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Review

Insights on Extracting Bio-Active Compounds from Plants that Act Against Bacteria

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ABSTRACT

Green technology is the worldwide urgent demand all over the world since various bioactive compounds are in use daily effecting by their composition man's health that led to the optimization for a most beneficial technique for extracting essential materials and compounds, the need for safe and effective methods in extracting essential compounds were raised among these novel methods: extracting for Bioactive Materials by Supercritical and subcritical fluid Extraction, by Ultrasound assisted Extraction, by Negative Pressure Cavitation Assisted Extraction, by Microwave Assisted Extraction, by Pressurized Liquid and Hot Water Extraction, by High Pressure Assisted Extraction, by Enzyme Assisting and many other methods which are all green and environmentally friendly. Researches proceed in inventing new effective green methods of novelty. This could be aided by the previous techniques and their yields quality and amount with less time, cost, energy, human interference. Our review highlights how these environmentally friendly techniques can enhance the recovery of bioactive compounds, with the goal of influencing future extraction procedures and industrial uses in food, cosmetics, and pharmaceuticals.

Keywords
Extraction method; Green technology; Essential plant oil; Bioactive compounds.

INTRODUCTION

Green technology is the worldwide urgent demand all over the world since various bioactive compounds are in use daily effecting by their composition man's health that led to the optimization for a most beneficial technique for extracting essential materials and compounds [1] which are extremely important for their diversity as nutrients such as pre- servatives, coloring agents, and antioxidants [2]. These bioactive compound extractions were done using conventional methods such as: Soxhlet extraction, water distillation, steam distillation or hydro distillation, and other methods of extraction as heating reflux has been in wide use at food industry. These methods could be done either using heat, solvents [3]. However, these methods are consuming time, cost, efforts and producing low extraction selectivity besides, it might cause thermal degradation for the thermolabile ex- tracted compounds or/ and cause environmental disposal problem [4].

Therefore, the need for safe and effective methods in extracting essential compounds were raised; Among these novel methods: extracting for Bioactive Materials by Supercriti- cal and subcritical fluid Extraction, by Ultrasound assisted Extraction, by Negative Pres- sure Cavitation Assisted Extraction, by Microwave Assisted Extraction, by Pressurized Liquid and Hot Water Extraction, by High Pressure Assisted Extraction, by Enzyme As- sisting and many other methods which are all green and environmentally friendly [5]. Rot- tenly, these green techniques are utilizing much lower amounts of solvents, providucing higher yields and less time consuming [6]. Our review article aims to focus the lights on the green extraction techniques, their applications, principles, and also their future prospective as effective extraction methods for bioactive compounds.

2. Conventional Extraction Methods for Compounds

Extracting bioactive compounds always was demanded from ancient ages, therefore, a verity of techniques used for these purposes conventionally by the aid of solvents, such as: Soxhlet extraction, soaking, boiling, heat refluxing and so on [7]. Some of the conven- tional extraction techniques are discussed below:

2.1. Extracting by Soxhlet

Usually, valuable bioactive compounds extracted from plant materials by Soxhlet apparatus, this process had been used since decades and still in use.

2.2. Extracting by Maceration Method

It is the cheapest method to extract bioactive compounds especially for essential plants oil by the aid of a solvent.

2.3. Extracting by Hydro-distillation Method

This method also had been used for bioactive and essential oils extraction without the need for using organic solvents [8].

3. Extracting for Bioactive Materials by Novel Extraction Method

Extraction considered important technique to isolate, identify and separate com- pounds before analyze them. The aim of demanded extraction method is a pathway with appropriate yield, safer, easier, faster, cheaper and no eco-harmful or energy consumer [6].

