Environmental Energy and Economic Research 2020 4(1): 69-81
DOI 10.22097/eeer.2020.198937.1106

Review Article

An Environmental Friendly Process for Extraction of Active Constituents from Herbal Plants

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Received: 22 May 2019 /Accepted: 19 November 2019

Abstract

Conventional methods for extraction of the active constituents from herbal plants, in addition to their high processing costs, are harmful to the environment owing to their time and energy consumption, uncontrollable parameters, use of toxic and dangerous solvents, loss of the extract, thermal instability, the contamination of the product with organic solvents and the loss of water-soluble compounds, and venting Volatile Organic Compounds (VOC). The use of supercritical fluids, especially supercritical carbon dioxide, is the most suitable option for extracting active constituents from the herbal plants. In this study, Due to the abundance of "Urtica dioica" (nettle) and "Sambucus ebulus" (elderberry) in Guilan province and the presence of valuable substances in them, the active constituents of these two plants and their application, the method of planting and extracting their valuable substances have been studied. Various methods were applied to extract active constituents from these two plants. Supercritical CO_2 is an attractive alternative process for traditional solvent extraction CO_2 was used in a process, and then recovered to use again. There have been an increasing number of commercialized production plants utilizing supercritical fluids extraction process. This article summarized and presented this environmentally friendly process for the extraction of active constituents from herbal plants to replace traditional techniques to reduce the environmental impact of the extraction process.

Keywords: herbal plants, supercritical fluid extraction, environmentally friendly, Nettle, Elderberry, active constituents.

Introduction

Herbal Essences as volatile, aromatic, and colorless materials with terpene and alcoholic origin have complex chemical compounds that are nowadays widely used in food, pharmaceutical, cosmetic, sanitary and chemical industries (Kumar and Zakir, 2019; McGaw et al., 2019; Yousefi et al., 2018). The division of effective drug substances into plants is the four main groups of alkaloids, glycosides, volatile oils, and other effective substances. By saying other active substances, we mean substances such as bitter substances, faluns, flavonoids, mucilages, vitamins, tannins, silicic acid (and certain similar acids) and such other compounds which due to their inconsistency and extent of chemical structures, are not included in the previous three groups (Parvez, 2018; Perez, 2018; Wang, 2019). Since active pharmaceutical ingredients

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usually exist in low concentrations in plants, many studies have been done to extract these compounds effectively and selectively from plant raw materials. Methods for extracting plant compounds include distillation with water (or steam), extraction with an organic solvent, and soxhlet techniques and extraction with a supercritical fluid. These methods have disadvantages and advantages that are selected according to the type of plant, composition, and technical and economic discussions of the process (Fattahi et al., 2016; Kavoura et al., 2019; Keshavarz et al., 2012; Motamedimehr and Gitipour, 2019). Among the whole plant species in Iran, there are about 1,500 species of medicinal use. Studies show that 450 of them are also grown in Guilan Province which is some of the most important medicinal plants that are used in traditional and modern medicine for the treatment of many diseases (Kuruppu et al., Silva, 2019; Naghibi et al., 2014). In this study, Due to the abundance of "Urtica dioica" (nettle) and "Sambucus ebulus" (elderberry) in Guilan province and the presence of valuable substances in them, the active constituents of these two plants and their application, the method of planting and extracting their valuable substances have been studied, also the environmentally friendly process for active constituents extraction from herbal plants was presented.

Material and methods

The herbaceous nettle a few years old belongs to the nettle grass and is scientifically called Urtica dioica. The stem is square and grows upright vertically up to one meter high (Figure 1). Its other names are Big Nettle, Nettle Diphne, and White Nettle and ... This plant grows self-growingly in the ruins, gardens and wet places where the cattle pass through. The roots of this plant are crawling and in the green region, it begins to absorb the entire region. The leaves are toothed and reciprocally placed on the stem. Leaves and stems are covered with rough and biting fluffs. These fluffs have a sharp tip made of silica at their ends which can be broken down into the skin of animals that are close to it, broken like glass or head of the ampoule, and its contents, including histamine, formic acid, acetylcholine and serotonin are absorbed into the skin, causing irritation, itching, sensation and redness of the skin (Al-Snafi, 2019; Sasanifar et al., 2019; Shi et al., 2019).

