Reducing acrylamide formation in fried potatoes

Identification

Key words
Potato, acrylamide, frying, temperature, organic acid, vacuum frying, carcinogen

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How does it work?

Primary objective
Reducing acrylamide concentration in potato

Working principle
Acrylamide is a potentially carcinogenic compound that has been found in fried food products containing protein and carbohydrate, more specifically the amino acid (the building blocks of protein) asparagine and a reducing sugar (carbohydrate). A reduction of this compound is therefore wanted. Acrylamide forms in food in a few reaction paths, but the most common is via the so-called Maillard reaction. This reaction is rather a family of reactions that occurs when heating carbohydrates and proteins above app. 150°C. The two most important parameters in reduction of acrylamide in potato are the heat regulation and the moisture control. By reducing the temperature of frying one can reduce the amount of acrylamide since it forms favourably over 150°C. Decreasing the frying temperature during traditional frying of potato chips from 180°C to 150°C reduces the acrylamide content by 51% (1). One technique to reduce the temperature and still keep the quality of the product high is low-temperature vacuum frying. The amount of acrylamide in fried potato chips could be reduced by 94% using this technique (1). If a product is pre-dried before processing it will take shorter time for the product to be ready and therefore it is possible to lower the formation of acrylamide (8). Also, blanching before frying of potato products is an effective method to reduce the acrylamide content due to the leaching of reducing sugars and asparagines during immersion in hot water (2,4). Another method is to reduce the limiting factor of the formation of acrylamide. In potato the limiting factor is the reducing sugars. Choosing a potato variety that is naturally low in reducing sugar can do this (1). Also, controlling of the storage temperature is important and should be above 8-10°C. Addition of specific chemical compounds is also an effective method. The addition of organic acids (e.g. citric acids) reduces the pH leading to a slower Maillard reaction (6). Rosemary extract can also lower the amount of formed acrylamide in the potato (6).

Images

Additional effects
Pre-drying of potato chips generates lower oil content and high crispiness of the final product.

Important process parameters
Temperature, processing time, pre-treatments, additives to product.

Models can be used to estimate the acrylamide formation based on the important product and process parameters (7,8).

Important product parameters
Potato variety, field site, storage time since harvest, reducing sugar content, water activity at the surface (8).
What can it be used for?

Products: French fries, potato chips.
Operations: Frying.
Solutions for short comings: Reduction of a potential carcinogenic substance that has been given a lot of attention in media is a good thing.

What can it NOT be used for?

Products: Non-acrylamide forming food products.
Operations: The acrylamide formation only take place at high temperatures, above 100°C, thus in processes at low temperatures the reduction strategies are not needed.
Other limitations: The effect on the final product quality needs to be considered when using the different methods.
Risks or hazards: None known.

Implementation

Maturity: Some methods already exist in the industry today, e.g. blanching. Vacuum frying exists in lab scale, but reduced pressure frying (closely related to vacuum frying) is used at industrial scale in south-east Asia.
Modularity/Implementation: These technologies are generally easily implemented into the existing production lines. Some of the pre-treatment might need an extra step in the process. Vacuum frying: existing frying equipment either has to be replaced or inserted into pressurized vessels.
Consumer aspects: Positive, reduction of a potential carcinogen is probably regarded as positive.
Legal aspects: None known.
Environmental aspects: None known.

Facilities that might be interesting for you

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<tr>
<th>Title</th>
<th>Institute/company</th>
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<tbody>
<tr>
<td>Auditorium IRTA</td>
<td>IRTA</td>
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<tr>
<td>Clean room – Histocell</td>
<td>Noray</td>
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<td>Video observation system for market research and product development tasks - Keki</td>
<td>NAIK EKI</td>
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Further Information

Institutes: KU Leuven LFT, DTU Food, Aarhus University - DJF
Companies:

Source: