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Lotne produkty degradacji glukozynolanów jako związki sensorycznie aktywne w warzywach kapustowatych

Volatile products of glucosinolate degradation as sensory-active compounds in Brassica vegetables

Rozprawa doktorska wykonana pod kierunkiem

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Summary

The aroma of food is one of the most important sensory features of food, which proves the product's high quality and determines the consumers' choice. According to the latest nutritional guidelines, consuming vegetables and fruits is the backbone of the nutrition pyramid right after physical activity nevertheless, proportions are also substantial. Vegetables and fruits should constitute at least half of the food eaten of which about 75% should be vegetables. In addition to nutrients, they also contain numerous bioactive compounds that have a wide range of health benefits. Consumption of Brassica vegetables brings a number of health-promoting effects, including anti-cancer, anti-inflammatory, antibacterial, antioxidant, cardioprotective, anti-obesity, and stomach diseases properties. It has been shown that the positive impact on human health is associated with the activity of glucosinolate breakdown products.

Volatile products of the decomposition of glucosinolates in sensory terms are still a little-known class of chemical compounds. The main objectives of this doctoral dissertation included: a literature review for volatile sulfur compounds, enhancement of the sensory data for isothiocyanates, finding a method for quenching myrosinase activity for the analysis of volatile compounds and identification and quantification of key volatile and odor-active compounds that are responsible for the aroma of raw and cooked kohlrabi.

The review of the literature on volatile odor-active sulfur compounds in Brassica vegetables was extended to Allium vegetables, truffles, and shiitake mushrooms due to the similarities in the pathways of their formation. After esters, sulfur compounds are the second most numerous class of volatile organic compounds found in food. In addition, they form the dominant group of compounds identified as key odor-active compounds in food including Brassica vegetables, Allium vegetables, truffles, and shiitake mushrooms. Volatile sulfur-containing compounds are formed mainly in enzymatic processes, but also during their thermal degradation from precursors such as sulfur amino acids, as well as from glucosinolates. Limited stability, susceptibility to oxidation, as well as low detection thresholds makes the qualitative and quantitative analysis of volatile sulfur compounds a challenge.

Sensory analysis (FPA) of 19 isothiocyanates provided information on the nature of the odor-active compounds and the odor threshold concentrations for the individual compounds. Gas/liquid partition coefficients were also determined for air and four liquid matrices - water, saliva buffer, artificial saliva, and human saliva. The collected data allow evaluation of the

migration to the headspace of isothiocyanates during the consumption/mastication of Brassica vegetables.

The activity of myrosinase - an enzyme catalyzing the reaction of glucosinolate hydrolysis in the process of sample preparation for the analysis of volatile and odor-active compounds should be inhibited. Due to the difficulties in inhibiting the activity of myrosinase in terms of the analysis of odor-active compounds using methods based on thermal treatment, the study of the suitability of inorganic salts for this purpose was undertaken. The effect of selected cations of inorganic salts (Cu^{2+}, Fe^{2+}, Fe^{3+}, Ag^{+}, Mn^{2+}, Ca^{2+}, Na^{+}) on the amount of formation of volatile glucosinolate breakdown products in the model system and in green kohlrabi tissue was evaluated. Anhydrous sodium sulfate was selected as the optimal myrosinase inhibitor from among the tested agents, which was used in the subsequent research task.

The composition of the volatile compounds found in kohlrabi was already tested, but no attempt was made to determine the key odor-active compounds responsible for the odor of this vegetable. In order to isolate the compounds, an extract of raw and cooked kohlrabi was prepared and concentrated. The sample prepared in this way was subjected to GC-O analysis and due to aroma extract dilution analysis, 55 aroma-active compounds were determined in raw and cooked kohlrabi. The application of GC-O analysis enabled the identification of 6 volatile and odor-active compounds whose presence in kohlrabi was previously unknown. The analysis of the extract with the addition of isotope-labeled standards allowed the determination of analyte concentrations in the kohlrabi sample and the calculation of the OAVs. Determination of the OAVs was crucial in the determination of eight key compounds responsible for the aroma of raw and cooked kohlrabi, including 3 isothiocyanates. For the most part, the calculated OAVs were higher for the raw kohlrabi sample and lower for the cooked kohlrabi due to the loss of volatile compounds during cooking.

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