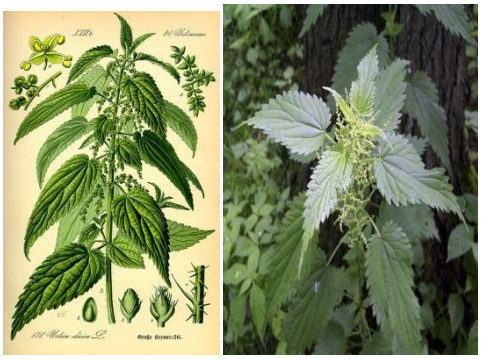

Figure 1. Various parts of nettle (Debnath, 2015)

The usable parts in nettle are fresh leaves, roots, sour milk and its seeds, and its nature is warm and dry. This plant contains a substance called secretin, which is the best ingredient for stimulating and activating digestive glands in the stomach, intestine, liver, pancreas and gallbladder. The vegetation of nettle is used to treat arthritis, rheumatism and pain associated with sciatica. According to extensive studies and available scientific sources, the anti-inflammatory properties of nettle have been proven. The phenolic and caffeic acid compounds available in the secreted materials from nettle leaves can inhibit the synthesis of arachidonic acid and its metabolites. The phenolic acid also inhibits the synthesis of leukotriene B4. Today,

the anti-allergic properties of the nettle are confirmed. It has an inhibitory effect on the lipoxygenase and cyclooxygenase enzymes. These two enzymes are responsible for converting arachidonic acid into prostaglandins and leukotrienes. The use of this plant in allergic rhinitis has been very effective. On the other hand, it is a kidney enhancer. This valuable plant is effective in increasing the acidity of urine and stimulating the secretion of uric acid, ultimately effective in treating gout, eczema (especially children's eczema and eczema with a neuronal origin), kidney stones, and many skin diseases (Domola et al., 2010; Gülçin et al., 2004). Also, the nettle is rich in minerals such as iron, which further improves the absorption of this mineral, and furthermore helps to form more haemoglobin in the red blood cells. The extract of nettle leaves prevents hair loss and stimulates the growth of new hair. Therefore, nettle extract is used in the formulation of many herbal shampoos. Since nettle leaves are a rich source of chlorophyll, their natural pigments are used for cosmetics, hygiene, food and drinking industries. The nettle contains tannin, lecithin, formic acid, potassium nitrate and calcium. It contains iron compounds and contains vitamin C and glucoside which redden the skin. A red material extracted from the branches of this plant is from called orthicon (Domola et al., 2010)

Elderberry (also scientifically known as Sambucus Ebulus) spp is also called "Kawli Grapes" "Khoman Kabir" in some regions of Iran. This plant grows wild on Mazandaran roads and different parts of Guilan. Sambucus nigra has been used by the people since ancient times and it was used to relieve various diseases, such as repelling mucus and bile. Its leaves are green, elliptical, toothed, padded and are composed of 5 to 7 leaflets. Its flowers are white and clustered which appear in the late spring. The fruit of Sambucus nigra is fleshy and tiny as grapes in the colour of dark blue (Figure 2). The usable part of this shrub is its flower, leaf and the inner skin of its stem (Dorling, 2008).

Figure 2. Flowers and fruits of Sambucus nigra (Atkinson and Atkinson, 2002)

It has a cool and dry nature and can be used to relieve constipation in the elderly and those with poor intestinal activity. This forest plant is effective in treating rheumatism, relieving joint pain, accelerating the development of broken bones and treating respiratory diseases. Oral and external use of this plant heals all kinds of skin lesions, heals skin irritation and brings freshness to the skin (Ebrahimzadeh et al. 2009a; Parker et al., 2003). The skin and leaves of this shrub contain materials such as sambosin, sambo nigerin, choline, cicotine and potassium nitrate. There is alderin 4 and a little essence in its flowers. Sambucus nigra also has Krizan Taemin 5, Sugar, essence, Gum, Valzianic acid and acetic acid (Ebrahimzadeh et al., 2009b). In this research, alongside with a comprehensive study of the effective substances in the two medicinal plants of nettle and elderberry, the effects of planting methods and the extraction methods of the active constituents from these plants have been analyzed. Figure 3 presented some process was used for the extraction of active constituents from herbal plants.

