

# Ohmic heating applied to the baking process: experimental and numerical approaches

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This work aims at studying the feasibility of ohmic heating (OH) technology applied to the baking process. The method includes proofing (fermentation) and baking and leads to the production of crustless sandwich bread without the need of cutting the crust away, in a shorter time and with theoretically lower energy costs than conventional baking.

An ohmic cell was made to study the electrical conductivity (EC) of bread dough under different experimental conditions. The results showed that the EC increased linearly with the temperature, except during the starch gelatinization stage (60 – 76 °C) because of the bounding of water. The EC decreased with the porosity of the dough when fermented by yeasts, and drastically decreased with the reduction of salt content in the dough, showing the need to control the product formulation.

An ohmic baking oven monitored by a PLC was developed to perform both proofing and baking in the same apparatus. The results showed that using OH to quickly reach the optimal temperature of yeast activity (35 °C) significantly reduced the lag phase and shortened the total proofing time.

A numerical model was developed and validated by experimental results, taking into account heat and water (vapour and liquid water) transfers. The results confirmed the importance of temperature gradients between the surface of the electrodes and the core of the product, first observed by the underbaked aspect of the bread loaf on its sides. Different baking scenarios and their impacts on temperature and water content gradients were modelled.