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Optimising combinations of selected sugar substitutes

AIM

Aim of this study is to establish sugar replacement in food by conventional sweeteners e.g. sucralose and natural sweeteners as maltitol, erythritol and stevia, without noticeable sensory differences. Based on this purpose the study analyses predominantly two natural sweeteners, the bulk sweetener erythritol and the intensive sweetener stevia rebaudiana.

SAMPLES

Erythritol and stevia rebaudiana are all-natural, non-glycaemic and non-cariogenic sweeteners with a high digestive tolerance.

The bulk sweetener erythritol features a clean and pleasant taste profile similar to sucrose, it is also reported to have a light cooling effect. Furthermore it provides qualitative and additive synergy in blends with intensive sweeteners by boosting the sweetness and masking undesired specific characteristics. These synergism can be realised when erythritol is the major contributor [1].

Stevioside or rather stevia rebaudiana is an intensive sweetener which offers predominantly a sweet taste but also a slight bitter note and unpleasant aftertaste.

Rebaudioside A, one of the main sweeteners extracted from the plant stevia rebaudiana, offers a less bitter aftertaste at high concentrations and even a slightly higher sweetness. Hence the reason rebaudioside A is used in this study. Due to the bitter note stevioside are generally combined with other sweetening agents for the application in food [2].

METHODS

After previous tests to determine the sweetness of each applied sweetener, the Quantitative Descriptive Analyses (QDA, acc. to DIN 10967-1) [3] was conducted by an experienced sensory panel consisting of 11 panellists.

STEP 1

Through the Quantitative Descriptive Analyses the descriptive panel produces taste and texture profiles of sucrose, erythritol, maltitol, stevia rebaudiana or rather rebaudiana A and sucralose in aqueous solutions, first by same intensities of sweetness (1,0) and second by similar amount of bulk sweeteners (30 g / l water).

STEP 2

Combinations of erythritol and stevia as well as combinations of erythritol and sucralose were sensorially analysed to investigate if they show a synergism and mask possible undesired specific characteristics of each other. The combinations were adjusted with a sweetness of 1,0 as well as with the maximum sweetness and tested in two different sessions.

In each of the conducted sessions the exclusive sweeteners as well as the combinations were analysed in direct composition to a sucrose-reference sample. All products were analysed in a balanced block design with monadic sample presentation and a scale from 0 to 10. Ten attributes were inquired. The data were performed in two repetitions and statistically assessed by Analysis of variance and LSD test.

RESULTS

The results from the descriptive sensory tests are used to describe the perceivable sensory attributes of the tested products. Moreover to identify significant differences among the sweeteners, especially between the sweeteners and sucrose. Significant differences between the samples are marked by '*' in the spiderwebs.

QUANTITATIVE DESCRIPTIVE ANALYSIS

STEP 1

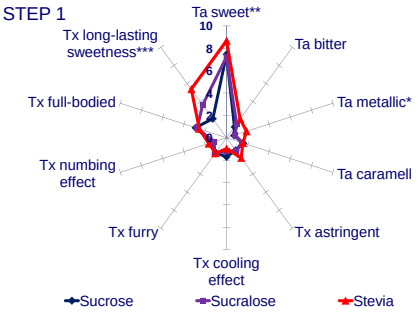

Fig. 1: Comparison of intensities between sucrose, sucralose and stevia **(sweetness 1,0)**

- **Stevia** indicates the significant highest intensities in the sweet and metallic taste as well as in the long lasting sweetness.
- **Sucralose** differentiates just in the long-lasting sweetness from sucrose, where it shows significant higher intensities.

