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TIME INTENSITY (TI) MEASUREMENTS OF SWEETENERS ON GREEN TEA CARRIER

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ABSTRACT

Aim of the study was characterize sweet intensity profiles of natural and artificial sweeteners during time interval on taste carrier (green tea). For analysis was selected time intensity (TI) methodology during 12 second time interval and assessors group was divided to male and female division. Difference between groups and sweeteners was investigated. Preference testing was done by CATA methodology and processed by correspondent analysis. During time intensity evaluation was observed similar profile shape of natural sweeteners. Different was performance of saccharin. During preference experiment was evaluated that all artificial sweeteners are associated with negative attributes of CATA questionnaire. Perception of sweeteners by male and female assessors was statistically significant.

Keywords: Sensory analysis, time intensity methods, sweeteners

INTRODUCTION

Complex taste cannot be measured directly by instruments; it is an interaction between food and the consumer (**von Sydow 1971, cited in Piggott 1995**). Therefore, sensory methods must be used to measure flavor. Even trained assessor is something like an „instrument" but opinion of consumers is also very important. A combination of assessments by expert and trained assessors with consumer tests is the most effective way to product optimization (**Pokorny, 1991**). This suggests the division of all sensory methods into two main general categories: the analytical and the consumer (or hedonic) approaches.

Hedonic approach describes consumer acceptance of a specific product, consumer preference for one product over the others, and sometimes the degree of pleasure caused by the product.

Analytical approach, as performed by a trained panel, describes the characteristics of a product, which often explain the consumer's choice (**Zawirska-Wojtasiak, 2012**). For structure of sensory methodologies see Fig.1.

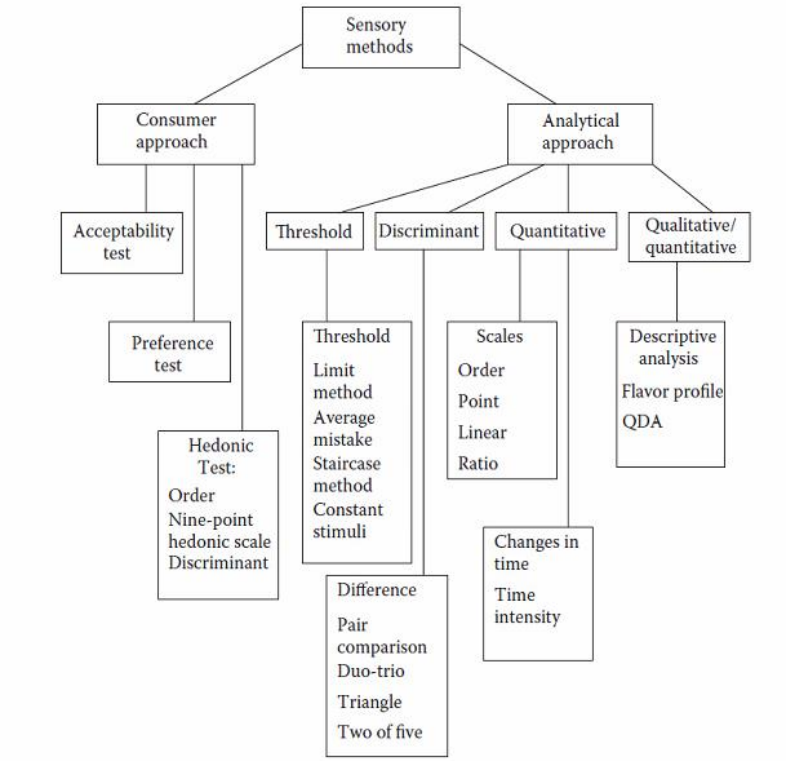

Figure 1 Possible division of sensory methods (**Zawirska-Wojtasiak, 2012**)

