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Cucurbita seed oil extraction, evaluation of physico chemical properties & health benefits

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ABSTRACT

Pumpkin seed oil (PSO) is recognised as a functional food oil because it contains bioactive components such as phenolics and tocopherols that have health benefits such as antioxidants, the prevention of some malignancies, the slowing of hypertension development, and the relief of diabetic mellitus. Several extraction procedures, both traditional like Soxhlet extraction and newer extraction systems like ultrasound-assisted extraction and supercritical extraction, were improved and developed to acquire optimum yields of PSO with highest bioactive components from the respective fruit seed. Because PSO contains tocopherols and other phenolic compounds, it may be useful in the treatment of disorders caused by oxidative stress. Because the prices of PSO and other vegetable oils varies, adulteration involving the substitution or addition of PSO with lower-cost oils such as palm oil and maize oils is feasible, and analytical methods capable of identifying the practise are available. The purpose of this review was to emphasise PSO's extraction method, physicochemical features, and health advantages.

Keywords: Pumpkin seed oil, Health, tocopherols, Soxhlet extraction

INTRODUCTION

Pumpkin, scientifically known as Cucurbita maxima, is a member of the Cucurbitaceae family, which is commonly grown in tropical places and has a great economic value across the world. Pumpkin has been used in the culinary sector to make juices, purees, jams, and alcoholic drinks (1). Meanwhile, a pumpkin seed is an edible seed that contains bioactive components that are commonly utilised as herbal remedies and functional meals. Pumpkin seeds are also widely utilised in cooking, particularly in Southeast Asian nations. In Indonesia, pumpkin is one of the most popular vegetables consumed and regarded as a functional food owing to its very high concentration of bioactive chemicals with health benefits (2). In addition, pumpkin seed oil (PSO) has gained great attention in fats and oils industry not only as edible oil but also as a potential nutraceutical (3). The world production of pumpkins was 27 million tonnes, and China led the total production accounting of 29%. PSO has been reported to contain phytosterols, phenolic compounds, antioxidants, tocopherols, and small levels of carotenoids responsible to some biological activities which are beneficial to human health (4) including prevention of gastric, breast, colorectal and lung cancers (5), retardation of hypertension progression, antihypertension (6), prevention of prostate disease, mitigation of hypercholesterolemia and arthritis, alleviation of diabetes mellitus by enhancing hypoglycemic activity, reduction of bladder and urethral pressure (7), improving bladder compliance and urinary disorder in human overactive bladder (8), and offering good antioxidant sources (9).

Because of the health benefits of PSO, various research have focused on chemical characterisation, such as triacylglycerol compositions, fatty acids (FA) compositions, tocopherols, sterols, and phenolic acids, and have linked these components to biological activities (10). PSO may have a high pricing value in the fats and oils business when compared to other vegetable oils such as palm and maize oils, but a low price value when compared to, say, olive oil (10). As a result, PSO may be adulterated with other oils. This review article highlighted some extraction methods, physico-chemical characterization of PSO, antioxidant activities, and the authentication of PSO.

METHODOLOGY

To accomplish this review article, numerous reputable databases such as Web of Science, PubMed and Scopus containing review and original articles related to the covered topics were identified and downloaded. The keywords explored during literature searching consisted of pumpkin seed oil+ Physico chemical properties, biological activities + pumpkin seed oil.

Extraction of pumpkin seed oil

PSO has been extracted from pumpkin seeds using a variety of procedures in order to get PSO with a high yield and high amount of bioactive chemicals. Organic solvent extraction, cold pressing (12), mechanical pressing, supercritical fluid extraction using liquid CO2, aqueous enzymatic extraction aided by microwave (1), ultrasound-assisted extraction, and microwave-assisted extraction are among these approaches (13). However, the most prevalent processes for commercially producing vegetable oils include extraction using an organic solvent and mechanical pressing. PSO was extracted utilising supercritical CO2 and an experimental design of composite rotatable design. Pressure, temperature, and time were among the factors that were tuned to improve extraction efficiency (highest yield) and physicochemical qualities. The maximum extraction yield was 30.7 percent when pressure, temperature, and time were tuned to 32,140 kPa, 68.1oC, and 94.6 minutes, respectively. These three factors had quadratic impacts, and each parameter had a considerable impact on the extraction yield (14).