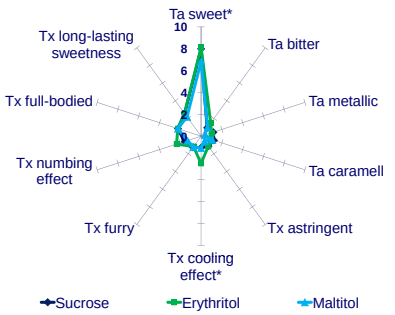

Fig. 2: Comparison of intensities between sucrose, erythritol and maltitol **(sweetness 1,0)**

- **Sucrose and erythritol** feature significant higher intensities in the sweet taste compared to maltitol.

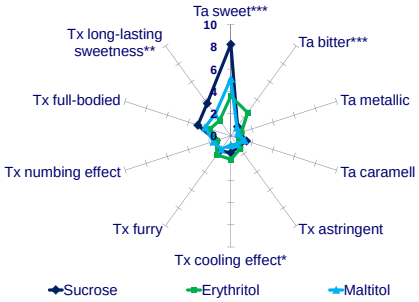

Fig. 3: Comparison of intensities between sucrose, erythritol and maltitol **(30 g/l water)**

- **Erythritol** features the significant lowest intensities in the sweet taste, with intensities half as strong as sucrose. It shows the significant highest intensities in the bitter taste as well as significant higher intensities than maltitol in the cooling effect.
- **Maltitol** tastes significant sweeter than erythritol but significant less sweeter than sucrose. Together with sucrose it shows significant lower intensities in the bitter taste and the cooling effect.
- **Sucrose** is the significant sweetest sample and the sweetener which has the significant highest intensities in the long-lasting sweetness.

STEP 2

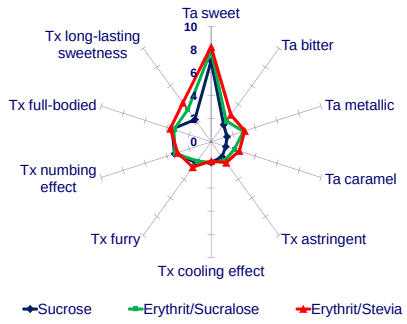

Fig. 4: Comparison of intensities between sucrose and sweetener combinations **(sweetness 1,0)**

- No significant differences in taste and texture.

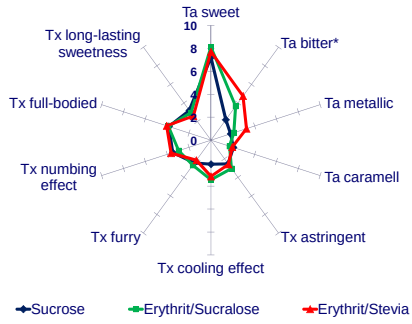

Fig. 5: Comparison of intensities between sucrose and sweetener combinations **(maximum sweetness)**

- Significant differences exist in the bitter taste between sucrose and the erythritol/stevia combination. This combination indicates higher intensities in this attribute.

CONCLUSION

The alternative sweeteners erythritol, maltitol, sucralose and stevia do not show sucrose-like taste and texture profiles but specific sensory characteristics. It has been demonstrated that a complete sugar replacement by using these sweeteners separately and keeping sucrose-like properties is not feasible.

The tested combinations of these conventional and natural sweeteners show sucrose-like taste and texture profiles by an adjusted sweetness of 1,0. Consequently, a possible sugar substitution in food is here readily identifiable.

Changing these optimal combinations with the aim of adjusting the maximum of sweetness the negative and characteristic taste of the sweeteners can be pointed out again.

Therefore the sweeteners or rather the combinations are application-specific and need to be adapted to different food matrices in future.

[1] LAWSON, P.: Erythritol, in: Ingredients Handbook, Sweeteners.(Editor: Wolson, R.), Surrey (Leatherhead Food International Ltd), 2007
[2] Dalzell, J.; Geuns, J. M. C.: Stevioside, in: Ingredients Handbook, Sweeteners.(Editor: Wolson, R.), Surrey (Leatherhead Food International Ltd), 2007
[3] DIN 10967-1, Sensorische Prüfverfahren – Profilprüfung Teil 1: Konventionelles Profil (1999)

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