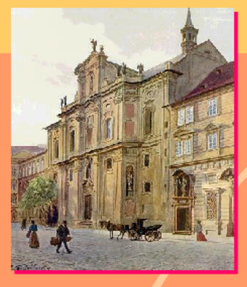
THE PART OF TASTE IN CEPHALIC PHASE OF INSULIN SECRETION



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Introduction

.Secretion of insulin by beta-cells of the islets of Langerhans is a very complex dynamic process that includes basal and stimulated insulin secretion. Two phases, one early and one late, can be distinguished in insulin secretion initiated by various stimuli. The early phase is characterised by the secretion of preformed insulin granules, lasts about 15 minutes and is formed by cephalic (Berthoud et al., 1981; Ahrén and Holst, 2001; Gautam et al., 2006) and gastrointestinal components
The cephalic phase of insulin secretion starts by stimulating visual, olfactory and taste receptors (Berthoud et al., 1981; Ahrén and Holst, 2001; D'Alessio et al., 2001) and therefore is not only a part of the first steps of food ingestion, but also of anticipatory physiological regulation in feeding (Power and Schulkin, 2008). Though taste is a very important factor for appetite and food intake, its separate role in the secretion of hormones taking part in glucose homeostasis has not been studied much in detail until now. The quantitative contribution of taste to changes in circulating hormonal levels in humans is, in particular, unknown.

Objectives

The aim of this study:
Show to what extent the concentrations of insulin, C-peptide and cortisol are changed by a simple mouth rinsing with a sucrose or sweetener solution.

Methods

Subjects
15 non-obese voluntary male participants aged 20–30 years were included in the study. Their average age was 28.8 ± 6.32 years, BMI 23.43 ± 1.71 kg/m2. Men were randomly selected in three groups. In the first group, the tests were carried out in the sequence sugar – sweetener – water; in the second in the sequence placebo – sweetener – sugar and, in the third, water – sugar – sweetener. A 5% sucrose and 0.018% aspartate solution was used for the sweet solution. Tap water was used as a placebo. The study was improved by the Ethical Committee of the Institute of Endocrinology and all participants signed the informed consent. The experiment started at 8 a.m.; the overnight-fasting volunteers were laid down and their forearm veins were cannulated and, following 15 min of rest, the zero-time blood withdrawal was carried out. The first mouth rinsing then started with blood withdrawals at 5, 10, 15 and 20 min. A 10-min pause was followed by the next rinsing. Serum was separated and glucose, insulin, C-peptide and cortisol
were determined in all samples.
Analytical methods
Blood glucose was measured using the enzymatic reference method with hexokinase (analyzer Cobas Integra 400 plus, Roche). The measuring range of the kit was 0.12–40 mmol/l. Intra- and inter-set reproducibility was 1.7% and 2.6%, respectively. C-peptide was measured using ECLIA (electrochemiluminescence immunoassay, analyzer Modular E 170, Roche). The measuring range of the kit (defined by the lower detection limit and the maximum of the master curve) was 0.003–13.3 nmol/l for plasma. Intra- and inter-assay coefficient of variation was 1.5% and 2.3%, respectively. Insulin was measured using ECLIA (electrochemiluminescence immunoassay, analyzer Modular E 170, Roche). The measuring range of the kit (defined by the lower detection limit and the maximum of the master curve) was 0.2–1,000 IU/ml. Cortisol was assayed using a RIA kit from Orion, Finland (intra-assay CV = 3.8%, inter-assay CV = 4.4%).
Statistical data analysis
Repeated measures ANOVA with subject factor and within-subject factor Time was used to evaluate the differences between the experiment stages followed by least significant difference (LSD) multiple comparisons. The original dependent variables and the covariate were transformed by a power transformation to attain a constant variance and symmetric distribution of the data and residuals (Meloun et al., 2000). Statistical software Statgraphic Centurion version XVI (Herndon, VA, USA) was used for the calculations. The homogeneity of the data and residual were checked as described elsewhere (Meloun et al., 2002).

Results

Fig.1.

