Helene Loos, Roman Lang, Thomas Hofmann and Andrea Büttner

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Influenced by Breast Milk

How do food preferences develop? An intervention study using curry as an example is dedicated to examining the transfer of flavour compounds into breast milk.

A traditional German expression for something acquired very early in life is that it has been "absorbed with mother's milk". This figure of speech is worth reflecting upon, also in the literal sense and from the point of view of various scientific disciplines, which are seeking clarification based on hard biochemical facts and data. What else does a baby absorb with breast milk, apart from the vital macro- and micronutrients it contains? It appears to be the case that many habits and skills have their origin in early childhood. Sensitive time frames in human development are well-known with regard to language acquisition, but similar phenomena can be observed regarding the acceptance of foods.

US researchers have found that there is a period within the first few months of human life, in which consumption of infant formula with a bitter taste will give rise to increased acceptance despite its flavour being perceived as unpleasant by grown-ups. However, breastfed infants can also come in contact with different sensorial impressions, via the breast milk. Together with other aspects, this can have an impact on future food preferences. This is the starting point of a joint study conducted by working groups from the Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU) and the Technical University of Munich (TUM). It builds upon past studies, some of which were also funded by the DFG, in which the aroma of breast milk and its influencing factors were comprehensively explored at the molecular level. Under examination were changes in aroma that occur after a certain period of storage of breast milk in a refrigerator or freezer, as well as diet-related aroma changes that occur in breast milk, for example, after eating garlic or wild garlic: it was found that aromatic substances consumed through food enter the breast milk without modification to a certain extent. Some substances, however, are metabolised in the body in the same manner as other food components.

This gives rise to new metabolic products that can also enter the milk. Furthermore, there are cases in which a food consumed by the mother does not cause any significant changes to the milk's aroma, as some aromatic substances are degraded in the body, or because the changes in concentration in the milk are small enough to be negligible. It is therefore not possible to make any general statements about the transfer of aroma into breast milk. Fundamental analytical research must be carried out for a range of representative individual cases. The studies conducted in this area of research to date are mostly concerned with the transfer of aromatic substances into the breast milk. In the current cooperation project funded by DFG, researchers from FAU and TUM are examining the transfer of chemosensorially active substances into breast milk in their entirety for the first time, studying not only a potential transfer of aroma, but also of other chemosensory impressions.

Chemosensorially active substances comprise odour compounds, tastants and the so-called trigeminally active compounds. Odour compounds usually have a relatively low molecular mass of less than 300 daltons (atomic mass unit) and they are sufficiently volatile to be able to reach the olfactory mucosa in the upper nasal cavity. This can take place either orthonasally via the nose, or retronasally via the throat (such as when eating a food item). Odour compounds cause an olfactory perception when they interact with G-protein coupled receptors on the olfactory mucosa.

Among the tastants there are many non-volatile compounds, such as element ions and amino acids, sugars and alkaloids. These cause a gustatory perception by interacting with ion channels (for sourness and saltiness) or with G-protein coupled receptors (for sweetness, bitterness and umami) in taste buds that are located on the tongue, for example.

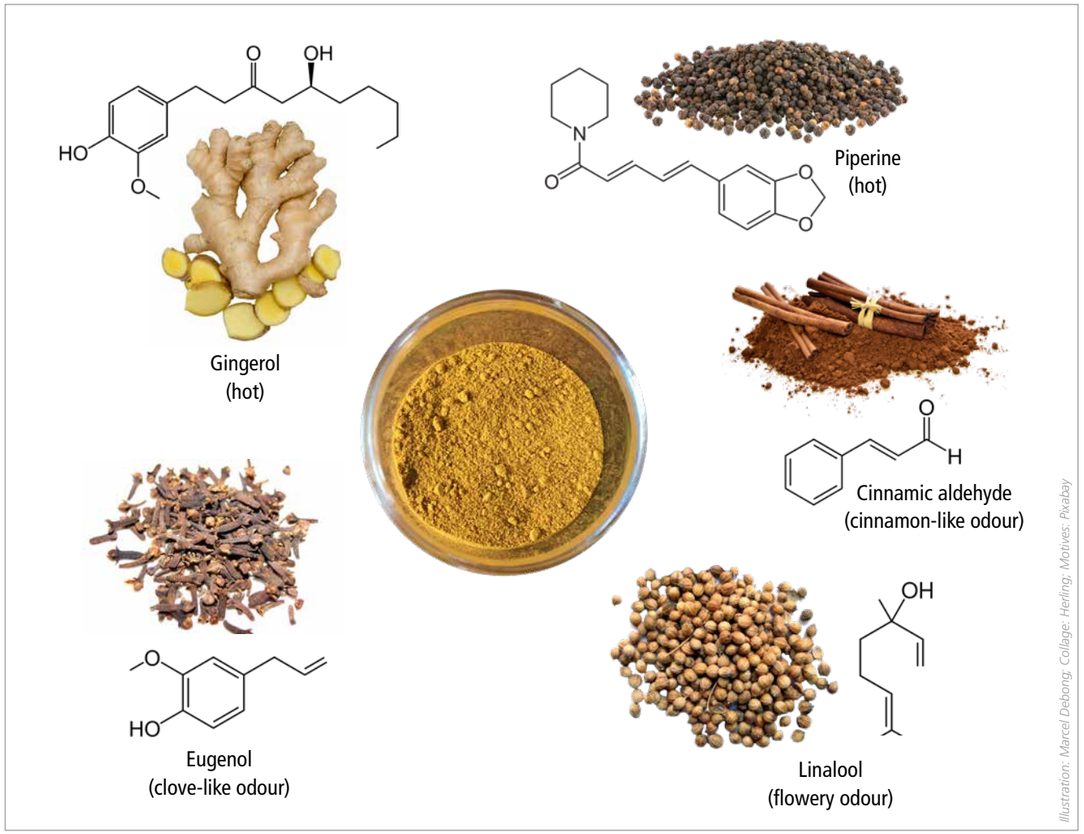
Realistic study design: a curry dish with ginger, sunflower oil, coconut milk and rice.

