The Effect of Palatinose on Mental Concentration in Humans

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Summary We investigated the effect of palatinose on mental concentration using the Uchida-Kraepelin psycho diagnostic test. A significant increase (p<0.01) in calculation ability was observed in both the sucrose and palatinose groups after administration. Although calculation ability in the sucrose group at 150 min decreased from the level achieved at 90 min in the same group, that in the palatinose group at 150 min decreased only slightly from the level achieved at 90 min. At the same time points, significant increases were observed even when 5 g of palatinose was administered.

Key Words palatinose, mental concentration, blood glucose

Recently, the role of glucose in the functioning of the brain has been reviewed, and the effects of blood glucose level on concentration or memory are gathering attention. The energy requirement of the brain is disproportionately large. Although the brain weight is about 2% of the body weight, the energy requirement of the brain amounts to 20% of the whole body energy consumption. The energy stores in the brain are extremely small when compared to glucose consumption. Therefore, the demand of glucose by the brain depends on a continuous glucose supply. The glucose in the brain is estimated to be exhausted in 10 to 15 min at the basal rate. There is an equilibrium between the levels of plasma glucose and that in the brain extracellular fluid (ECF); thus, higher plasma levels of glucose are associated with higher levels of glucose in the brain (1-3). The mechanism by which an increased supply of glucose enhances memory has not been clarified. One possibility is that synthesis of the neurotransmitter acetylcholine is increased (4). Many reports have shown that memory or concentration is associated with acetylcholine (5, 6). Palatinose (6-O-α-D-glucopyranosyl-D-fructofuranose) is widely used in various food products and confectionaries. It is a digestible disaccharide, and the ratio of digestibility about one-fifth that of sucrose (7). When palatinose is administered, blood glucose and insulin increase slowly and decrease gradually (8).

In the present study, we studied the blood glucose pattern induced by palatinose and investigated the effect of palatinose on mental concentration using the Uchida-Kraepelin psycho diagnostic test.

Materials and Methods

Experiment I. The Uchida-Kraepelin psychodiagnostic test was conducted to determine the power of concentration. In this test, the subject is asked to add each two neighboring numbers of serial numbers shown in a line and provides the number in the first digit of the answer of addition continuously for 1 min. Then, the subject goes to the next line and continues the same procedure for another minute. The subject repeats the procedure 15 times; that is, over a 15 min period. The study was conducted on 14 healthy volunteers. The subjects were arranged by age and divided alternately into two groups (sucrose group and palatinose group). The subjects in the sucrose group consisted of five men and two women (average age [mean±SD]: 40.0±11.4 y), and those in the palatinose group, six men and one woman (average age [mean±SD]: 40.4±10.3 y). The subjects were instructed not to take any food or liquid except for water or mineral water for at least 12 h previous to the first test. First, the subjects took the Uchida-Kraepelin psycho diagnostic test for 15 min. After completion of the first test, the subjects were given a palatinose solution or a sucrose solution (Table 1). These samples were prepared to have similar sweetness by the addition of aspartame and acesulfam K. The subjects were told to drink the sample within 5 min. Ninety and 150 min later, the subjects underwent the test a second and third time.

Experiment II. Similarly, we investigated the minimum dose of palatinose to have an effect on concentration using the Kraepelin test. The subjects were 14 healthy volunteers. The subjects were divided into two groups (5 g group and 10 g group). The subjects in the 5 g group consisted of four men and three women (average age [mean±SD]: 33.4±3.3 y), and those in the 10 g group, six men and one woman (average age [mean±SD]: 32.2±4.1 y). The test samples are shown in Table 1. These samples were also prepared to have similar sweetness by the addition of aspartame and acesulfam K. The subjects were instructed not to take any food or liquid except for water or mineral water for at least 12 h previous to the first test. The test was carried out in the same manner as Experiment I.

Statistical analysis of all data obtained in this study was conducted by two-way repeated measures ANOVA.

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Table 1. Content of the test samples.

<table>
<thead>
<tr>
<th>Contents</th>
<th>Experiment I</th>
<th>Experiment II</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sucrose group</td>
<td>Palatinose group</td>
</tr>
<tr>
<td>Sucrose</td>
<td>40 g</td>
<td>0 g</td>
</tr>
<tr>
<td>Palatinose</td>
<td>0 g</td>
<td>40 g</td>
</tr>
<tr>
<td>Aspartame</td>
<td>0 g</td>
<td>0.06 g</td>
</tr>
<tr>
<td>Acesulpham K</td>
<td>0 g</td>
<td>0.06 g</td>
</tr>
<tr>
<td>Water</td>
<td>200 mL*</td>
<td>200 mL*</td>
</tr>
</tbody>
</table>

*Final volume.

Fig. 1 Effect of palatinose or sucrose administration on mental concentration in humans. Data are expressed as the mean±SE. Factors between standard groups are not significantly different. Factors among the standard groups (0, 90 and 150min) are significantly different (p<0.01). Interaction (factors between standard groups×factors among standard groups) are not significantly different.

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This study was done in accordance with the code of ethics of the World Medical Association (Helsinki Declaration of 1964 as revised in 1989).

Results and Discussion

Experiment I

Figure 1 shows the effects of palatinose or sucrose administration on calculation ability. A significant increase (p<0.01) in calculation ability was observed after administration in both the sucrose and palatinose group. There was no significant difference between the palatinose effect and sucrose effect. Although calculation ability in the sucrose group at 150 min decreased from the level achieved at 90 min in the same group, that in the palatinose group at 150 min was only slightly lower than the level achieved at 90 min.

Experiment II

Figure 2 shows the effects of 5 g or 10 g palatinose administration on calculation ability. A significant increase (p<0.01) in calculation ability was observed after administration in both the 5 g group and 10 g group. There was no significant difference between the 5 g effect and 10 g effect.

The results of the present study indicate that palatinose significantly increases mental concentration in humans in the same way as sucrose, but the effect of palatinose tends to last longer than that of sucrose. The minimum effective dose of palatinose is estimated to be more than 5 g.

We are now investigating the mechanism of the effect of palatinose feeding on mental concentration.

REFERENCES

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