Annals of Agricultural Science (2014) 59(1), 53–61

HOSTED BY

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Faculty of Agriculture, Ain Shams University

Annals of Agricultural Science

www.elsevier.com/locate/aoas

ORIGINAL ARTICLE

Charactrization of carotenoids (lyco-red) extracted from tomato peels and its uses as natural colorants and antioxidants of ice cream

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Received 11 February 2014; accepted 12 March 2014
Available online 25 July 2014

KEYWORDS

Tomato peels;
Carotenoid;
Lyco-Red;
Stability;
Rancimat;
Sunflower oil;
Antioxidant and ice cream

Abstract The nine carotenoid pigment compounds of tomato peels were identified by HPLC analysis. The main component of carotenoids (lyco-red) extracted from tomato peels was lycopene, phytoene, phytofluene, β-carotene, *cis*-lycopene and lutein. Consequently, the higher stability of carotenoids (lyco-red) extracted from tomato peels was observed in alkaline pH ranging from 7 to 10 and temperature ranging from 40 to 70 °C. Meanwhile, the degradation of carotenoids (lyco-red) extracted from tomato peel did not exceed than 16.20% of total pigments after 180 min incubation at 100 °C. On the other hand, the antioxidant activity of carotenoids (lyco-red) extracted from tomato peel was also studied by the Rancimat test at 110 °C on sunflower oil by adding 50–200 ppm of carotenoids (lyco-red) extracted from tomato peels. However, sunflower oil containing 50–200 ppm recorded higher induction period than 200 ppm BHT. Supplementing ice cream with carotenoids lyco-red extract increased the Radical Scavenging Activity RSA and Ferric Reducing Antioxidant Power (FRAP) in the ice cream by increasing the concentration of adding lyco-red extract. On the other hand, analysis of variance for sensory evaluation of prepared ice cream indicated that, ice cream containing 3% and 2% of carotenoids (lyco-red) extracted from tomato peels had the highest scores for flavor, body and texture, melting and color and the best mix compared with that prepared with 1%, 4% and 5% which recorded the lowest scores in all tested quality attributes.

Introduction

By-products derived from food processing are attractive source for their valuable bioactive components and color pigments. These by-products are useful for development as functional foods, nutraceuticals, food ingredients, additives, and also as cosmetic products. Lycopene is a bioactive red colored pigment naturally occurring in plants. For instance Industrial by-products obtained from the plants are good sources of lycopene. (Kin et al., 2010). The main wastes of tomato processing industry are Seeds and peels. The peel can contain about 5 times more lycopene than tomato pulp (Sharma and Maguer, 1996).

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Peer review under responsibility of Faculty of Agriculture, Ain-Shams University.

http://dx.doi.org/10.1016/j.aoas.2014.06.008
0570-1783

Lycopene is a red plant pigment found in tomatoes, guavas, watermelons, papayas and grapefruits. Mean while tomatoes being the largest contributor to the dietary intake of humans than others (Chalabi et al., 2004). Lycopene exhibits higher singlet oxygen (O_2) quenching ability. Due to its strong color and non-toxicity, lycopene is a useful food coloring (registered as E160d).

Lycopene extract from tomato peel is intended for use as a food colorant. It provides the similar color shades, ranging from yellow to red, as do the natural and synthetic lycopenes. Lycopene extract from tomato is also used as a food/dietary supplement in products where the presence of lycopene provides a specific value (e.g., antioxidant or other claimed health benefits). The lycopene may also be used as an antioxidant in food supplements. Lycopene extract from tomato is intended for use in the following food categories: baked goods, breakfast cereals, dairy products including frozen dairy desserts, dairy product analogs, spreads, bottled water, carbonated beverages, fruit and vegetable drinks, soybean beverages, candy, soups, salad dressings, and other foods and beverages. (Lee and Chen 2002 and Yang et al., 2006).

Oleoresin is the material that remains after solvent extraction of a plant material followed by removal of the solvent. Tomato oleoresin is a semisolid mixture of a resin and essential oil that can be obtained from tomatoes and tomato pomace. Tomato pomace is a byproduct from the tomato processing industry, consisting of 5–10% of the fresh weight of tomatoes (Fondevila et al., 1994). Tomato oleoresin is a lycopene rich material that has potential for use in foods and supplements to enhance the nutritional value, functionality, color, and flavor.