Illustration: Pixabay / Larry White

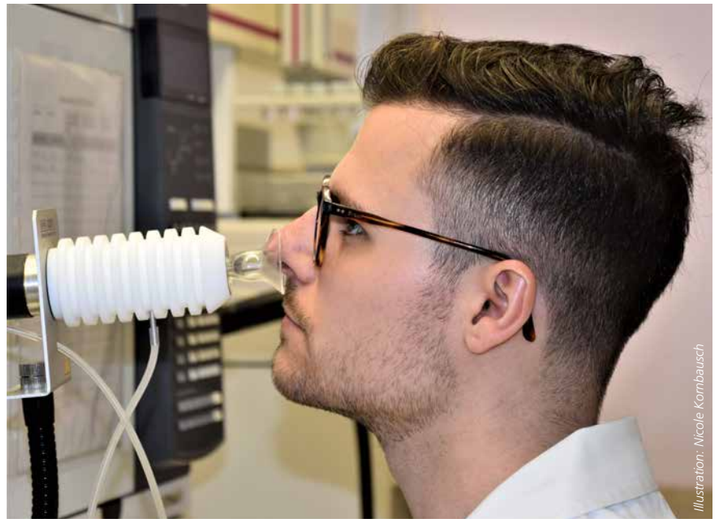
Trigeminal compounds, meanwhile, give rise to cool, pungent or related sensory impressions via the trigeminal nerve (Nervus trigeminus). Some compounds also feature multiple sensory properties: a compound can elicit odour and taste perception at the same time, or also be cooling, stinging or pungent. In order to explore, which chemosensorially active compounds pass over from food into breast milk, and are therefore sensorially recorded or absorbed by the infant, it must first be determined which of these are constituents of the original diet. Sensory-analytical methods are used for this purpose, which allow for chemosensorially active substances to be distinguished from other substances, using methods for the chemical analysis of food in combination with the human sensory system. Input from human beings is in fact essential here: the human nose or tongue is used in both the so-called gas chromatography-olfactometry/mass spectrometry and in the liquid chromatography taste dilution analysis.

The team of the DFG project "Tracing the transfer of dietary chemosensory molecules and their metabolites from the maternal diet into human milk and urine by means of a curry spice intervention study" uses a scenario that is as realistic as possible: the participants are asked to eat a curry dish. Individual odour substances were often used in past studies. However, this does not correspond to normal dietary behaviour with actual meals. This situation has been reconstructed using a dish that contains a curry spice mixture, as well as ginger, sunflower oil, coconut milk and rice. To be able to clearly relate the sensory impact, the participants were asked to refrain from consuming any of the ingredients of the curry dish, two days prior to taking part in the study. This enables the researchers to trace the effects in detail, that eating the curry dish has on the composition of breast milk.

Curry is a spice mixture that contains various flavour substances. Shown here are a few typical components.



Curry contains a wide range of odour and taste substances with distinct chemical structures. The excretion routes of these substances are traced in the intervention study. Odour substances can be excreted in a number of ways – not only via breast milk, but also through urine, the skin or the breath. Tastants are usually primarily excreted via urine after metabolisation. Investigations of the different excretion routes allow for insights into the metabolic processes in the body, including the elucidation of metabolites.



Gas chromatography-olfactometry. So far, only the human nose is able to distinguish odour-active and non-odorous volatile compounds.

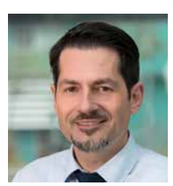
A number of questions can be answered thanks to these examinations, which are relevant not only to early childhood nutrition, but also to our understanding of human digestion, and of metabolic and excretion processes in general. Another question investigated in the study that directly refers to the human senses is, whether the concentrations of chemosensorially active compounds that enter the breast milk are high enough to be perceived by the infants. This would be the basic prerequisite to attain a kind of training effect in infants, concerning particular aroma or taste impressions, and to assume that sensory imprinting is taking place in early childhood in this manner.

In addition to this, the physiological effects of chemosensorially active substances and their metabolites are of interest. Some chemosensorially active substances are known to affect human physiology and health, e.g. by being anti-inflammatory or antioxidative. This gives rise to research questions regarding the possible effects that such compounds and their derivatives have in human beings. Especially concerning bioactive substances, the question arises, what impact these may have on infants when ingested via breast milk, besides their chemosensory effects through odour and taste.

Dr. Helene Loos
is a junior research group leader at the Chair of Aroma and Smell Research, Friedrich-Alexander-Universität Erlangen-Nürnberg.

Dr. Roman Lang
is a research associate at the Technical University of Munich.

Professor Dr. Andrea Büttner
holds the Chair of Aroma and Smell Research at the Friedrich-Alexander-Universität Erlangen-Nürnberg and is Executive Director of the Fraunhofer Institute for Process Engineering and Packaging IVV.



Professor Dr. Thomas Hofmann
holds the Chair of Food Chemistry and Molecular Sensory Science and is the President of the TU Munich.

Department of Chemistry and Pharmacy

Contact: Friedrich-Alexander-Universität Erlangen-Nürnberg, Department Chemie und Pharmazie, Lehrstuhl für Aroma- und Geruchsforschung, Henkestraße 9, 91054 Erlangen, Germany

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