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Texture-taste interactions: Enhancement of taste intensity by structural modifications of the food matrix

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Abstract

The reduction of salt and sugar in food products remains a challenge due to the importance of those ingredients in providing a highly desired taste quality, enhancing flavor, determining the behavior of structuring ingredients, and ensuring microbiological safety. Several technologies have been used to reduce salt and sugar content in foods such as replacement of sugar by sweeteners, replacement of sodium salts by blends of other salts, taste enhancement by aromas and taste boosters or gradual reduction of sugar and salt in small steps over time. In this study we present two alternative approaches to enhance taste perception. First, the use of an inhomogeneous spatial distribution of sugar in food gels is introduced as a way to enhance sweetness perception [1]. The translation of the concept of taste contrast to bread applications is discussed which allows to reduce salt content in bread by 25% without loss of saltiness intensity and without addition of taste enhancers, aromas or salt replacers [2]. Secondly, it is demonstrated how the serum release under compression of mixed polysaccharide/protein gels can be engineered to enhance sweetness perception. An increase of serum release by 5x allowed to reduce sugar content of gels by 30% while maintaining sweet taste intensity [3]. The translation of this concept to low salt sausages is discussed. Sausages were engineered to exhibit enhanced juiciness which lead to a boost of saltiness allowing for up to 40% salt reduction [4]. These approaches can be used to further optimize the development of products with reduced salt and sugar content while maintaining taste intensity.

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Keywords: Salt and sugar reduction; food texture; taste contrast; serum release; taste enhancement

1. Introduction

In recent years, concern has grown about the association of dietary practices to the development of health problems. In this context, a decrease in sugar and sodium intake has been recommended to

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diminish the incidence of obesity, dental caries and cardiovascular diseases caused by high blood pressure. Sugar and sodium reduction remains a challenge for food manufactures, as it generally leads to changes in the overall quality which may compromise consumer acceptance. Different strategies have been proposed to reduce sugar and sodium content of foods. One strategy is to replace sugar by high potency sweeteners and sodium salts by blends of other inorganic salts such as potassium chloride and magnesium chloride. Another reduction strategy is the addition of taste enhancers which amplify the taste intensity. An alternative approach to reduce sugar and salt content is by gradual reduction of the sugar and salt content over a longer time period, typically months or years. However, reduction is limited since it requires industry-wide cooperation and long time periods to achieve significant reductions. Therefore, other means to reduce the sugar and salt content in food and beverages are desired.

In this study we present two alternative approaches to enhance taste perception by structural modifications of the food matrix. The first approach is to generate an uneven spatial distribution of tastants such as sugar and salt in the food matrix leading to taste contrast which gives rise to taste intensity enhancement. The second approach is to engineer the microstructure of the food matrix to enhance the amount of serum which is released from the matrix upon mechanical compression such as chewing. As tastants need to be dissolved and delivered to the taste buds in order to trigger a response, enhancement of serum release in the food matrix is a tool to effectively release and deliver tastants. The applicability of both approaches to real foods is discussed using examples from bakery and processed meat applications, respectively.

Meiselman and Halpern showed [5] that the delivery of continuously alternating concentrations of aqueous salt solutions enhances saltiness intensity compared to model salt solutions with the same overall salt content but delivered in a non-alternating fashion. Their results indicate that the presentation of contrasting salt intensities can be used to enhance taste intensity. In this study, we show that taste enhancement in semi-solid gels can be achieved by an inhomogeneous spatial distribution of tastants, which might lead to a discontinuous stimulation of taste receptors [1]. Semi-solid model gels exhibiting an inhomogeneous spatial distribution of sucrose were prepared by placing four layers of mixed agar/gelatin gel containing different sucrose concentrations on top of each other. The sweetness intensity of all samples was evaluated by a panel consisting of naïve subjects. We demonstrate that taste enhancement through sensory contrast can be achieved by alternating sucrose concentrations in the mouth temporally and spatially in semi-solid model gels under realistic eating conditions. The concept of taste contrast is also applied to bread applications [2]. It is shown that an inhomogeneous distribution of salt in bread can be used to enhance saltiness intensity allowing for reduction of salt of more than 20% without loss of saltiness intensity.

Semi-solid gelled food products are generally complex products containing different ingredients, such as proteins, carbohydrates and fats. Mixed or composite products comprising both proteins and polysaccharides are sensitive to phase separation. In cold-set whey protein isolate (WPI)/polysaccharide mixed gels minimal variations in the type and concentration of the polysaccharide result in a wide range of microstructures. The microstructure of the mixed gels strongly affects their large deformation and sensory properties. The occurrence of serum release from WPI/polysaccharide gels is of importance with respect to the perception of tastants. Serum release can be related to the juiciness perception in fruits, vegetables and meat products. The phenomenon of serum release is mainly dominated by the microstructure of the gel, whereby gels with bicontinuous microstructure show the highest amount of serum release upon compression [6]. As tastants need to be dissolved in saliva before they can be perceived by the taste buds, serum release is likely to improve this process and enhance the perception of tastants in gelled products. In this study we show that serum release from cold-set mixed gels can enhance the perception of tastants. A set of mixed WPI/gellan gum gels with controlled serum release, constant large deformation properties and different sugar concentrations was prepared [3]. It is shown that serum release boosted sweetness intensity significantly. The translation of this concept to low salt sausages is discussed. Sausages were engineered to exhibit enhanced juiciness which lead to a boost of saltiness