Saccharides are very interesting for sensory ability training. During food production, carbohydrates, especially sucrose, glucose, and fructose, are widely used because of their sweet taste and mouth sensing. However, not only carbohydrates evoke sweet taste in humans but also a number of diverse chemical compounds, showing high sweet intensities at low levels of use. These high intensity sweeteners (HIS) can be both artificial and of natural origin, their structures ranging from small molecules such as saccharin to highly complex proteins, such as thaumatin or monellin (**Duffy et al. 2004; Kinghorm and Soejarto 1986**). Often applied artificial sweeteners include saccharin (approved as food additive in United States and the European Union [EU]), which was the first commercially used artificial HIS; cyclamate (EU only); aspartame (United States, EU); acesulfame K (United States, EU); and sucralose (United States, EU). Saccharin is considered to bemo re than 400 times sweeter than a 10% sucrose solution, but a typically bitter taste occurs at higher saccharin concentrations, which can be detected only by about 25% of the European population (**Helgren et al. 1955**). Cyclamate is 40 times sweeter than a 2% sucrose solution. Aspartame shows a 340 times higher sweet intensity in comparison to a 0.34% sucrose solution (**Belitz et al. 2007**) and is described to have a clean sweet taste without any bitter or metallic off-notes aftertaste. The new high-potency sweetener neotame (United States only), a derivative of aspartame, is considered to be 30–60 times sweeter than aspartame. Because of its lower use levels, it can also, unlike aspartame, be consumed by patients with phenylketonuria (**Stargel et al. 2001**). Sucralose is approx. 750 times sweeter compared to a 2% sucrose solution, while the taste is perceived similar to that of sucrose: sweet without any off-tastes (**Goldsmith and Merkel 2001**). Other HIS include neohesperidine dihydrochalcone and alitame, a representative of the series of l-aspartyl-d-alanine amides. HIS, however, are not only obtained as artificial compounds, but occur also naturally (**Kinghorn 2002; Kinghorn and Compadre 2001**). Nowadays, thaumatin of *Thaumatococcus daniellii* and rebaudioside A from *Stevia rebaudiana* (**Carakostas et al. 2008**) are the most important naturally occurring sweeteners of commercial interest (Fig. 2). The objective of our study was analyze perception of sweeteners on taste carrier (green tea) and apply to more complex carrier during next phase of senior product development.

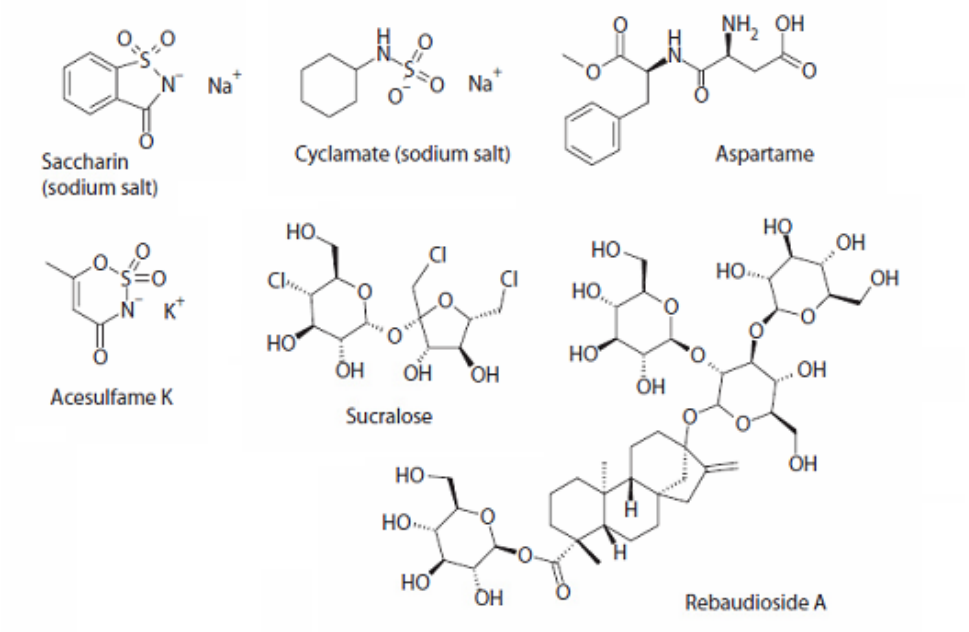

Figure 2 Formulas of commercial important HIS (**Vietoris, 2014**).

MATERIAL AND METHODS

SAMPLE PREPARATION

For experiment we used natural sweeteners sucrose, honey, maple syrup, sugar cane sweetener. Artificial sweeteners were represented by saccharin, cyclamate, aspartame and stevia sweetener. All samples were commercial brand available in food store. Taste carrier was prepared by standardized way of manufacturer (Lipton). We used not flavored green tea and amount for sweetener declared on package by manufacturer. Tea was served in same condition (amount, temperature) to all assessors in plastic cups. We used water as palate cleaner during experimental sessions.

SENSORY METHODOLOGY

We used time intensity (TI) methodology with intensity scale (6 degrees) during 12 seconds interval. Samples were served monadic in balanced randomized complete block design (BRCBD) and each assessor used palate cleaner – water. Assessor took a break after half of experiment. Group of 30 assessors was separated to male and female division. Each assessor (15 male, 15 female) tasted all 8 samples three times and recorded intensity perception by senzorika 1.02 software (own) during 12 seconds interval. For preference testing of sweeteners we used CATA questionnaire with attributes: sweet, bitter, delicious, plastic, and artificial. All time intensity measurements were performed in sensory laboratory of FBP.

