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Processing Contaminants from the Food Production

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INTRODUCTION

Contaminants like acrylamide, furan or PAHs (polyaromatic hydrocarbons) as e.g. Benz(a)pyrene may be formed during food processing. All of the substances are genotoxic carcinogens, and for that reason mitigation strategies to reduce the levels are needed. Examples of the formation of the processing contaminants and factors that influence the occurrence are given as well as suggestions for mitigation.

EXPERIMENTAL

The analytical methods for detection of acrylamide, furan and PAHs are described in the references 4, 2 and 3 respectively. The analytical techniques performed are LC-MS/MS (acrylamide); headspace GC-MS (furan) and GC-MS (PAHs). The experiments for studying the formation or mitigation of the contaminants are made as lab-scale experiments or in full scale in cooperation with Danish food industries.

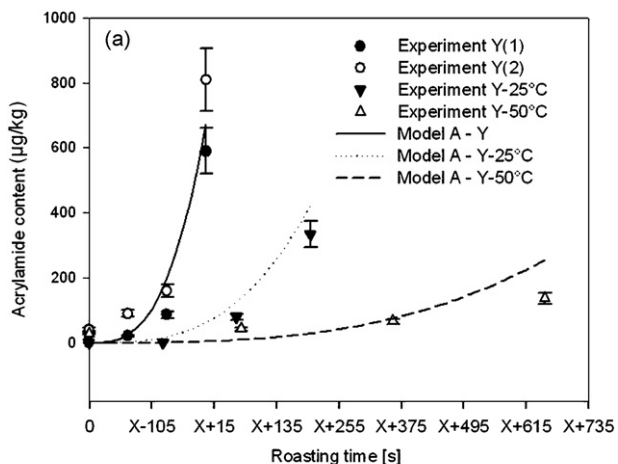


Figure 1. Acrylamide ($\mu\text{g}/\text{kg}$) in an extruded breakfast cereal as function of roasting time at usual (Y) or reduced (Y-25°C; Y-50°C).

RESULTS and DISCUSSION

Case 1: acrylamide in breakfast cereal

An industrial case study of a breakfast cereal production showed that the occurrence of acrylamide in the products greatly depends upon the combined effect of temperature and time. The levels increased exponentially with heating time and it is possible to reduce the acrylamide levels by reducing the temperature. By lowering process temperature and prolonging residence time, acrylamide contents were lowered to 20% with the product quality still maintained.

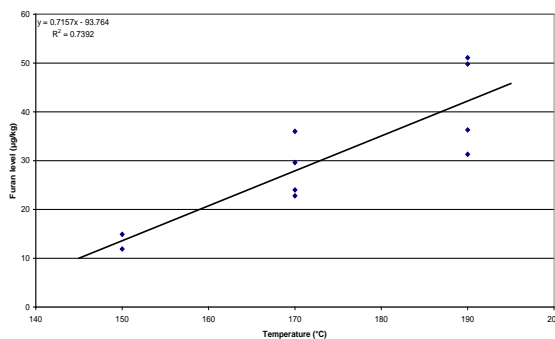


Figure 2. Formation of furan in potato crisps deep-fried at 150-190°C.

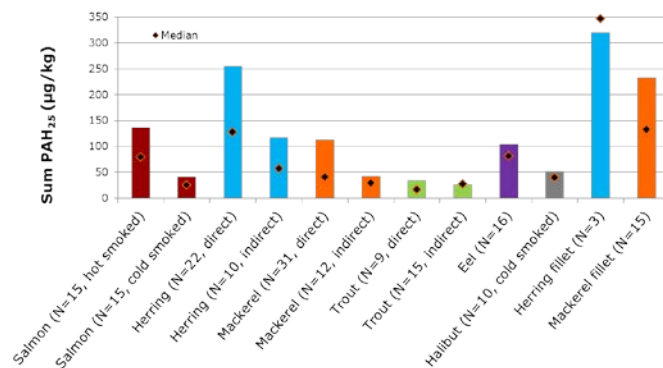


Figure 3. Mean and median ΣPAH_{25} in industrially smoked fish samples

Case 2: Furan in potato crisps

The furan formation of potato crisps produced at similar general conditions as in industry was studied by deep-frying in palm oil at 150°C for 7 min. at 170°C for 5 min or 190°C for 3.5 min. respectively. The different preparation conditions all produce crisps with a water content of approximate 2%. The result from the frying of the home made crisps reveals a linear relationship between the frying temperature and the furan content which at frying conditions 190°C for 3.5 min formed crisps with furan contents up to 50 $\mu\text{g}/\text{kg}$. Hence reducing frying temperature will mitigate furan level in the products.

Case 3: PAHs in smoked fish

The study on ΣPAH_{25} in industrially smoked fish samples from Danish fishmongers or larger production sites revealed that indirect smoking from a separate smoke generator mitigated the contaminant level compared to direct smoking. The cold smoked products contained less PAHs than the hot smoked product. Furthermore fillets with a larger relative surface contained more PAHs than the whole fish. Increased combustion temperature also increased PAHs.

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