

# Modeling Melting Profiles in Chocolate Pieces for Optimizing Their Sensory Properties

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## Abstract

### Introduction:

Chocolate is a pleasurable product largely consumed over the world. It is known that ingredients, process and particle size distribution largely impact the chocolate sensory perceptions. The final aim of this study was to enhance pleasure during chocolate consumption through chocolate pieces shape modulation.

### Use of COMSOL Multiphysics®:

A conductive heat transfer model was built to provide the identification of the major parameters of in-mouth heat transfer and of in-mouth melting profiles of different chocolate designs, where melting is considered as pre-requisite for release of taste and aroma compounds.

### Results:

Nine one-bite chocolate shapes were designed based on criteria that could modify heat transfer and melting profiles (chocolate composition and the chocolate weight were kept constant). Twelve subjects participated to the study. They were instructed to consume the chocolate pieces with the mouth closed and to let the chocolate melt in their mouth (chewing was not allowed). Sensory perception tests as well as direct measures of aroma were performed.

After data treatment, it came that shape plays a role in flavour perception (high cocoa, high caramel notes and high aftertaste) as well as melting and smooth properties perceptions. To better understand the observed differences in texture and especially in melting attribute, we used modelling. It came out that appropriate combination of chocolate surface being in contact with the oral surfaces in mouth and remaining in-mouth volume available for aroma release allow combined good heat transfer by conduction across the parts and good flavour release opportunities (time and space).

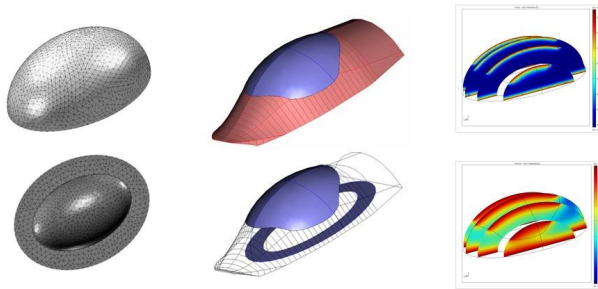
### Conclusion:

We proceeded to the simulation of melting of chocolate bites in mouth. The human mouth has a specific shape and according to how a food product fits into it, it may induce different perceptions. The full description of the in-mouth perception was obtained through sensory profiling whereas time-intensity was used to characterize cocoa flavour dynamics. Modelling allowed to link these perceptions and data to the simulated melting and aroma release profiles and may be used then to determine if a shape will have enhanced sensory perceptions.

## Reference

F. Lenfant; C.Hartmann, et al., "Impact of the shape on sensory properties of individual dark chocolate pieces." Food Science and Technology, 51, 545-552 (2013)

## Figures used in the abstract



**Figure 1:** Left: Example of a chocolate geometry after meshing. (also seen from below). Middle: Docking of the shape on the palate. The contact surface area between chocolate and palate is coloured in blue. The blue zone below represents the surface area in contact with the tongue. Right: Temperature slices through the chocolate at 2 different times.