D –Strategies to Improve Food Quality and Safety

Time-Intensity Studies of Sweeteners

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Abstract: We used time-intensity studies in this work for evaluating the perception of sweet taste of sucralose, aspartame, and saccharose over time. In second part of this study the mixture of sweeteners and zinc sulphate, which modifies sweet taste perception, was used. We determined the following parameters from the assessor's charts of time profile: maximum intensity of sweet taste and the time which was needed to get to its maximum, the time period of perception of sweet taste and the area under the curve. For evaluation each assessor received 20 ml of a water solution with the sweetener followed by the mixture of the same sweetener with zinc sulphate. The intensity of sweet taste was measured before and after spitting out the solution. Then it was measured at intervals of 5 s for 70 seconds. It can be seen from the charts that sucralose has a more gentle sweet taste perception in time than the other sweeteners and that the zinc sulphate modifies the sweet taste but it does not inhibit it absolutely.

Keywords: aspartame; saccharose; sucralose; time-intensity studies; zinc sulphate

INTRODUCTION

Each human likes the sweet taste from the beginning of his/her life. The first food we experience is the breast milk which is sweet. From that time we are looking for food with the sweet taste which provides us pleasant feelings. Consumers and producers of foods are looking for new types of sweeteners which can offer the same sweet taste as saccharose but with fewer calories. This is one of the reasons for use of synthetic sweeteners.

Sensory properties which are evaluated for sweeteners include the intensity and pleasantness of sweet or bitter taste, the presence of aftertastes, etc. It is important both for consumers and producers of food that the used sweetener has similar sensory profile to the profile of saccharose. Many sweeteners elicit bitter or metal aftertastes, licorice or other off-tastes. It is also important that the sweet taste has no delay in initial onset and that no lingering afterwards.

We used time-intensity studies in this work for evaluating the perception of sweet taste in sucralose, aspartame, and saccharose over time. In second part of this study the mixture of sweeteners and zinc sulphate, which modifies sweet taste perception, was used. According to Keast *et al*. (2004) zinc sulphate inhibited the sweetness of most compounds in a concentration dependent manner, peaking with 80% inhibition by 50mM.

MATERIAL AND METHODS

Two types of solutions were prepared for the evaluation. The first type was the solution of sweetener in potable water. Sweeteners used were as follow: aspartame (0.7424 g/l; 0.0025 mol/l), saccharose (100 g/l; 0.2921 mol/l) and sucralose (0.2 g/l; 0.0005 mol/l). Aspartame was obtained from Urseta, Czech Republic, saccharose from Penta, Czech Republic, and sucralose was obtained from Tate & Lyle Sucralose, Inc., USA. Concentrations of sweeteners were adjusted for the rate of same sweet taste intensity. The second type of solutions was the solution of the same concentration of

sweetener with zinc sulphate in a concentration of 3.5 g $ZnSO_4 \cdot 7H_2O$/l (0.0122 mol/l).

Assessors evaluated the sweet taste and the mixture of sweetener and zinc sulphate in a sensory analysis laboratory in the Department of Food Chemistry and Analysis at Institute of Chemical Technology in Prague. Every sweetener and its mixture with $ZnSO_4$ were evaluated by approximately 40 assessors, 40% males and 60% females between 20 and 50 years old.

For evaluation each assessor received 20 ml of a water solution with the sweetener followed by the mixture of the same sweetener with zinc sulphate in 25 ml beakers with a four-digit number code. The temperature of the samples was approximately 20°C.

Each assessor was introduced to the experiment. The method used was time-intensity profile of sweet taste. The intensity of sweet taste was measured before and after spitting out the solution.

