

The scent of food: analysis of aroma compounds

What's That Smell?

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Winner of the Pro Scientia et Vita 2011 prize awarded by the Polish Academy of Sciences

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In order to understand what constitutes the specific aromas of food, we first need to study the chemical structure of their constituents. This is being done by researchers working at modern chromatography laboratories

The world around us is filled with different smells, both pleasant ones and those we would prefer to forget as quickly as possible. But answering the question of how these scents arise is not so easy. How many basic smells are there? Is a particular scent formed by a single compound, or is it a mixture of various chemical compounds?

Aromas

By trying to understand what makes up the unique and specific aroma of food, we must first elucidate the chemical nature of compounds which work alone or in combination to create the product's unique aroma. Even when all these compounds are identified, it is still necessary to determine the precise contribution of the given component to the final aroma. The number of volatile compounds in certain foods can reach hundreds, especially in products which have been processed thermally – such as coffee – or both thermally and by fermentation, such as bread or cocoa. However, in spite of the wide range of volatile compounds present in food, their total content is generally relatively low, not exceeding 20 mg per 1 kg of product. Moreover, only those volatile compounds present at concentrations exceeding the sensory perception threshold are significant in creating aromas. Of all the volatile com-

pounds present in a given food product, therefore, just a small fraction are active, and only these compounds will have a significant effect on its aroma, perceived by the human sense of smell.

Chromatography and oatmeal

Food scents are the research focus of the team led by Prof. Erwin Wąsowicz at the Institute of Food Technology, University of Life Sciences in Poznań, where the present author started her scientific research and began working with Prof. Henryk Jeleń. In a chromatography laboratory equipped with gas chromatographs and state-of-the-art mass spectrometers, the identification of volatile compounds in various types of food should not be a difficult task. However, the volatile compounds that are important in forming the scent of oat flakes and muesli products proved to be elusive. Solving this problem was the subject of a PhD project, made possible by a grant obtained under the 29th competition of the Polish Scientific Research Committee.

Fractions active in producing scents are identified using gas chromatography in combination with olfactometry using the human sense of smell. This combination, originating from an innovative concept created in the early 20th century, is now a routine and common



Solvent Assisted Flavor Evaporation (SAFE) equipment

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method used in the analysis of volatile compounds key for a given product's aroma.

Natural detector...

Using our own noses as detectors during chromatographic analysis enables us to define the fragrance of individual fractions responsible for a product's aroma. The variety of fragrances in each product can be rather startling; it may come as a surprise that volatile compounds forming the pleasant nutty fragrance of oat flakes, for instance, include some also found in boiled potatoes, cabbage, parsley root and mushrooms, whereas fragrances shaping the muesli aroma include earthy, grassy and floral tones.

...plus modern techniques

In order to precisely identify individual components of food fragrances, it is necessary to use the latest techniques for isolating volatile compounds that do not cause changes or their breakdown. Using Solvent Assisted Flavor Evaporation (SAFE) to isolate mixtures of volatile compounds from cereal products creates an extract whose composition reflects the mixture of aroma compounds found in the product. Aroma extract dilution analysis makes it possible to ascertain the intensity of individual aroma fractions, expressed as a dilution factor. Dilution factors characteristic for the aroma of oat flakes and muesli typically range between 4 and 1024.

Fragrance fingerprint

However, this is still not the end of the analysis; the most difficult and complex stage involves identifying the compounds whose aroma depends not just on the composition of the molecules, but also on their concentration. This is achieved by using GC-MS, a method combining gas chromatography with mass spectrometry. The mass spectrum obtained during the analysis, specific for the given compound and providing it an individual fingerprint, allows us to find out which compounds are present in our product. In this case, the identified volatile compounds responsible for the aroma of cereal products included aldehydes, ketones, and pyrazines.

A university on the prairie

This research brought forward the concept of using natural antioxidants as factors inhibiting certain negative changes that occur in food as a result of oxidation, affecting the aroma. Searching for sources of natural antioxidants was also the main aim of the research the author conducted during her year-long post-doc assignment at Prof. Roman Przybylski's Department of Chemistry and Biochemistry at the University of Lethbridge in the very heart of the prairie in Alberta, Canada. ■

Further reading:

Klensporf-Pawlik D., Jeleń H.H. (2009). Nitrogen atmosphere and natural antioxidants effect on muesli oxidation during long-time storage. *Acta Sci. Pol., Technol. Aliment.* 8 (1), 5-15.