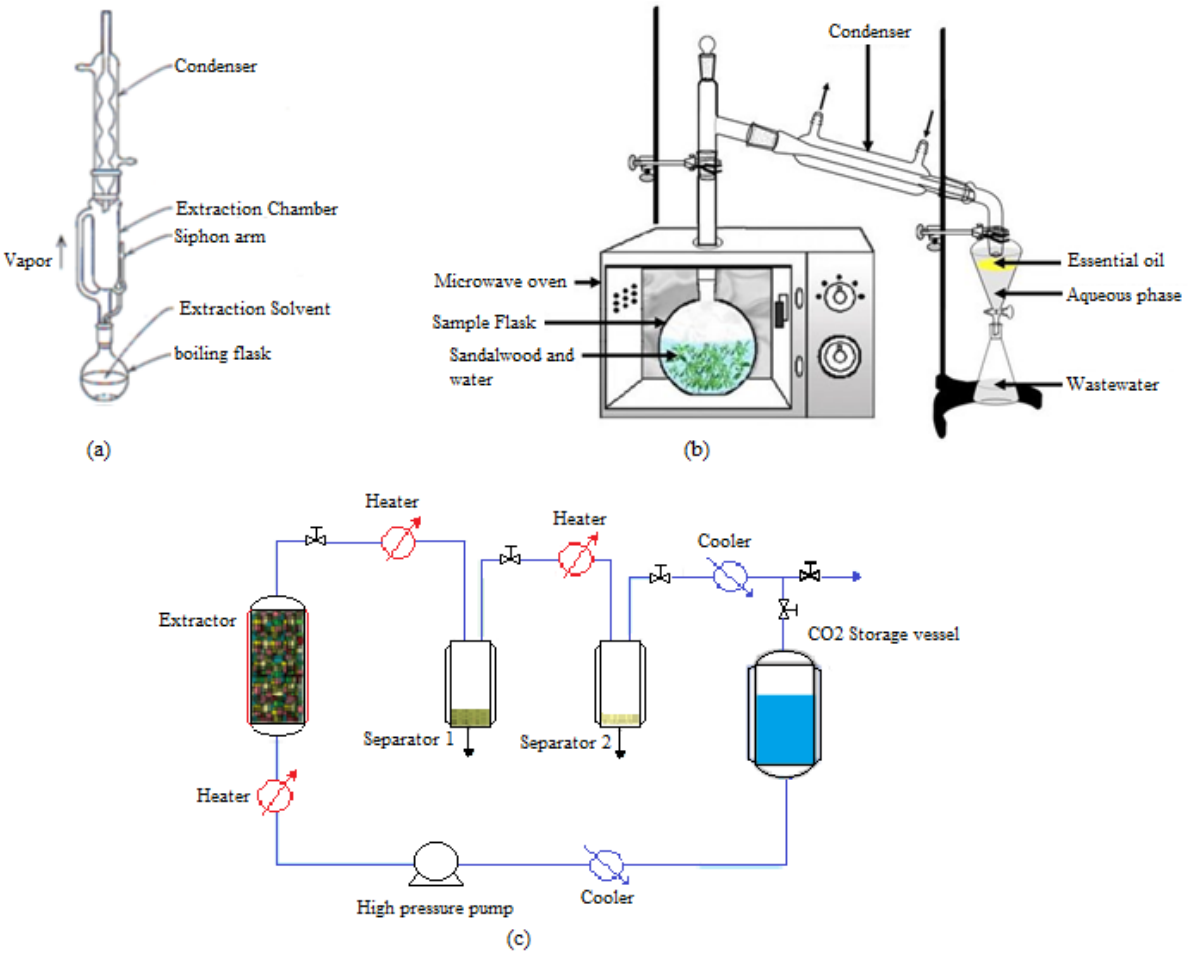

Figure 3. Schematic of extraction processes: (a) Soxhlet extractor, (b) microwave extraction, (c) supercritical fluid extraction (SFE) (Azmir et al., 2013)