Rao et al. (1998), reported that lycopene from tomato oleoresin was readily absorbed and may act as an in vivo antioxidant. Lipid extracts containing lycopene from tomatoes are available commercially for use in foods and nutritional supplements. Lyco-oleoresin extract from tomato is a lycopene-rich extract prepared from the ripe fruits of tomato (*Lycopersicon esculentum* L.). They also added that, the product is manufactured by crushing tomatoes, to produce crude tomato juice that is then separated into serum and pulp. The pulp is subsequently extracted using ethyl acetate as a solvent. The final extract consists of tomato oil in which lycopene together with a number of other constituents that occur naturally in tomato, are dissolved and dispersed. These constituents include fatty acids and acylglycerols, unsaponifiable matter, water soluble matter, phosphorous compounds, and phospholipids.

The intended use of Lyco-oleoresin (LycoRed) extract from tomato considered as a food colorant in dairy products, non-alcoholic flavored drinks, cereal and cereal products, bread and baked goods and spreads, to provide color shades from yellow to red. Also, Lycopene extract from tomato may be used in food supplements. EFSA, 2008).

The advantages of tomato lycopene used as an excellent natural food colorant and it is stable to heat and extreme pH values encountered in food processing, effective in low concentrations, has no off-flavors, and covers the full range of colors from yellow through orange to deep red. Addition of lycopene as a food colorant depends on the formulation, method of food preparation, and the manufacturing techniques involved. The nutraceuticals status of lycopene has accelerated research activities to improve processing factors that lead to maintaining the nutritional as well as sensory quality of tomato product. Yildiz (2007).

The storage stability of butter, ice cream, and mayonnaise indicated that the addition of lycopene pigment from tomato waste peel did not have a detrimental effect on their quality during 4 months of storage. Sensory data of these products containing lycopene pigment had good consumer acceptability for fresh, as well as stored, products. Kaur et al. (2011).

The objective of the present study was to extract carotenoids (lyco-red) from tomato peel and identification of the most effective carotenoids by using HPLC. The stability at different pH values and temperature of extracted (lyco-red) was studied. Also, assessment of antioxidant activity of carotenoids (lyco-red) extracted from tomato peel on sunflower oil, physicochemical properties of functional ice cream mix and Sensory evaluation of prepared ice cream using various levels of carotenoid (lyco-red) extracted was also undertaken.

Materials and methods

Tomato peel was obtained from Kaha Company for Preservative Foods Kaha, Kalyobia, Egypt.

Fresh buffalo's milk (6% fat) was obtained from a private farm. Skim milk powder, gelatin, fresh cream (25% fat) and sugar were purchased from the local market.

The solvents used for spectral and HPLC analysis were of HPLC grade and all other solvents used in this study were of ACS grade and obtained from Sigma Chemical Company, St. Leuis, USA.

Refined sunflower free from antioxidants was obtained from Arma Food Industries, 10th of Ramadan Cairo, Egypt.

Synthetic antioxidant, namely butylated hydroxy toluene (BHT) and standard carotenoid were purchased from Sigma Chemical Co., St Lewis, USA.

Extraction of carotenoid (lyco-red) from tomato peel

Lyco-red was extracted according to the method described by Hackett et al. (2004).

The obtained tomato peel was dried in oven dryer at 40 °C until the moisture content reached to 6% then ground and passed through 0.15 mm sieves.

Hundred grams of tomato peel powder were placed in 4-L beaker and 500 mL of ethanol was added, stirred for 20 min, and allowed to stabilize for 1.5 min. The mixture was then homogenized for 1 min. After that the mixture was filtered through Whatman filter papers (Whatman No 1 and cheesecloth. The filtrate was mixed with 250 mL of acetone/hexane solution (50:50, v/v) and homogenized for 1 min. A separatory funnel was used to separate the non-polar hexane layer containing lipid materials from the water-soluble fraction, and solvents were removed by reduced pressure at 40 °C. The oily of carotenoids (lyco-red) extracted from tomato peel was kept in a dark bottle and frozen stored until analysis and their uses.

Determination of total carotenoids

Carotenoids content was determined by spectrophotometric method according to (Hornero and Minguez 2001).