Changes in Blood Glucose and Insulin after an Oral Palatinose Administration in Normal Subjects

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Abstract

Changes in plasma glucose and insulin concentration in response to palatinose ingestion were compared with those to sucrose in eight normal volunteers. When 50 g of palatinose was administered, the plasma glucose gradually increased to its peak of 110.9 ± 4.9 mg/dl at 60 min after administration and maintained a plateau during the 120 min of the experiment. The peak value of plasma glucose to 50 g sucrose in the same group was 143.3 ± 8.8 mg/dl at 30 min after administration and then the value sharply decreased to the fasting level. The cumulative increase in plasma glucose (Σ ΔPG) to palatinose was significantly smaller than that to sucrose. The changes in the plasma insulin level almost paralleled those in the plasma glucose level. These results indicate that palatinose is more slowly absorbed than sucrose and therefore useful as a sweetener for diabetic patients.

Palatinose (6-0-α-D-glucopyranosyl-D-fructose) is a rare natural product and one of the sweet elements in honey (Siddiqui and Furgala, 1967). Recently, it was produced from sucrose by an immobilized glucosyltransferase method at an industrial level (Nakajima, 1984) and expected to be used as a non-cariogenic sweetener (Ooshima et al. 1983). However, there is little information available about its absorption and metabolic effects in man. Therefore, we studied the changes in plasma glucose and insulin after its oral administration in normal men.

Materials and Methods

Experiments were performed on 8 normal healthy volunteers (4F, 4M) after an overnight fast, aged 23.0 ± 0.4 yrs, 53.6 ± 2.5 kg, 95.6 ± 4.1% of ideal body weight. Informed consent was obtained from each volunteer after an explanation about the study. After the blood sampling through an indwelling catheter placed in a forearm vein, 50 g palatinose (donated by Mitsui Sugar Co. Ltd. Tokyo, Japan) or sucrose dissolved in 150 ml water was ingested over 2–3 minutes. Blood samples were drawn through the catheter according to the time schedule. The same experiment with the other sugar was performed after two days with in random order. No gastrointestinal symptoms or signs such as nausea and diarrhea was observed in any of the subjects throughout the study.

Received August 27, 1985
An oral administration of palatinose (1.5-4.5 g/kg body weight) to Sprague-Dawley rats for 26 weeks caused no derangement of growth, food ingestion or blood chemistry (Yamaguchi and Yoshimura, 1985). In addition, no significant changes were observed in liver function tests after oral administration of 50 g palatinose to normal volunteers (Nakajima et al. unpublished data).

The plasma glucose concentration was determined by a glucose oxidase method (glucose analyzer 2, Beckman). The plasma insulin concentration (IRI) was measured by radioimmunoassay according to the method of Herbert et al. (1974).

Statistical analysis was performed with Student's t-test for paired data. A level of 0.05 or less was considered significant and all data in the text were expressed as mean±SEM.

**Results**

*Change in plasma glucose in response to oral palatinose or sucrose*

After an oral palatinose administration, the plasma glucose gradually increased from its basal level of 92.4±1.9 mg/dl and maintained an almost constant level of about 110 mg/dl during the experiment, whereas after an oral sucrose administration it increased more rapidly to its peak value at 30 min after administration (143.3±8.8 mg/dl).

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**Fig. 1.** Changes in plasma glucose and IRI in response to oral administration of palatinose or sucrose. N=8, mean±SEM. * p<0.05, ** p<0.01; palatinose vs. sucrose.
dl) and decreased to near the basal level after 90 min (Fig. 1). The cumulative increase in plasma glucose ($\Sigma \Delta$PG) after palatinose was significantly smaller than that after sucrose ($74.6 \pm 3.1 \, \text{mg/dl} \, \text{vs.} \, 170.7 \pm 22.0 \, \text{mg/dl}, \, p<0.05$).

Change in plasma IRI in response to oral palatinose or sucrose

The IRI response almost paralleled that of glucose (Fig. 1). After the palatinose administration, plasma IRI gradually increased from its basal level of $11.5 \pm 1.4 \, \mu\text{U/ml}$ and stayed at an almost constant level of $20 \, \mu\text{U/ml}$ throughout the experiment. After the sucrose administration, the plasma IRI level increased rapidly to its peak value of $43.8 \pm 8.6 \, \mu\text{U/ml}$ at 60 min. The cumulative increase in plasma IRI ($\Sigma \Delta$IRI) after palatinose was also significantly smaller than after sucrose ($56.5 \pm 4.7 \, \mu\text{U/ml} \, \text{vs.} \, 118.7 \pm 20.3 \, \mu\text{U/ml}, \, p<0.05$).

Discussion

The present results clearly showed that the increase in plasma glucose and IRI after palatinose ingestion was significantly smaller than those after sucrose. This difference may be ascribed to the difference in their digestibility because palatinose is digested to glucose and fructose by the intestinal isomaltase, and the hydrolysis of palatinose by the homogenate of human intestinal mucosa was one-fourth that of sucrose (Dahlquist et al. 1963). The relative increase in postprandial blood glucose [[“glycemic index”]] of sucrose was reported to be $59 \pm 10\%$ (Jenkins et al. 1981). From our data, the glycemic index of sucrose is estimated to be larger than this value because the plasma glucose increase after glucose ingestion by different normal volunteers showed almost the same glycemic response to sucrose with larger IRI responses.

The greater part of various disaccharides ingested is absorbed as monosaccharides. It has been reported that the rise in blood maltose or sucrose concentration after an oral administration of 50 g maltose or sucrose is less than a few $\mu\text{g/ml}$ (Nakamura and Tamura, 1972). Although we have no information about how many percent of palatinose was digested and absorbed by man, we suppose that a large part of it is digested at least because of its plateau pattern of plasma glucose and IRI. The sweetness of palatinose is reported as 40% of glucose (Kaga and Mizutani, 1985). Thus, it is expected that palatinose is a useful natural mild sweetener that is digested slowly.

Acknowledgment

The authors wish to thank Miss Yuko Suzuki for her expert technical assistance.

References


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