

Possibilities in Simulating Frying Processes with Respect to Minimizing Acrylamide Contents

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Abstract

Deep-fat frying of foods like French fries is one of the food heating processes which causes higher acrylamide contents in the prepared products. The reason is that parts of the product or the total product, e.g. potato crisps, reach temperatures above 100°C after evaporation of the water from the outer product layers.

In the dried parts the temperature raises to values up to 120°C and more. This supports the formation of Maillard reaction products which are necessary to give the desired product quality. However, the formation of acrylamide is also initialized.

Due to the complexity of food constituents and numerous interactions between product and heating medium (frying fat) simple relationships for the prediction of acrylamide contents depending on single process parameters, for example frying temperature measured at the temperature control probe in the frying apparatus, do not exist.

Therefore, only an integrated approach considering all relevant variables regarding process - product/raw material - equipment is suitable to generate sustainable new knowledge about resulting acrylamide contents in fried products. Especially, the quality of the fried products, e.g. color, crispness or taste, is an important parameter which has to be considered with respect to measures or proposals for acrylamide minimization.

The role of frying equipment and process conditions on heat transfer, on evaporation and also on temperature/moisture distribution within the product during frying will be discussed in the presentation. The list of relevant variables with respect to batch frying equipment used in catering facilities will be established. The large number of single variables necessary to describe the influence of frying equipments in an adequate way requires a lot of experiments based on statistical factor designs to get valuable information about their influence and their interactions. Additionally, these experiments has to be carried out for every type of fryer.

Therefore, an engineering approach for the characterization of frying processes using thermodynamic parameters is necessary to get a device-independent description of the process. The next step is the modeling of the process, e.g. heat transfer or water evaporation, by suitable mathematical equations. Based on such a mathematical model internal temperature and moisture profiles of foods during frying can be simulated for any processes in different frying devices. These results can be used to evaluate different frying processes and parameters with respect to acrylamide minimization. Because only few tests are necessary on real equipments to confirm the simulation results, time and money for trial and error test series can be saved.

In the presentation basic requirements, approaches and first results for such a simulation of frying processes will be discussed. Possibilities and limitations of the method will be demonstrated.