STATISTICAL ANALYSIS

Sensory data was post-produced by statistical software R. Assessors Data was converted to pilot tables and processed by Correspondence Analysis by R software. (**R Core Team, 2014**).

RESULTS AND DISCUSSION

Sucrose curve shape was set as reference sweetener. Other natural sweeteners (honey, sugar cane) generated similar curve of intensity perception During first period of intensity measurement is sweet taste increasing in sucrose sample. Sensation of intensity is stable afterwards with slightly decreasing here was statistical significant difference between male and female assessor (**p<0.001**). Female perception from stable phase is stronger in this sample. Maple syrup sample is still increasing during measurement phase and there is significant difference between both genders (**p<0.001**). Perception of honey sample copied sucrose with lower values of sweetness. Difference between male/female is still statistical significant (**p<0.001**), where women percepted more intensive. Sugar cane sweetener time profile shape is similar to maple syrup sample, even jump of female division. In the comparison of increasing is sugar cane increasing little slower of maple syrup. The gender difference is significant (**p<0.001**). Time intensity profile are shown in Fig.3.

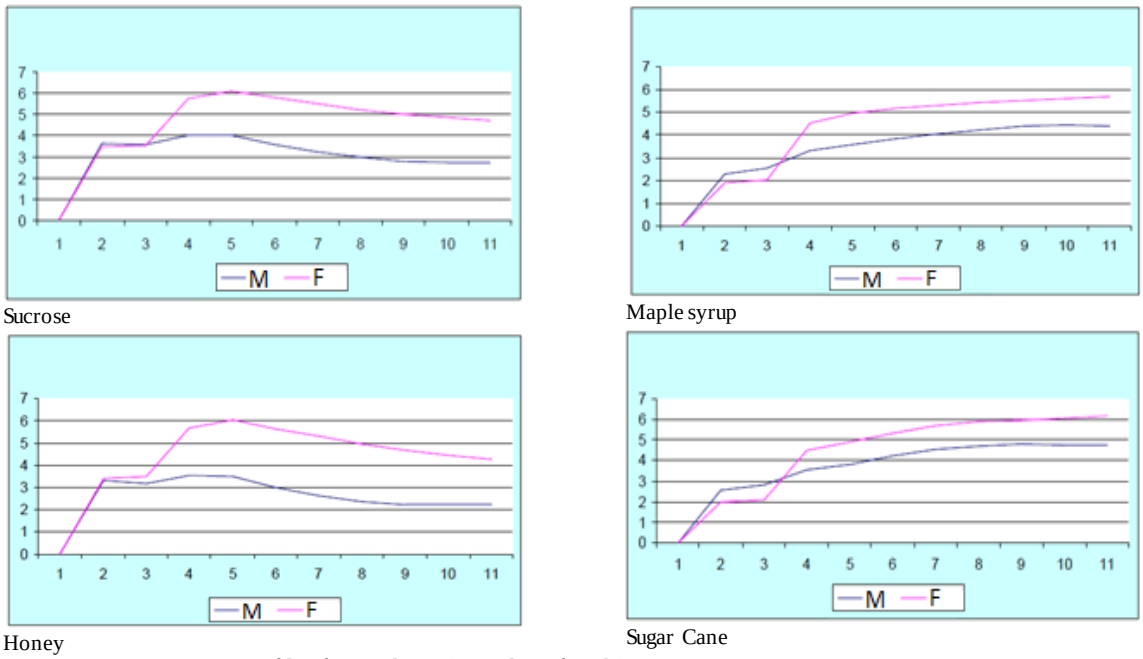

Figure 3 Time intensity profile of natural HIS (M-male, F-female)

Alternative sweeteners (AS) had different taste profile. The increasing of AS started rapidly. There is decreasing in last period of measurement (aspartame and cyclamate samples). There is significant difference (**p<0.001**) for both divisions in perception of intensity. Stevia sample is more similar to natural sweeteners (sugar cane) but assessors percepted more intensive. There is significant difference between male and female division. Females percepted sweetness stronger again. Cyclamate sweetness profile is similar to sucrose. There is statistical difference between genders (**p<0.001**). Sample of saccharin was specific. During evaluation time was still increasing of intensity and female and male assessors percepted with no statistical difference (**p<0.371**).

