The word “authenticity” is increasingly used in the marketing of food products. A product can be marketed claiming its authenticity such as containing only natural ingredients or originating from a special location produced using local traditional production methods. Within the area of food ingredients a problem with authenticity of aroma compounds has occurred, because natural aromas are wholly or partly replaced with synthetic ones. This is a large economic problem, since natural aromas are often more expensive than artificial ones. Furthermore, the European Union has legal requirements that every product marketed as containing natural flavours should be able to document that the flavours are in fact of natural origin. Such parameters are very difficult to verify because similar aromas often have the same chemical composition regardless of the production method or origin. It is therefore necessary to develop new methods able to verify whether the authenticity of the food products is in agreement with the labelling.

Some aroma compounds are chiral, meaning that they can exist as two enantiomers with different spatial orientation. Synthetic aroma compounds will consist of almost equal amounts of both enantiomers contrary to natural aromas where often only one of the enantiomers will be in excess. Consequently, if equal amounts of enantiomers are detected in a food product labelled “Natural” it could be an indication of adulteration. Artificial aroma compounds often have very different ratios of stable carbon isotopes compared to compounds synthesized in plants. Furthermore there can be large variations in isotopic compositions in plants synthesized compounds, since different plants utilize carbon dioxide through various cycles which will be reflected in different fractionations of carbon isotopes. This fact can be used for authenticating aroma compounds. Weather and climate conditions will affect the ratios of stable isotopes of hydrogen in the plants and consequently, differences of stable hydrogen isotopes can be used for tracing the geographical origin of the plant from which a flavour is extracted.

The purpose of this PhD project was to establish an analytical platform based on gas chromatographic enantiomeric separation and compound specific isotope analysis. Aromas of known authenticity were then analysed in order to create a database of reference values. Based on this database the authenticity of aromas from food products was evaluated.

Before gas chromatographic enantiomeric separation could be performed, it was necessary to extract and concentrate the aroma components. The use of solid phase micro extraction was investigated for an extraction of aroma compounds, especially the chiral α-ionone, from raspberry aroma. A mixed fiber coating consisting of divinylbenzene, carboxen, and polydimethylsiloxane was found suitable for the purpose. The addition of sodium chloride was found to inhibit the extraction of α-ionone. The two enantiomers of α-ionone could be separated using a chiral column consisting of cycloexetrins. Aroma components from raspberries and samples labelled to contain raspberry aroma were extracted using the above method. 13 of the 27 samples analysed contained almost racemic mixtures of α-ionone. Hereof was 4 products falsely indicated to contain raspberries or raspberry juice. Vanilla aroma made by chemical synthesis, microbiological processes, and extracted from natural vanilla pods were analyzed using Gas Chromatography-Isotope Ratio Mass Spectrometry. Based on measurements of ratios of stable isotopes of carbon it was possible to differentiate between the vanilla aroma extracted from vanilla pods and vanilla aroma made otherwise. Furthermore, the species of the vanilla pods was identifiable by measurements of carbon stable isotopes. By combining measurements of stable isotopes of carbon and hydrogen for natural vanilla, it was seen that adjacent geographic origins of growth had a tendency to cluster. Compound specific isotope analysis can therefore be a valuable tool in authenticating and tracing a vanilla aroma.

Methods for extracting vanilla aroma from food products were investigated and it was found that vanilla aroma could be extracted and concentrated using solid phase micro extraction with a polyacrylate fiber coating. The isotopic composition of the aroma extracted from vanilla custard powder, vanilla sugar, and cookies were determined and their authenticity evaluated accordingly. Extraction of vanilla aroma from ice cream was more complicated and a preliminary extraction was investigated. A liquid-liquid extraction was chosen in combination with solid phase micro extraction. With this method it was possible to analyze vanillin from 7 different ice creams and to evaluate their authenticity based on the measured carbon isotopic composition.

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