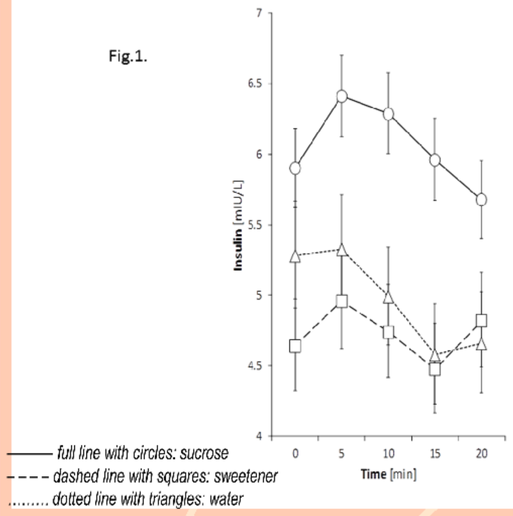


Fig.2.

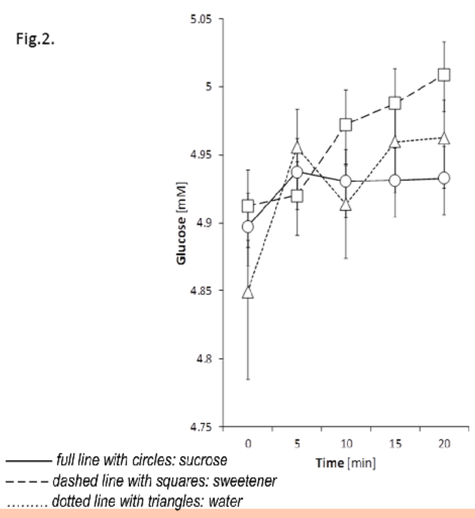
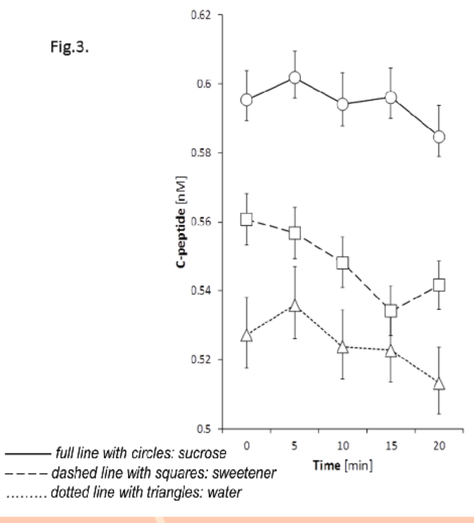


Fig.3.



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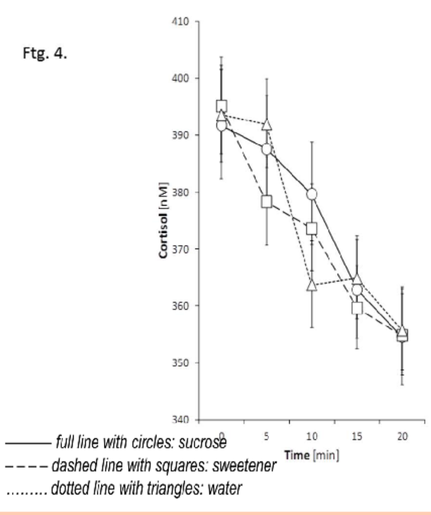

To prove effect of mouth rinsing with water and sugar or sweetener solutions, the time course analysis by ANOVA was decisive (see: Time in Figures 1–4).
Oral stimulation by rinsing mouth with a 5% sucrose solution caused a slight but significant rise in insulin level in circulating blood (Figure 1) over the course of 5–10 minutes and then returned to the basal level. No change in glucose and C-peptide levels were observed (Figures 2 and 3). Sucrose rinsing also caused a distinct drop in cortisol level, though this effect was observed also with the sweetener and placebo (Figure 4). This probably indicates an unspecific effect. Less pronounced changes in insulin concentration caused by the sweetener (aspartate) solution in an organoleptic concentration similar to the sucrose solution were insignificant. Aspartate decreased significantly the time course of C-peptide (Figure 3).The placebo (water) had no effect on circulating insulin or C-peptide concentrations.

Conclusions

The contribution of taste to the cephalic phase of insulin secretion is small yet significant, and mouth rinsing with 5% sucrose causes an insulin increase of just under 1 mIU/l, which returns to starting level within 15 min.

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