Table 1. Intensity (mm) of sweet taste of sweeteners and mixture of sweetener and zinc sulphate

Time (s)	Aspartame		Aspartame and zinc sulphate		Saccharose		Saccharose and zinc sulphate		Sucralose		Sucralose and zinc sulphate	
	AM	RSD	AM	RSD	AM	RSD	AM	RSD	AM	RSD	AM	RSD
3	79	21	64	26	89	13	72	25	82	16	49	28
8	80	15	46	33	85	15	63	28	80	14	37	28
13	74	16	43	33	80	17	52	28	75	14	34	26
18	70	17	39	31	73	6	46	27	69	16	33	26
23	64	17	36	31	68	18	43	26	63	18	32	25
28	59	18	36	31	63	20	41	26	57	19	37	22
33	54	19	36	30	58	20	38	27	50	21	41	25
38	48	20	36	27	54	20	35	27	44	22	41	24
43	44	21	35	25	49	21	33	27	41	24	43	25
48	40	21	33	25	47	21	31	26	38	25	43	26
53	35	21	33	25	44	21	30	25	34	25	42	26
58	31	21	32	25	40	20	28	24	31	24	40	26
63	27	21	30	24	37	20	27	23	29	24	36	25
68	24	21	30	25	33	21	24	21	27	25	34	24
73	21	20	29	27	30	21	22	20	25	26	31	22
78	17	20	28	29	26	21	20	19	23	26	27	21

AM – arithmetic mean, RSD – relative standard deviation; 0 – no intensity, 100 = very intensive

Table 2. Parameters determined from results

Parameter	Aspartame	Aspartame with zinc sulphate	Saccharose	Saccharose with zinc sulphate	Sucralose	Sucralose with zinc sulphate
Maximum of intensity (mm)	80	64	89	72	82	49
Time of maximum of intensity (s)	8	3	3	3	3	3
Area under the curve	3.595	2.700	4.093	2.795	3.578	2.810

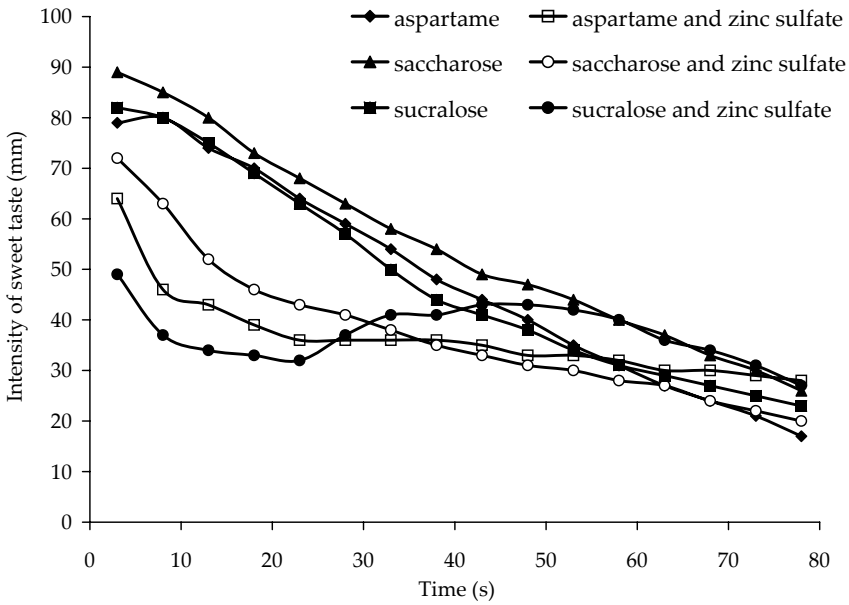

Figure 1. Time intensity profile of sweeteners and their mixture with zinc sulphate

Then they were measured at intervals of 5 s for 70 seconds. Participants marked the intensity of sweet taste in time on graphic scale with extreme points: 0 = no intensity of sweet taste, 100 = very intensive sweet taste.

RESULTS

The mean results of evaluations are shown in Table 1 and Figure 1.

The following parameters, named in Table 2, were determined from the results. If we would like to determine the time of perception of sweet taste we would have to measure the profile over a longer period of time.

DISCUSSION

From the results and parameters determined from these can be seen that sucralose has more gentle perception of sweet taste in time than saccharose, it is similar to the perception of sweet taste of aspartame.

Zinc sulphate is a potent inhibitor of the sweetness of most sweeteners (Keast *et al.* 2004). Addition of zinc sulphate modifies the perception of sweet taste but does not inhibit it absolutely in this study. In the case of aspartame and saccharose, the inhibition is about 20% of intensity in used conditions. In case of mixture with sucralose the inhibition is about 40% and it can be seen that the sweet taste of sucralose come back later in time with even more intensity.

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References

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