Rezig et al. (2018) have compared two different extraction methods, namely solvent extraction with extracting solvents of pentane, hexane, and the mixture of chloroform: methanol (3:1, v/v) and cold pressing. These extraction techniques affected the oil stability and antioxidant activities. PSO extracted by mechanical extraction exhibited the best stability and highest tocopherol levels than other PSOs. PSO extracted by mechanical pressing also had the highest values in total carotenoids, total phenolic compounds (TPC), βcarotene, quercetin, squalene, fecosterol, stigmasterol and antioxidant activities DPPH using radical scavenging, ABTS radical scavenging, and reducing power. PSOs were extracted using n-hexane as the extracting solvent in the Soxhlet apparatus by thermal cycles at 76°C for 4 hrs. (15)

Hernández-Santos et al. (2016) have evaluated the effects of amplitude and time of ultrasound-assisted extraction (UAE) during PSO extraction. Using experimental design, the amplitude of 62.50% and a time of 5 mins offered a higher extraction yield than others. The extraction yield increased with the increased amplitude because the larger ultrasonic wave amplitude could enhance the cell disruption which led thus the extraction efficiency increased (16).

Aqueous enzymatic extraction is regarded to be safer, cheaper, and more ecologically friendly than organic solvent extraction. PSO extraction was done by Jiao et al. (2014) using microwave-assisted aqueous enzymatic with cellulose, pectinase, and proteinase (w/w/w). Response surface methods was used to improve several extraction variables, such as extraction temperature, enzyme concentration (percent, wt/wt), duration (min), and power (W) (RSM). The greatest oil yield of 64.17 percent was reached using optimal conditions (extraction temperature of 44°C and enzyme concentration of 1.40 percent (wt/wt), extraction period of 66 minutes, and irradiation power of 419 W). PSO extracted using microwave-assisted aqueous enzymatic extraction showed higher oxidative stability than that extracted using Soxhlet extraction with hexane as extracting solvents.

According to Nederal et al. (2012), the chemical characteristics of PSO were also altered by the manufacturing methods(17). The results showed that pressing of roasted pumpkin seed paste, pressing of unroasted ground pumpkin seeds, and pressing of unroasted ground pumpkin seeds while cooling the press produced higher total phenol content, higher initial peroxide value, and better oxidative stability, while cold-pressed oils had higher tocopherol content. However, these extraction techniques had no significant effect on FA composition or TAG profiles. The chemometrics of principal component analysis (PCA), based on the score plot of first principle component (PC1) and second principle component (PC2), using fatty acid and triglyceride compositions as variables could classify PSOs from two varieties and three production processes.

Chemical characterization of pumpkin seed oil

To describe PSO, it was necessary to determine its physico-chemical characteristics, which could subsequently be employed for authenticating reasons. The chemical composition and qualities of PSOs are influenced by a number of factors, including pumpkin variety (cultivars) and origin area. Varying cultivars of PSO have drastically different fatty acid (FA) compositions (18). Table 1 compiles the physicochemical characterization of pumpkin seed oil which include some constants specific for PSO. Habib et al. (2015) have reported that the physical properties of PSO were as follows: specific gravity of 0.9412 (at 31° C), the iodine value of 114.33 gI2/g PSO, saponification value of 193.73 mg KOH/g PSO, acid value of 0.516 mg KOH/g PSO and percentage of free fatty acid of 0.2646%.

As indicated in Table 2, PSO has nutritional value since it contains vitamins that are required in the human diet (Nishimura et al., 2014). The primary FAs in PSO, according to Rezig et al. (2012), were oleic, linoleic, and palmitic acids. In addition, PSO contains -tocopherol and -sitosterol, with syringic acid being the most prevalent phenolic acid (Table 3). Furthermore, PSO's chemical composition revealed that it contains 40.58 percent oleic acid, 27.06 percent stearic acid, 17.39 percent palmitic acid, and 14.97 percent linoleic acid in terms of fatty acid content. Siano et al. (2016) have noted that the polyunsaturated FA (PUFA), monounsaturated FA (MUFA) and saturated FA (SFA) contents in PSO cultivated in southern Italy were of 48.14%, 25.54%, and 25.20%, respectively. The high degree of unsaturated FA makes PSO suitable to be used as valuable drying agent, while low value of free FA contents indicates the suitability of PSO as edible oils.