Result and discussion

Research on the extraction of active constituents from nettle

Nettle leaves have been used for centuries for medical purposes, while its roots have been used only for decades. According to the latest research, nettle root contains many important substances such as scopolamine, sterols, fatty acids, polysaccharides, polyphenols, minerals, etc. (Domola et al., 2010). Nikoumanesh et al. (2017) investigated ethanolic extract of nettle leaves from Tonekabon region phytochemically. In this research, they produced nettle extract from the samples harvested from the area of "Seh-Hezar" in Tonekabon by boiling method and identified Theronides, flavonoids, phenols, tannins, dipropenides, coumarins, saponins, cardiac glycosides, quinones and phlebatanenes in them. In their research, they concluded that due to the biological activity of certain compounds identified in the phytochemical study of nettle, this plant can be used in food, cosmetic, pharmaceutical, pharmacological and pharmaceutical industries. Abedi et al. (2015) studied the components of essence and extracts of medicinal herbs and its pharmacological effects. Based on the results of HPLC and GC / MS analysis of extracts and essential oils of the nettle, the compounds in the plant include chlorophyll, carotene, xanthophyll, leucoanthocyanidin, flavon flavonol, a small amount of leucoanthocyanidin, triterpenes, sterols including beta-sitosterol and various types of Other chemical compounds. Their findings showed that the two important bacteria of food corruption

parahaemolyticus and Vibrio Bacillus cereus had no growth in the presence of nettle extract. Antioxidant activity of nettle extract has always been considered and many studies have been carried out in Iran in this field. Polyphenols have an antioxidant effect and reduce haematological disorders, as well as anti-cancer and anti-bacterial effects. Gulcin et al. (2004) investigated the antioxidant activity of nettle extract. They confirmed the presence of tannin, phermic acid, lecithin, and useful minerals in the nettle, and from its branches, they gained a substance called Urticine. In their research, they considered optimization of antioxidant activity of nettle extract. Antioxidant activity of different concentrations of the extract was determined by DPPH free radical control and beta-carotene colorlessness. In general, nettle extract was confirmed as a strong antioxidant in all antioxidant tests. Also, the results of the DPPH free radical inhibitory tests and the beta-carotene decolorization were consistent. In all cases, with increasing concentration, the antioxidant activity of the extract increased and the best result was observed in by solvent method with a concentration of 1500 ppm. Ebrahimzadeh et al. (2015) reviewed the properties of the medicinal and antioxidant properties of the nettle, its pharmaceutical uses and the antioxidant and antimicrobial properties of the extract from this plant. In the study of antioxidant properties of various organs of nettle, Mirzaei et al. (2013) conducted a comparative study on the number of phenolic compounds of leaf, stem and gooseberry organs in Golestan province. In this study, they collected nettle from three regions of Gorgan, Sarkhonkalate and Ziarat in Golestan province. The total flavonoid, total phenol and antioxidant activity of the extracts were measured respectively using the chlorometric method of aluminum chloride, Folein Sive-Calcio and FRAP. The highest total phenol content was observed in the roots of the plant collected from Ziarat region (44167.77 mg / grDW) and the lowest amount of phenol was in the root of the plants collected from Gorgan area (51127 mg / grDW). The highest and lowest amount of flavonoids was observed respectively in the leaf of the collected plant from Gorgan (40417 mg / grDW17) and the stem of the plant collected from the Sarkhonkalate area (192276 mg / grDW). The highest and lowest levels of antioxidant activity were observed in the leaf of the plant collected from Sarkhonkalate region (35035 mg / grDW08) and the plant collected from Ziarat area (17501 mg / grDW05), respectively.

Antibacterial activity is one of the most important characteristics of nettle extract, and many studies have been carried out in this field. Modarresi-Chahardehi et al. (2012) investigated the antibacterial properties of nettle extract against pathogenic bacteria. They investigated different concentrations of nettle extract (0.5-1.5) with 2% gum concentrations of Pseudomonas aeruginosa (-), E.coli (-) and Listeria monocytogenes (+). The nettle extract has high antibacterial properties due to its compounds such as catechins and epitheca. In all cases, with increasing the density, antibacterial properties of the extract increased. Kamkar et al. (2010) examined the isolated compounds of Iranian nettle and the antibacterial properties of its essence and extract. The separation of compounds method for Iranian nettle was investigated using GC-MS chromatography with the aim of application possibility of its essence and extract and as an alternative for industrial preservatives and anti-diabetic agents. The analysis of nettle essence by chromatography showed that the aqueous essence of this leaf contains phytol, betadkonone, isoalemycin, alpha-planendron, Linalool, ethyl hexane, monoethanol and benzaldehyde. Its alcoholic extract includes caffeic acid, routine, corsetine, hyperin and isoquinisterin. Therefore, extracts and essence of nettle leaves can be used as an antibacterial agent and an alternative to industrial preservatives.

