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ORIGINAL ARTICLE

Effect of freezing on the pungency and antioxidants activity in leaves and bulbs of green onion in Giza 6 and Photon varieties

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KEYWORDS

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Abstract The shelf life of green (spring) onions was short (from 3 to 4 weeks). Therefore, the aim of this investigation is to elongate green onion shelf life by freezing at −18 °C with slight changes in antioxidant activities and pungency for each spring onion *Allium cepa* L. varieties (Giza 6 and Photon) which cultivated in Egypt. This study included leaves and bulbs in each varieties of spring onion. Results showed high contents of total phenols and flavonoids in leaves compared with bulbs either of Giza 6 or Photon types, therefore Giza 6 had high content of total phenols and flavonoids than Photon variety, in parallel the results were obtained of total chlorophyll and total carotenoids contents. While, chlorophyll a content showed higher than chlorophyll b in leaves than in bulbs for each variety. Results indicated that the diversity in kind of polyphenolic and flavonoids components either leaves or bulbs in each spring onion types. Benzoic acid showed the major polyphenolic compounds in the bulbs of either Giza 6 or Photon spring onions varieties (11.92% and 27.43%), while salicylic acid (8.37%) and ellagic acid (9.10%) were major ones of the leaves of Giza 6 and Photon variety. The major components of flavonoids were myricetin, quercitin and rutin in leaves and bulbs for each variety. Myricetin which was the highest flavonoids components was the major; it also showed higher percentage in the leaves than bulbs of two varieties (Giza 6 and Photon). It also was higher in Photon leaves than Giza 6 leaves. Giza 6 bulbs was highest content of pungency, then Photon bulbs followed by Giza leaves and Photon leaves at zero time till 3 months of storage at freezing. Also, results of pungency and antioxidants activity by DPPH method in leaves and bulbs for each variety indicated that there were slightly decrease during storage (3 months). Results indicated that export onion spring can be stored under freezing at −18 °C during 3 months without high changes in pungency.

Introduction

Flavonoids and organosulfur compounds are the two major classes of secondary metabolites found in onions believed to promote beneficial health effects. Their mode of action and

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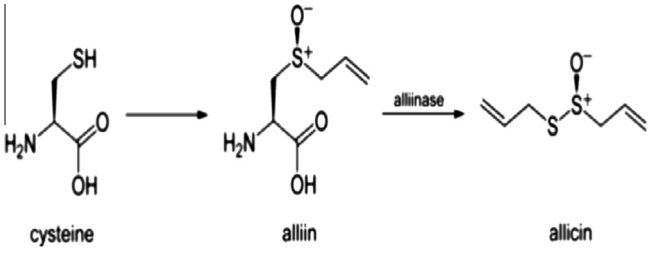
biosynthetic pathways are quite different. The organosulfur compounds are believed to possess anti-inflammatory, anti-allergic, anti-microbial, and anti-thrombotic activity by inhibition of cyclooxygenase and lipoxygenase enzymes (Block et al., 1997). Most likely the compounds work through sulfur–sulfur or sulfur–oxygen linkages (Augusti, 1996). These compounds are formed when an onion is cut and the cell walls are disrupted. Allinase enzymes produce sulfenic acids *via* S-alk(en)yl cysteine sulfoxides (ACSOs) which rearrange to various compounds such as thiosulfinates, cepaenes, and onion lachrymatory factor (Block et al., 1997; Lancaster et al., 1998).

Quercetin and kaempferol, the major flavonoids in onions, are found in the flavonol subclass. The degree of hydroxylation distinguishes them from one another. The beneficial health effects associated with these compounds such as reduced risk of coronary heart disease and different types of cancer are thought to be primarily from anti-oxidative activity including metal ion chelation and inhibition of lipid peroxidation (Anonymous, 1998) (see Fig. 1).

Pungency in onions is derived from a number of volatile sulfur compounds. The consumer perception of onion pungency depends on the presence of organosulfur compounds that are fertilized from enzymatic reactions involving S-alk (en) yl-L-cysteine S-oxide decomposition (Lancaster et al., 2000).

