Mechanistic modeling approach as a tool to better understand in-mouth flavour release during the eating of a solid food product

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Flavour release during food consumption depends on both food properties (composition, structure, rheology) and the physiological characteristics of individual (breakdown efficiency, saliva flow, breath frequency). The high inter-individual variability that exists on these physiological parameters can explain a part of observed differences between panelists on stimuli release and thus on perception.

The objective of this work was to identify the main mechanisms explaining flavour release kinetics during the consumption of a solid food (model cheese). A mechanistic model, based on the physiological steps of oral processes (product mastication and swallowing) and including physiological and physico-chemical parameters, was developed. Model parameters (physiological and physicochemical) were experimentally determined through specific measurements. Chewing efficiency and frequency, air and saliva flow rates and oro-naso-pharynx volumes were determined for each panelist. The physico-chemical properties of aroma compounds during bolus formation were predicted from empirical regressions based on in vitro measurements at various saliva-product mixing ratios.

Model sensitivity analysis showed that the mass transfer coefficient of aroma compounds in the bolus, chewing activity and salivary and respiratory air flow rates mainly impact release kinetics. The comparison of model predictions with experimental in vivo release kinetics of ethyl propanoate, obtained by APCI-MS during the consumption of 4 cheeses by 10 panelists, led to the determination of 2 parameters (unmeasurable experimentally): the speed of saliva incorporation in the bolus and the frequency of velopharynx opening during food consumption. These values were in agreement with literature data. Complementary work is on-going to check model predictions for a more hydrophobic compound.