Nettle is one of the most nutritious foods that are easily digested and full of minerals (especially iron), vitamin C and the precursor of vitamin A. In addition to its medical use, it has high nutritional value due to its mineral and vitamin content, and its beneficial effects on human health have also been studied. In this regard, Ahmadi et al. (2014) studied nettle and its use in food. Using natural compounds in the process of preserving food and protecting them from chemical reactions with microbial contamination as a secondary protector has been proposed.

Koch (2001) investigated the medicinal aspects of nettle And suggested that this plant can be used to lower blood pressure, lipids and blood glucose levels. Also, the aqueous and alcoholic extracts of nettle hurt the proliferation of mosaic-causing viruses in rose and they can likely be used to remove virus contaminations from any rose species in its culture medium. In another study by Sharafzadeh and Alizadeh (2012), nettle has been investigated as an inhibitor for the growth of two important bacteria causing food corruption, Parahaemolyticus Vibrio و Bacillus cereus. Nettle protects small intestine mucus. This may be due to the improved blood circulation or improved nervous system function by reducing the production of sorbitol. Also, medicinal plants like nettle, decrease blood cholesterol and triglyceride due to the compounds such as carvacrol and thymol in them.

Research on the extraction of active constituents from elderberry

Sambucus ebulus belongs to the Adoxaceae family and is one of the most valuable and medicinal species in northern Iran. For many years, the indigenous people of the province have been using traditional medicines to prevent and treat their common health problems.

Identification of Sambucus nigra compounds has been done by some researchers and Zahmanov et al. (2015) developed a design for the separation of individual compositions using various chromatographic techniques, while the discovery of the structure was performed using 1D and 2DNMR. Five flavonoid glycosides, for example, quercetin 3-O-laminaribiose, isorhamnetin-3-O-laminaribiose, quercetin 3-O-rutinoside, isorhamnetin-3-O-rutinoside, and isorhamnetin-3-O-glucoside were determined respectively. Compounds 1 and 2 were reported for the first time. Several tert-penicillin-ursolic, oleanolic and maslinic acids were briefly identified by GC-MS. Anti-oxidant (anti-herpes simplex virus type 1) evaluation in ORACFL and HORACFL properties showed that the fruits of Sambucus nigra may act as a powerful source of valuable molecules for various purposes. Calina Alipova et al. (Alipieva et al., 2017) extracted two new types of glycoside iodide (1) and (2) with 3 known flavonol glycosides [chorestine 3-O-β-glucopyranosyl 7-O-α-Ramenpyranoside (3), quercetin 3-O -β-glucopyranoside (4) and Isorhamnetin -3-O-β-glucopyranoside (5) from Sambucus nigra leaves. Their structure is characterized by 1D, 2D-NMR and UPLC-TOF MS. Compound 2 is a rare representative of the iridoid dialycosides, which contains the condensed extract of ribohexo-3-olpiranosyls (Figure 4).

Yesilada et al. (2014) examined anti-glutagenic activity of Sambucus nigra in different models of in vivo peptic ulcer and gastric biochemical parameters using biometric processing to isolate active structures and describe its structure. Biosystem degradation techniques activate the dual flavonoid glycoside control as anti-glutagenic principles. The structures of these compounds were identified using the 1H, 13C-NMR and FAB-MS techniques as isomercen-3-O-monoglycoside and Quercetin-3-O-monoglycoside. This study proves the use of follicles in Sambucus nigra for treating gastric diseases in traditional Turkish medicine (Figure 5).

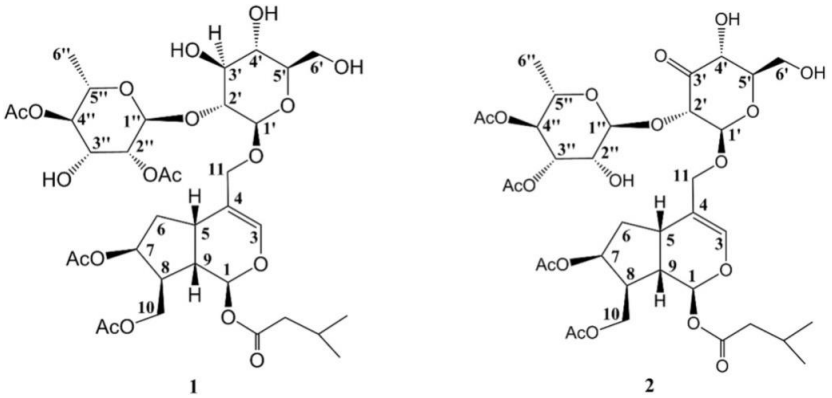

Figure 4. New types of extracted compounds (Alipieva et al., 2017)