These compounds then come into contact with the alliinase enzyme (cysteine sulfoxide lyse, C.S. lyse EC 4.4.1.4), which is normally isolated in the vacuole (Lancaster and Collin, 1981), and the enzyme activity is almost instantaneous when the cell membranes are broken. The compounds produced by alliinase are pyruvate, ammonia and sulphenic acid, and the pungency of onions is absolutely correlated with the pyruvate production (Schwimmer and Weston, 1961).



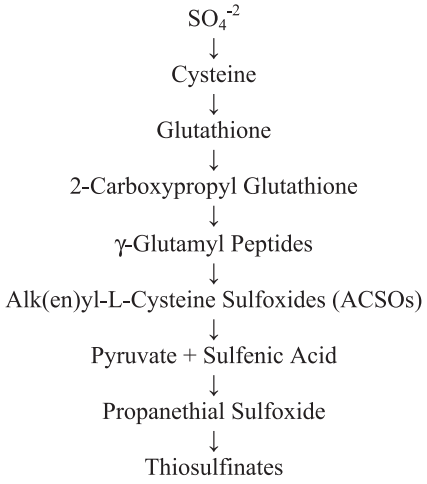


Fig. 1 Sulfur transformation in Alliums (Augusti, 1996).

The accumulation of organosulfur compounds in onions depends upon many factors, especially sulfur-based fertilization, the environment, and the genotype of the cultivars (Yoo et al., 2006; Chope et al., 2007). However, sulfur-based fertilization and onion pungency are not always positively correlated, and contrary results have been reported (Randle and Bussard, 1993). Also, the pyruvic acid content is influenced by environmental growing conditions, clones and storage (Yoo et al., 2006; Gallina et al., 2012).

Bunched green onions can be stored 3–4 weeks at 0 °C with 95–98% RH. Under these conditions, bunched onions stored in polyethylene-lined containers and top-iced maintain excellent quality for 1 month. Storage-life decreases to 1 week if the temperature is 5 °C, and rapid yellowing and decay of leaves occurs at higher temperatures (Adamicki, 1998). Furthermore, onions are not sensitive to chilling and can be stored at −2 to −3 °C, since the highest freezing point is −0.8 °C. Storage at < -4 °C may cause freezing injury (Grzegorzewska, 1999).

The preservation commercial method in Egypt to export spring onion was treated with chloride solution 7%, then cooling 4 °C to store 3 weeks only (2 weeks shipping and 1 week on the shelf). Therefore, the aim of this investigation was to elongate shelf life without change in antioxidant activities and pungency for each spring onion species (Giza 6 and Photon). This investigation is useful for national economic of Egypt and at the same time to Egyptian income when export onion abroad.

Materials and methods

Materials

Giza 6 and Photon are the two varieties in spring onion (*Allium cepa* L.) were collected from Cairo-Alexandria dessert road cultivar. After collection, the samples were cleaned and washed. All samples divided into two parts, fresh and frozen samples at −18 °C to determine antioxidant activity and pungency.

Total phenolic contents in leaves and bulbs at zero time were determined using the Folin–Ciocalteau reagent (Singleton and Rossi, 1965). While, the content of total flavonoids was determined by a pharmacopeia method (Pharmacopeia of USSR, 1989), also the content of flavonols was determined by Yermakov et al. (1987) using rutin as a reference compound.

Methods

Total chlorophyll, chlorophyll a and b and carotenoids were determined according to Fedtke (1973) and Wettstian (1957). Also, β-carotene was determined according to the method of Nagata and Yamashita (1992). Phenolic compounds and flavonoids fractions in two types of spring onions were determined by high performance liquid chromatography (HPLC) as mentioned by Goupy et al. (1999) and Mattila et al. (2000). HPLC used in this investigation was Hewlett Packard series 1100. Column hypersil BDS 5 μm C 18. Detector UV 254 nm. Flow rate 0.3 ml/min. Mobile phase A: (0.5 ml acetic acid/99.5 ml distilled water). B: (0.5 ml acetic acid/99.5 ml acetonitrile). Temperature ambient 25 °C.

Pungency in spring onion leaves and bulbs were determined at zero time and every month during frozen storage for 3 months, as pyruvate analysis which was performed according