th>
<th>Weight (g) Mean ± SD</th>
<th>Hct % NS</th>
<th>Hb % NS</th>
<th>RBC C≤10⁶/mm³</th>
<th>WBC NS, C≤10⁶/mm³</th>
<th>PMN % NS</th>
<th>Band %</th>
<th>Lymph %</th>
<th>Mon %</th>
<th>Eos %</th>
<th>Baso %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control group water 10 ml/kg/d</td>
<td>8,F</td>
<td>31.4±2.7</td>
<td>45.2±2.4</td>
<td>13.9±1.6</td>
<td>8.8±0.9</td>
<td>2.0±0.9</td>
<td>12.5±3.9</td>
<td>-</td>
<td>ab</td>
<td>86.2±4.6</td>
<td>0-1</td>
<td>0-2</td>
</tr>
<tr>
<td>Standard group pectin 0.25 g/kg/d</td>
<td>8,F</td>
<td>29.7±2.8</td>
<td>42.8±4.5</td>
<td>13.5±2.1</td>
<td>8.4±1.4</td>
<td>1.5±0.9</td>
<td>13.0±6.0</td>
<td>-</td>
<td>ab</td>
<td>86.2±5.9</td>
<td>0-1</td>
<td>0-2</td>
</tr>
<tr>
<td>Test group DF II DF II 0.5 g/kg/d</td>
<td>8,F</td>
<td>29.7±5.6</td>
<td>43.2±5.2</td>
<td>11.3±2.9</td>
<td>7.2±1.7</td>
<td>1.3±0.8</td>
<td>11.2±3.9</td>
<td>-</td>
<td>ab</td>
<td>88.2±4.0</td>
<td>-</td>
<td>0-2</td>
</tr>
<tr>
<td>Test group DF II DF II 0.25 g/kg/d</td>
<td>8,F</td>
<td>31.1±2.6</td>
<td>43.8±4.8</td>
<td>14.2±4.2</td>
<td>7.8±0.9</td>
<td>1.8±1.3</td>
<td>8.7±4.9</td>
<td>-</td>
<td>a</td>
<td>90.6±4.7</td>
<td>-</td>
<td>0-1</td>
</tr>
<tr>
<td>Test group DF I DF I 0.25 g/kg/d</td>
<td>8,F</td>
<td>33.3±1.6</td>
<td>46.0±2.0</td>
<td>14.3±0.7</td>
<td>8.8±0.5</td>
<td>3.3±1.9</td>
<td>15.8±6.1</td>
<td>-</td>
<td>a</td>
<td>81.0±5.7</td>
<td>0-3</td>
<td>0-4</td>
</tr>
</tbody>
</table>
Figure 4. Biochemical analysis of serum in male mice after 60 days treatment with DF₁ and DF₆. Each bar represents mean ± SD, ns = no significant difference between groups (p> 0.05), a, b = significant difference between groups (p ≤ 0.05). Control male mice were fed with water 10 ml/kg/d. Standard male mice were fed with pectin 0.25 g/kg/d. M = male, n = number of mice.

Figure 5. Levels of enzymes in serum in male mice after 60 days treatment with DF₁ and DF₆. Each bar represents mean ± SD, ns = no significant difference between groups (p> 0.05), a, b = significant difference between groups (p ≤ 0.05). Control male mice were fed with water 10 ml/kg/d. Standard male mice were fed with pectin 0.25 g/kg/d. M = male, n = number of mice.
Consumption of polysaccharide gel from durian in mice

Pongsamart, S., et al.

Vol. 24  No. 4  Oct.-Dec. 2002

660

Figure 6. Biochemical analysis of serum in female mice after 100 days treatment with DF_I and DF_II. Each bar represents mean ± SD, ns = no significant difference between groups (p>0.05), a, b = significant difference between groups (p<0.05). Control female mice were fed with water 10 ml/kg/d. Standard female mice were fed pectin 0.25 g/kg/d. F = female, n = number of mice.

Figure 7. Levels of enzymes in serum in female mice after 100 days treatment with DF_I and DF_II. Each bar represents mean ± SD, ns = no significant difference between groups (p>0.05), a, b = significant difference between groups (p<0.05). Control female mice were fed with water 10 ml/kg/d. Standard female mice were fed with pectin 0.25 g/kg/d. F = female, n = number of mice.
higher than normal ALP level in female mice. The results of the present study suggest that polysaccharide gel, DF₁ and DF₂, at a dose 0.25g/kg/d and DF₃ at a high dose of 0.5 g/kg/d, could be consumed safely for long periods of 60 and 100 days in male and female mice, respectively. Interestingly, at a high oral dose (0.5 g/kg/d), DF₂ seems to induce low level of serum cholesterol and low body weight gain in male and female mice after long term treatment. These properties have also been observed with some other dietary fiber (Chandalia, et al., 2000; Vahouny, et al., 1988).

Acknowledgement

This work was supported in part by Rachadapiseksompoach Research Funds, Chulalongkorn University.

References


Pongsamart, S. 1989. The studies of carbohydrate extracts from durian rinds to use as suspending agent. Research Report, Department of Biochemistry, Faculty of Pharmaceutical Sciences, Chulalongkorn University.