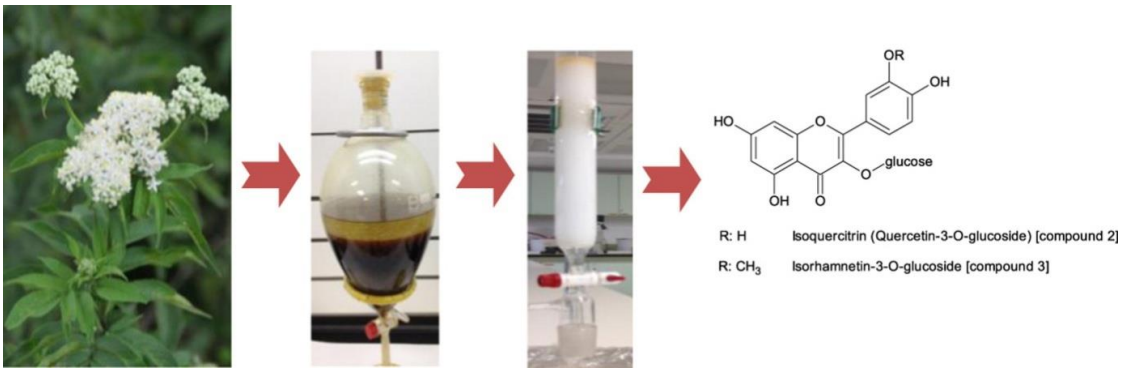

Figure 5. Extracting Effective Compounds from Sambucus nigra (Yesilada et al., 2014)

One of the new methods for controlling pests and plant diseases, especially for the production of organic products, is the use of natural substances of plant origin. Also, in recent years, the identification of medicinal plants and native plants with antioxidant properties that are effective in improving the health of the human community is very much considered by researchers. Sambucus ebulus has a lot of good antioxidant properties that have been considered by many researchers. Among them, Ahmadiani et al (1998) studied the antioxidant properties of a crop extracted from a natural habitat in Bandar Anzali. To investigate the most important secondary compounds from plant powder, the methanolic extract was prepared and antioxidant properties and the number of techniques and flavonoids were investigated. Extraction of the essence was performed by steam distillation method and using a Clevenger apparatus. Separation and identification of essence combinations were performed using GC / MS apparatus. Of the 25 compounds identified in the essence of Anzali (12.22) Limonene and (48.16) Phytol and (68.6 Lonone (E -beta) had the highest percentage of essence components. In the antioxidant study of this plant which was performed by the DPPH method, it was shown that the plant has antioxidant activity. Researchers at the Center for Viral Radiology "Retroscreen" found that Sambucus nigra's extract is effective in fighting the H1N1 swine flu virus type A. Sambucus nigra's extract helps the immune system of individuals to fight against viruses, prevents the virus from penetrating healthy cells and reduces the duration of disease (Figure 6) (Castillo-Maldonado et al., 2017; Charlebois et al., 2010; Schwaiger et al., 2011). In a controlled study on placebo (pseudo-drugs) conducted in a laboratory, it was found that the Sambucus nigra's extract, commercially termed as "sambukul", is up to 70% effective in the reduction of the transmission of H1N1 to healthy cells in Inner cell reproductions. Thus, only 5 minutes after the period of the communicable disease (ie when the microbes enter the cell until symptoms appear) has a significant effect on the cells being tested(Cunha et al., 2016).

