

Tribology of micro-aerated chocolate – relating mechanical and thermal properties to perception

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The perception of foods is related to a range of mechanical processes that occur in the mouth during processing of food. Oral processing includes the so-called first bite, as well as mastication, during which the food is compacted, fractured, and mixed with saliva so that a bolus is formed, and subsequent swallowing. Oral processing of chocolate is a complex process that combines fracture mechanics, tribology and thermal aspects. These parameters are linked to results obtained in a temporal perception experiment. The objective is to better understand the interplay of various parameters and their effect on perception.

Micro-aeration has been successfully applied to chocolates to achieve a reduction in sugar and fat, whilst consumer feedback on these micro-aerated chocolate products indicates wide acceptance and an improved sensory profile. The micro-bubbles in these chocolate products have approximately the same size as the other the ingredients, and as a result will directly affect both the microstructure and the bulk material properties.

From a tribology point of view, experiments were performed on a biotribometer (PCS Instruments), using load and speed conditions similar to those applied to chocolate whilst consuming. It was observed that the coefficient of friction increases with cocoa solids percentage and decreases with increasing micro-aeration level. The presence of artificial saliva in the contact reduced the friction for all chocolate samples, however the relative ranking in terms of friction remained the same. These friction tests were combined with fracture mechanics investigations such as three point bending and compression as well as thermal conductance with the aim to better understand how food structure influences fragmentation, melting and friction and relate this to sensory attributes.