# Modelling of heat and mass transfer phenomena during contact heating of food products

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Contrary to thermal convection and radiation heat transfer, and in spite of their importance in some heat treatments such as shallow frying or roasting, contact heat transfer has rarely been studied from a thermal engineering point of view in the case of food products. This is mainly due to the metrological and theoretical difficulties associated with the characterization of transfer phenomena occurring between a solid heating surface and a heated food product whose structure and composition are likely to change drastically during contact heating inducing an important series of phenomena affecting in return the studied heat and mass transfer phenomena: deformation of the heated surface lowering the surface of heated product in contact with the heating surface, release of liquid exudates and rapid evaporation then formation of a crust at the level of the contact with the heating surface. To deal with this, kinetics of product water loss and temperature rise were recorded during contact heating of three different types of food product (potato slices, omelette, pancake batter) in order to examine the influence of the heating power and of the presence or not of an oil layer below the heated product and the heating surface. From these experimental data, a 2D mathematical model based on a moving boiling-front approach was developed and validated. One of the objectives of our study is to propose a mathematical formalism that is sufficiently mechanistic to identify the sequence of transfer phenomena that occur during heating, but generic enough to be applied to the three products chosen for the study and even generalized to other solid or liquid food products. The analysis of the calculated results showed that, the overall heating of the product is limited by: (i) the evaporation of liquid water at the position of the boiling front propagating within the heated product and (ii) the formation, below the boiling front a dried zone which acts as an insulating layer. Realistic values of contact heat transfer resistance were also identified filling gaps in the bibliography on the subject.