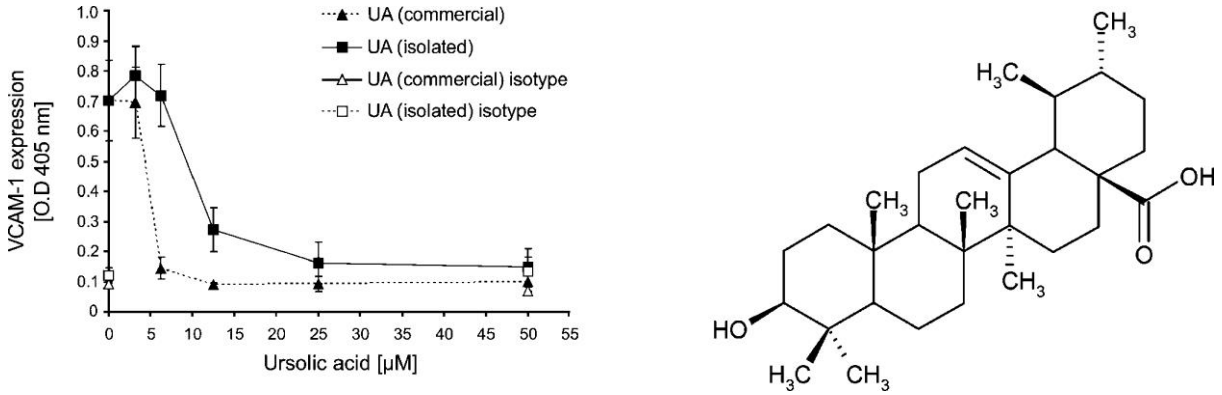

Figure 6. Study of ursolic acid's anti-inflammatory activity (Schwaiger et al., 2011)

A lot of research has been done on the extraction of these valuable compounds and optimization of the parameters of extraction and selectivity of active constituents. In table 1, a summary of the processes using to extract active constituents from the herbal plant is presented.

Table 1. A summary of the processes used for extracting active constituents from herbal plant

Methods	Experiments	Result	Reference
maceration, percolation method, Soxhlet method, an ultrasonic method	Extraction temperature, ethanol concentration as an extraction solvent, and the solvent to plant ratio and extraction time as the most important parameters affecting the extraction process.	the best method for extraction of flavonoids compounds was using ultrasonic extraction method and the optimum extraction conditions were at 70 ° C, the ethanol concentration of 40%, the solvent to plant ratio of 1:30 and time of 30 minutes	(Pinelli et al., 2008)
ultrasound extraction	extraction of phenolic and flavonoid compounds from nettle leaves	The results showed that 20% solvent ethanol solvent extraction at 60 kHz had the highest phenolic and 80% ethanol solvent extraction at a frequency of 60 KHz had the highest amount of flavonoids	(Vajić et al., 2015)
Ultrasonic waves.	extraction temperature, ethanol solvent concentration, and solvent to plant ratio and extraction time	Optimum conditions for finding the highest amount of flavonoids were obtained at 66.79˚C, 32.41% ethanol density, the ratio of solvent to plant, 27.81 mg / g and the extraction time of 76.31 min	(Roselló-Soto et al., 2015)
ultrasound	extraction of phenolic compounds	Optimal conditions were obtained as follows; temperature: 46.49˚C, time:82.28 min., the ratio of solvent to the sample: 21:06. Under these conditions, the phenolic components were 413.425.	(Leger and Morel, 2015)
microwave	Five different microwave power options include 90, 270, 450, 630 and 900 watts	The highest and the lowest amounts of phenolic substance (50 and 19 mg / g dry weight, respectively) were drying treatments at 399 watts microwave and drying at room temperature.	(Olt and Kikas, 2016)

Table 1. Continued

extraction of nettle extract with supercritical carbon dioxide	Effects of operating parameters: pressure (140, 210 and 350 bar) and temperature (40 to 60 ° C) on the amount of extract	The highest amount of extract (4.48% in dry matter) was obtained with 0.88% chlorophyll a + b and 0.5% beta-carotene in 350 times, 60 ° C and extraction time of 6 hours.	(Rafajlovska et al., 2002)
soxhlet with 96% ethanol, soxhlet with n-hexane and extraction with supercritical carbon dioxide	Comparison of the performance of three extraction methods	The highest yield was obtained by extraction of soxhlet with ethanol. Soxhlet extraction and supercritical extraction had lower yields	(Kőszegi et al., 2015)
Supercritical carbon dioxide extraction of beta-sitosterol and scopoletin from the nettle root.	A modified solvent was used with ethanol (0-4.9 wt%) at pressures of 100, 200, 250 and 280 times, at a temperature of 25, 40 and 60 degrees Celsius	The maximum β-sitosterol and scopoletin yields were 0.63 and 0.058 mg / g dry weight, respectively Compared to the extracts using diethyl ether, the maximum efficiency of the supercritical carbon dioxide was at least two times higher in both materials.	(Sajfrtová et al., 2005)
solvent and extraction with near-critical carbon dioxide	A solvent modified ethanol (0-7 wt%) was used at pressures with 200, 250 and 280 bar and at the temperatures of 25, 40 and 60 ° C	In comparison to the extractions using conventional solvents, the maximum yield with CO_2 is the same for carotenoids, higher for chlorophyll b and lower for chlorophyll a.	(Sovová et al., 2004)
Solvent extraction	four extracts were evaluated using different hexane solvents, diethyl ether, ethyl acetate and methanol from Sambucus	Experimental data showed that methanolic extracts of elderberry leaves have significant activity in wound healing	(Süntar et al., 2010)
supercritical water	extracts of leaves, roots, and fruits from elderberry	comparison to the root and fruit, the extracts from elderberry leaves under supercritical water have stronger biological effects with higher levels of phenolic compounds	(Cvetanović et al., 2018)

