Studies on the Contribution of Flavor Precursors to the Flavor Formation of Thermally Processed Shallot and Welsh Onion

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ABSTRACT

Shallot (Allium cepa L. Var. aggregalum) and welsh onion (Allium fistulosumL.) are two important flavoring vegetables used in a wide range of Chinesefoods. nonvolatile flavor precursors, i.e., S-alk(en)yl-L-cysteine sulfoxides,have been found in the intact cells of shallot and welsh onion. After thephysically break down of the shallot clove or welsh onion tissue, some of theseprecursors can be transformed enzymatically to the primary flavor compounds withthe pungent odor. These primary flavor compounds, which are mainlythiosulfinates, thiosulfinates can further break down or transform to othersulfur-containing volatile compounds. Most of the researches on Allium flavorbefore have only been focused on the enzymatic flavor formation. Only a fewresearches focused on the probable contribution of the amino-typesulfur-containing nonvolatile flavor precursors of Allium to the flavor ofthermally processed Allium plants through the thermal degradation or thermalinteractions of these precursors with ot her components in the Allium species. In this study, the potential contributions of nonvolatile flavor precursorsof shallot and welsh onion to the flavor of thermally processed shallot andwelsh onion were therefore studied. This thesis included four parts: (1) Volatile compounds of fried blanchedshallot and fried shallot slices were isolated by using instantaneousLikens-Nickerson steam distillation/ dichloromethane extraction method. Theextracts were further fractionated into four fractions by using acid/ basefractionation method. After being concentrated, the isolates were applied to GCand GC-MS analysis. (2) volatile compounds of shallot, baked shallot, friedshallot, blanched shallot, baked blanched shallot, and fried blanched shallotwere isolated, concentrated, and analyzed by using the same method as that shownin (1). (3) Wesh onion tissue was divided into two parts, i.e., green leaf andwhite sheath. Volatile compounds of green leave and white sheath, baked greenleaf and white sheath, fried green leaf and white sheath, baked blanched greenleave and white sheath, and fried blanched green leave and white sheath wereisolated, concentrated, and analyzed by using the same method as that shown in(1). (4) Six nonvolatile sulfur-containing flavor precursors, they are,S-methyl-L-cysteine (MeCy), S-propyl-L-cysteine (PrCy), S-1-propenyl-L-cysteine(PrenCy), and the sulfoxides of these three cysteine derivatives (MeCySO, PrCySOand PrenCySO) were purchased or synthesized. The aqueous solutions of these sixprecursors were mixed with or without glucose, and then heated at 170 °C in aclosed stainless reaction container for 1 hr. The volatile compounds generatedwere isolated, concentrated, and analyzed by using the same me thod as thatshown in (1). Here were some important conclusions for this study: 1. The fried shallot sample with the best overall acceptance was that friedin initial oil temperature 200 °C and final oil temperature 170 °C. 2. From the fact that only small amount of volatile compounds were generatedin the blanched shallot and blanched welsh onion, whereas abundance volatilecompounds were generated in unblanched, fried, and baked shallot and welshonion, it showed that blanched treatment could deactive the activity of flavorenzymes and stop the enzymic formation of volatile compounds from the precursorsin shallot and welsh onion. 3. From the fact that the yield of volatile compounds in fried blanched orbaked blanched shallot was higher than that in fried or baked shallot, and theyield of volatile compounds in fried blanched or baked blanched welsh onion wasvery close to that in fried welsh onion or baked welsh onion, the importance ofthe nonvolatile flavor precursors to the flavor of thermally processed shallotor welsh onion was then proved. 4. The volatile compounds isolated from shallot can be divided into (1)those probably generated from the thermal degradation of sulfur-containingnonvolatile flavor precursors; (2) those probably generated from thermaldegradation of lipids; (3) those probably generated from thermal degradation ofsugars; (4) those probably generated from Maillard reactions; and (5) thoseprobably generated from uncertain sources.The contributions of the flavor precursors of shallot to the flavor or thermally processed shallot were found both through the thermal degradation of these precursors and the Maillard type interactions of these precursors with others sugars in shallot. Whereas, he contributions of the flavor precursors of welsh onion to the flavor of thermally processed welsh onion were found to be mainly through the thermal degradation of these precursors. 5. The major sulfur-containing volatile compounds degraded from thenonvolatile sulfur-containing flavor precursors of shallot during frying orbaking treatment were the sulfur-containing volatile compounds carried themethyl and propyl group. Whereas, the major sulfur- containing volatile compoundsdegraded from the nonvolatile sulfur-containing flavor precursors of welsh oniondu ring frying or baking treatment were the sulfur-containing volatile compoundscarried the methyl and 1-propenyl group. 6. The IR spectrum analysis of the synthesized flavor precursors confirmedthe authencity of these compounds. The TLC analysis of the synthesizedprecursors showed that they had very high purity. 7. The major volatile compounds generated in the MeCy and MeCySO systemswere monosulfides and disulfides. 8. The major volatile compounds generated in the PrCy and PrCySO systemswere disulfides and trisulfides. 9. The major volatile compounds generated in the PrenCy and PrenCySO systemswere thiophenes and thiazoles.

Keywords : shallot ; welsh onion ; flavor precrusors ; model reactions ; thermally process

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