Majority of assessor described some off-taste and artificial aftertaste. In discussion with some authors we agree with reported sweeteners characteristics (**Cardoso and Bolini, 2012, DuBois and Prakash, 2012, Kinghorn et al., 2010).**

Sucrose, honey and cyclamate had decreasing tendency of sweet intensity. Other natural and artificial sweeteners had increasing tendency. Females were percepted all sweeteners stronger (**p<0.001**) but saccharin. All time intensity profiles of analyzed sweeteners are shown on Fig.4

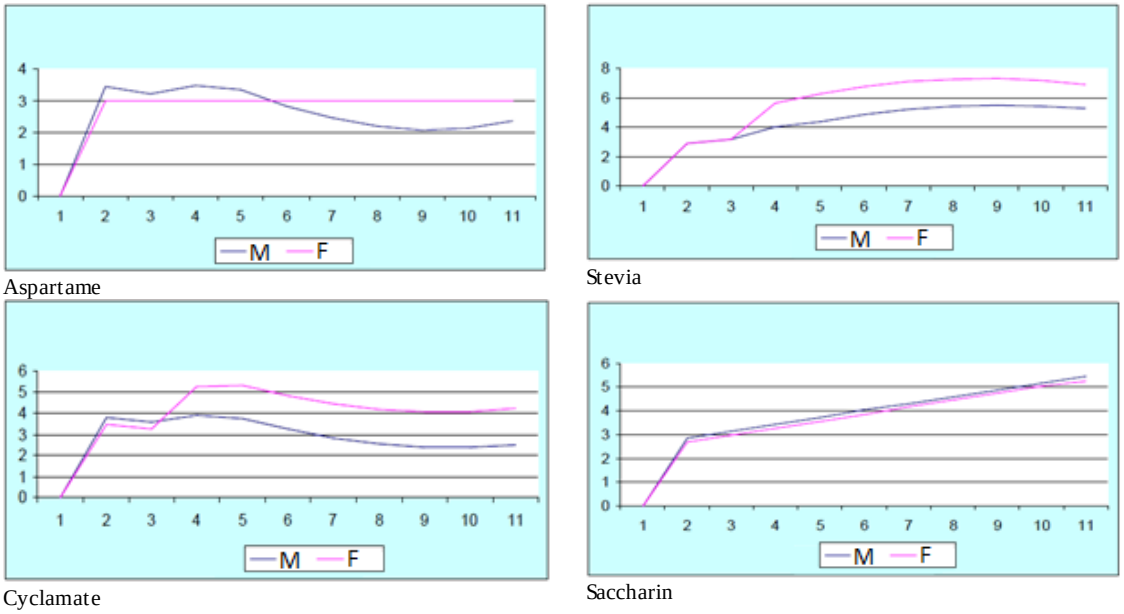

Figure 4 Time intensity profile of alternative HIS (M-male, F-female)

PREFERENCE POSITIONING

By CATA methodology consumers described sweeteners as delicious in order: sucrose, sugar cane, honey and stevia. The highest sweetness was detected in sucrose, honey, stevia and sugar cane, lowest in group of artificial sweeteners. All negative attributes (artificial and plastic) are connected to aspartame, cyclamate and saccharin. All associated attributes and sweeteners positions are described in Fig.5.

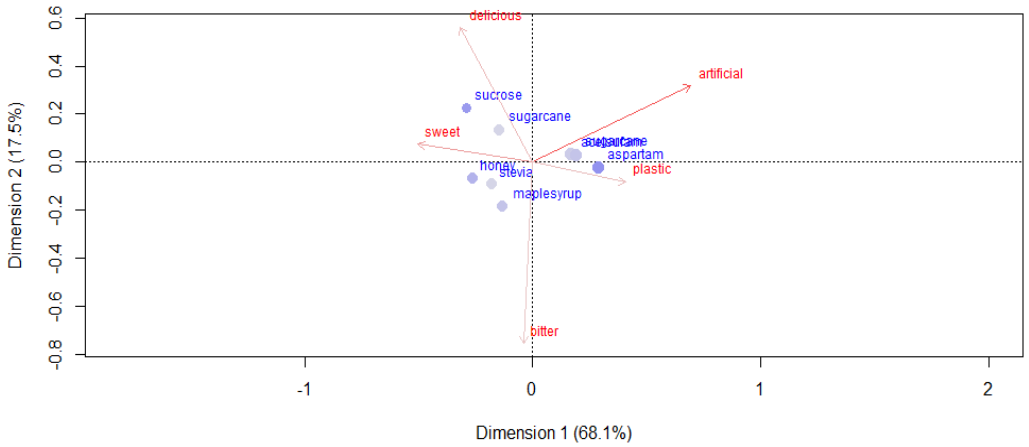

Figure 5 Correspondence analysis map of sensory attributes and samples positions (**Vietoris, 2014**).

CONCLUSION

In conclusion, this paper is interaction study of sweet taste of sweetener on bitter carrier (green tea). We were study time intensity profile during 12 seconds time interval and we could conclude, that it is still big difference between perception of natural and artificial sweeteners. There are lot of ways to lead a research for further information.

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