Extraction of active constituents from herbal plants was investigated by different methods and solvents. Comparing the yields of the extraction methods it was established that the highest yield value was reached by Soxhlet extraction with ethanol and supercritical extraction. The extract of the Soxhlet extraction with ethanol or n-hexane contains the unpleasant solvents, which have to be removed, while the carbon dioxide from the supercritical extraction can be separated easily. And also, the supercritical extraction with use of co-solvent is a proper method for the separate of polyphenols. SCFE technology proposes alternative for conventional methods because:

Environment friendly process: no environmental hazards residual; Lower energy and operating costs; Flexible to extract multi product with single solvent; Easy recovery of CO_2; High controllability (by varying temperature and pressure); Best process for heat sensitive natural products; High selectivity to extract constituents; SC CO_2 extraction is presented in view of the current environmental concerns, regulations, and cost effectiveness.

Conclusion

Elderberry and nettle belong to the indigenous and self-growing plants in Guilan province that extensive conducted studies on these valuable plants are presented here. The nettle extract has antibacterial properties due to the presence of compounds such as catechins and epithelial catechins. Extracts and essence of nettle leaves can be used as an antibacterial agent and an alternative to industrial and anti-diabetic preservatives. Elderberry has traditionally been used because of its anti-inflammatory properties to help protect the body from viruses and viral diseases such as influenza. Because of the time-consuming nature, the availability of a limited number of parameters to control selectivity, the use of high levels of toxic and hazardous solvents, the loss of volatile analytic at the concentration stage of the extracted sample, the decomposition of unstable compounds, the contamination of the product to the organic solvent and Loss of water-soluble compounds, as well as high consumption costs and legal constraints in the traditional methods of extracting the active constituents of these plants, there have been great interest in the extraction methods in which organic solvent consumption has been minimized. Conventional solvent extraction produces low-quality oil that requires extensive purification operations (solvent removal, degumming, neutralizing, decoloring, deodorizing, etc).

The solvent used not only increases costs but also leads to additional environmental issues. Supercritical CO_2 extraction, were compared with conventional processes for extraction of active constituents from herbal plants in terms of environmental, energetic and economic aspects. And the result showed that this process is a new cleaning technology for this industry. Significant cost savings and yield improvements, nontoxic, inexpensive, non-flammable, and non-polluting solvent could certainly be applied as a replacement for conventional solvents in extractive and non-extractive processes. Typical thermo physical properties of SCFs are low viscosity, high diffusivity, density, and the dielectric constant of SCF, which can easily be changed by varying the operating pressure and/or temperature. Using SCFs in numerous processes may lead to the production of completely new products with certain characteristics having a very low impact on the environment, such as low energy consumption during the process, along with health and safety benefits.

The use of supercritical (SC) fluids in industrial processes can replace far more damaging conventional solvents. So, the use of supercritical carbon dioxide as an efficient and environmental-friendly extraction method is introduced. As a conclude, Supercritical fluid technology can be utilized for environmental protection by extraction of active constituents from Iranian herbal plants and make value addition of natural products instead of exporting the raw materials, and it will bring economic benefits. So, utilization of this technology for Iranian herbals especially for north of Iran will solve environmental issues and avoid emitting pollute to the atmosphere.

Acknowledgements

The authors wish to acknowledge the support extended by Iran National Science Foundation (INSF) in the form of research project No. 95849014.

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