

Comparative study on the extraction of natural dye by conventional magnetic stirring and ultrasound-assisted extraction techniques from carrot

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Received : 10.04.2018; Accepted : 13.04.2018

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■ **Abstract :** In the food and dairy industry, most of the colouring agents used are artificial in nature which are reported to cause harmful effects when consumed in higher doses. Carotenoids is red orange colour pigment present in carrot and can be used as a natural dye in milk and milk products. Looking to the above fact as attempt was made for the extraction of Carotenoids by conventional magnetic stirring (MS) and ultrasound-assisted extraction techniques (UAE). A comparative study of extraction of Carotenoids from the carrot were systematically evaluated between MS and UAE. The optimum operating conditions to yield maximum Carotenoids from the carrot were fixed. The solvent used for extraction was ethanol. The power, frequency, temperature, time and agitation speed were 150 W, 40 kHz, 50°C, 25 minute and 100 rpm, respectively. It has been observed that Carotenoids yield was higher in UAE (0.008%) as compared with MS (0.006%).

■ **Key words :** Carrot, Ultrasound-assisted extraction, Magnetic stirring, Carotenoids, Natural dye

■ **How to cite this paper :** Bramhankar, Chanda, Khare, Archana, Nikam, Pranali, Qureshi, Mehar Afroz and Naik, Y.K. (2018). Comparative study on the extraction of natural dye by conventional magnetic stirring and ultrasound-assisted extraction techniques from carrot. *Internat. J. Agric. Engg.*, **11**(Sp. Issue) : 99-101, DOI: 10.15740/HAS/IJAE/11.Sp. Issue/99-101.

Color is a measure of quality and nutrient content of foods. Color is the first characteristic to be noticed and is one of the main ways of visually assessing a food before it is consumed. Color provides an indication of the expected taste of the food. Color maintain or improve nutritional value of food. The objective of adding color to foods is to make them appealing, augment the loss of color during processing, to improve the quality and also to influence the consumer to buy a product. At present, the demand for natural dyes is increasing worldwide due to the increased awareness on therapeutic and medicinal properties and their benefits among public and also because of the

recognized profound toxicity of synthetic colors. The demand for food color in global market on 2000 was 2400 MT which increased to 3000 MT by the year 2005 and further to increase to 8000 MT by the year 2010 and is expected to increase to 15000 MT by the year 2015. The investment in natural food color market across the globe has touched to US \$ 1 billion and is continuously growing as there is demand for natural food color against synthetic food color (Lakshmi, 2014). Natural food colours are-Annatto, Betanin, Cramine, Carotene, Carthmin, Curcumin, Anthocyanin, Betalain etc. Artificial food colouring causes: Attention deficit hyperactivity disorder (ADHD), depression, food allergies, headaches

and migraines, diarrhoea, vomiting (Vargas *et al.*, 2010).

Carrot (*Daucus carota* L.) is one of the popular root vegetable grown throughout the world and is the most important source of dietary carotenoids in Western countries including the United State of America (Block, 1994). Carrot were first used for medicinal purposes and gradually used as food. Written records in Europe indicated that carrots were cultivated prior to the tenth century (Dias, 2014). China is the major carrot producing country in the world (FAO, 2014). The annual production of carrot in India 968.37 thousand tonnes in 2014 to 2015, with Haryana, Tamil Nadu, Uttar Pradesh, Assam, Karnataka, Bihar, Andhra Pradesh, Telangana, M.P., Jammu and Kashmir being the major producing states. The annual production of carrot in Chhattisgarh 20.38 thousand tonnes in 2014 to 2015 (National Horticulture Board, 2014-2015).

The colour of the carrot root flesh may be white, yellow, orange, red, purple or very dark purple. Orange carrots, today more popular, were developed in the 15th and 16th centuries in Central Europe. A rapid rise in the popularity of orange carrots was observed with the recognition of its high carotene content and provitamin A content. Carotenoids is an antioxidant in carrot are classified as carotenes and xanthophylls which give attractive red or yellow colour and contribute to food quality. Total carotenoids content in edible portion of carrot roots range from 6,000 to 54,800 $\mu\text{g}/100\text{g}$ (Simon and Wolff, 1987). The presence of high concentration of antioxidant carotenoids especially β -carotene may account for the biological and medicinal properties of carrot (Sharma *et al.*, 2012).

UAE is based on the frequency, improve the mass transfer of the extraction process by generating cavitation within the material. When the cavitation bubbles are produced and collapsed, the cell walls of the material will be destructed and the release of the solution promoted (Almahy *et al.*, 2013).

■ METHODOLOGY

Fresh dark orange colour carrot was purchased from the local market. Washed it properly and paste them by using grinder.

Extraction of carotenoids using magnetic stirring:

A sample of 100 gm of carrot paste was kept in a glass flask, and then add 100 ml of ethanol (marck

company, high grade). The beaker was covered using aluminum foil to prevent loss of solvent by evaporation. This beaker was stirred magnetically for 3 hours having 100 rpm. After extraction, the extract was filtered through whatman filter paper no. 1 under the vacuum, and the solution was collected in volumetric flask. Then concentrate the filtrate under vacuum oven.

Ultrasound-assisted extraction :

A sample of 100 g of carrot paste was kept in a glass flask, and then add 100 ml of ethanol (marck company, high grade). The beaker was covered using aluminum foil to prevent loss of solvent by evaporation. Content were dissolved by using magnetic stirrer for 5 min. Ultrasound-Assisted Extraction (UAE) was performed in a sonication water bath. The working frequency and power were fixed at 40 kHz and 150 w at 50°C for 25 min. After extraction, the flask was immediately cooled to room temperature by using chilled water. The extract was filtered through whatman filter paper no. 1 under the vacuum, and the solution was collected in volumetric flask. Then concentrate the filtrate under vacuum oven.

■ RESULTS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Extraction yield (%) :

The total extract yield of dye obtained after concentration will be weighed to obtained extraction yield.



0.008% yield in UAE method and 0.006% yield in MS method.

Conclusion:

Natural dyes provide an environmentally safe option for coloring of food and other materials. Extraction was done using ultrasound as well as magnetic stirring methods and extraction efficiency were compared. It was found that the application of ultrasound can increase the extraction of dyes from carrot. The reason for the improvement could be due to better mass transfer to solvent assisted by acoustic cavitation provided by ultrasound.

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