Benefits of Pumpkin seed oil

Pumpkin seed oil is extracted from pumpkin seeds and used in a variety of culinary and cosmetic applications. It's a popular in desserts, salad dressings, and as a finishing oil for foods because of its nutty flavour. It's also available as a treatment for hair and skin that's in good shape. Pumpkin seed oil's capacity to heal wounds is also being investigated by researchers. Rodent studies have been undertaken, but further study into the impact on people is required. Pumpkin seeds are abundant in antioxidants, which aid in disease prevention. Their anti-inflammatory capabilities are being investigated as well.

Nutrition Information

One tablespoon of pumpkin seed oil contains: Calories: 120, Protein: 0 grams, Fat: 14 grams, Carbohydrates: 0 grams, Fiber: 0 grams, Sugar: 0 grams, Pumpkin seed oil is a good source of: Potassium, Magnesium, Calcium, Iron, Zinc, Phosphorus, Pumpkin seed oil is also an excellent source of poly unsaturated and monounsaturated fats. Studies show that unsaturated fats can improve your blood cholesterol levels, which can decrease your risk of heart disease and type 2 diabetes.

Potential Health Benefits of Pumpkin Seed Oil

Pumpkin seed oil is a rich source of vitamins and minerals. However, the same thing that makes pumpkin seed oil so potent can also create complications for people with certain medical conditions. Research has found a number of potential health benefits to consuming pumpkin seed oil:

Prostate Health

Pumpkin seed oil may help improve benign prostate hyperplasia, which is an enlarged prostate. In a randomized trial, pumpkin seed oil eased symptoms of enlarged prostate and improved participants' quality of life over a three-month period. Topical pumpkin seed oil has also safely and non-invasively treated chronic nonbacterial prostatitis, a bacterial infection common in older men.

Hair Growth

For people trying to grow hair, pumpkin seed oil may be a helpful supplement. One study tested the success of pumpkin seed oil in men with mild to moderate hair loss. Those in the pumpkin seed oil group grew 30 % more hair than those in the placebo group.

Overactive Bladder Support

In a 12-week study, pumpkin seed oil extract significantly reduced symptoms of overactive bladder. It may also aid the treatment of urinary disorders.

Heart Health

Pumpkin seed oil can improve heart health by lowering cholesterol and reducing high blood pressure, both of which are risk factors for heart disease. This may occur because pumpkin seed oil is a healthier alternative to saturated and trans fats.

Potential Risks of Pumpkin Seed Oil

Because pumpkin seed oil has such potent ingredients, you should consult with your doctor before taking it or any other supplement. Consider the following risks before consuming pumpkin seed oil:

Weight Gain: Pumpkin seed oil is a fat that should be consumed in moderation. Follow the serving suggestions to enhance flavors when you cook and keep your consumption within a moderate range.

Shelf Life: Pumpkin seed oil spoils easily if not stored properly. Keep pumpkin seed oil in a cool place and out of direct sunlight to extend its shelf life.

Hypotension:Because it may lower blood pressure, people with blood pressure that is already low should take care when consuming pumpkin seed oil and share any concerns with their healthcare provider. (18-29)

CONCLUSION

Pumpkin seed oil (PSO) is valuable oil having functional oil properties and exhibits several biological activities, mainly antioxidant due to high contents of phenolic compounds and tocopherols. The high price of PSO in the market make it to be adulterated with lower price oils, and some analytical methods have been successfully used for authentication of PSO. Pumpkin seed oil is rich in heart-healthy fats and antioxidants. Animal and human studies have shown it can improve heart health, increase hair growth, and support urinary tract health. It's also very versatile and can be used as cooking oil, taken as a supplement, or combined with other oils and applied to the scalp.

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