3.1. Extracting for Bioactive Materials by Supercritical and Subcritical Fluid Extraction

The supercritical and subcritical extraction methods are genuine to obtain bio-active compounds efficiently with the aid of specific solvent [9] they are working separately or combined with another method for extracting compounds efficiently from natural re- sources. [10], that subcritical water extraction (SWE) considered a green extraction mech- anism to utilize compounds with the special characteristics of water at its subcritical point which is 374°C under 220 bar; could be called (hot liquid solvent) or/and (pressurized hot water) extraction [11], this includes the mechanism of diffusion for the solute from ex- tracted sample to the medium [12]. (Generally, supercritical fluid extraction (SFE) which is a widely used efficient extraction method for being fast, low cost, green at the final product; carbon dioxide (CO2) is the solvent in use because it has low critical pressure (7.4 MPa), temperature (32°C) beside being available, no-toxic and no-explosive [13]. Manipulating the extraction parameters (extraction time, pressure temperature and solvent flow rate) enhances collecting specific fractions separately. Mainly, the super critical fluid formed as a result of increasing pressure and temperature above critical points at the presence of a particular gas or liquid, that the separation surface which is available between liquid and gas disappears in the supercritical area and forming a homogeneous super critical fluid which has a density differs from that of the liquid making any slight pressure change lead- ing to improve the extraction [14]; this super critical fluid having a volatile properties which makes it easy to recover from active extracts [13]. SFE mechanism includes using heat along with pressurization whereby mass transfer takes place by diffusion in solutions [15]. Hence, a lot of applications for super critical and subcritical processes in the area of extracting food materials analysis especially natural extracts are mentioned for their anti- microbial and antioxidant compounds from natural sources or extracting essential oils from plant sources as coconut oil extraction [16].

3.2. Extracting for Bioactive Materials by Ultrasound assisted Extraction

This green technique for extraction is in use for its sustainability against wide range of natural derivatives [7]; it could be carried out typically at 35 KHZ (frequency) to extract natural compounds which affect bacterial presence, at seventy °C for two hours, minimiz- ing by that the solvent damage and the thermal degradation capacity of the bioactive com- pounds produced, beside reduction of bioactive compounds thermal degradation [17]. The current method is more efficient and consumes less energy beside using much lower tox- icity solvents. This method is more suitable for compounds rich with phenoles according to specific operational parameters which are time, temperature, solvent type, frequency, ratio of solvent and solid and the power [7].

3.3. Extracting for Bioactive Materials by Negative Pressure Cavitation Assisted Extrac- tion

This type of extraction could be assumed as the best technology causing a cavity to produce a negative pressure aiding in creating a disturbance at the main material and the solvents, yielding the higher yield with the lowest economic cost [18] that the negative pressure penetrates the whole system including the loaded sample, rupturing their cells formulation accompanied by extraction under ultrasound assisted to complete the separa- tion [19]. Moreover; this brilliant technique could be also combined along with other ex- traction technique for the enhancing the final product from food extracts with high effec- tivity especially in industry [18].

3.4. Extracting for Bioactive Materials by Microwave Assisted Extraction

This type of extraction utilizes microwave energy at the frequency = 2.45 GHz.; it is considered low in using solvent, time, energy and it uses microwaves; it is about convert- ing the electromagnetic energy into heat passing by 3 main levels [17] the first includes separating solutes under specific temperature and pressure from the sample active site; the second is about diffusion of the solvent across the sample matrix; and the third includes solutes releasing from the sample within the solvent. All these steps made the procedure less in thermal degradation and using solvents beside yield enhancement; therefore, its suites food processing mechanisms as a non-conventional technique for extracting natural products [20,21].

3.5. Extracting for Bioactive Materials by Pressurized Liquid and Hot Water Extraction

Pressurized Liquid Extraction refers to the status of raising pressure to assist better yields, in fact, the pressure is increased for the solvent content in the extracted material, so that, a situation of a special state for both the solvent and the material at the boiling point exists aiding in faster and efficient extraction while using the less suitable amount of the required solvent with specific degrees of temperature under exact timing. Sometimes, the solvent in use is the water, leading to call the procedure: pressurized hot water extraction, which is suitable for both polar and non-polar bio-active compounds, beside moderately polar ones [22].

3.6. Extracting for Bioactive Materials by High Pressure Assisted Extraction

This process could be applied at the rang e of pressure equals 100 MPa to 1000 MPa especially used in food processing without harming for human's health. It considered a green technology for it separates bioactive compounds naturally by maintaining their functions [23]. The extraction took place while cells expose to balanced

pressures inside and outside as well, allowing by this a fast solvent permeability thereby, which dissolve active compound in a less time [24]. Final yields affected by the degrading enzymes and the pressure values applied [25].

3.7. Different Other Techniques of Extraction

Frankly speaking, many other effective extraction methods are there to extract bio- active materials and compound from their natural sources such as ohmic-assisted hydro distillation, electrical assisted extractions, ohmic accelerated steam distillation, thermome- chanical transient control pressure drop, ionic liquids extraction and thermos-mechanical transient under control pressure drop, several techniques of these are in use at the green extraction by un-using organic solvents [26].

3.8. Extracting for Bioactive Materials by Enzyme Assisting

A unique eco-friend method to extract bioactive compounds with a high yield from the source material that it has the ability to utilize using water as solvent instead of organic chemicals [27]. Unlike the ordinary extraction methods, the enzyme assisted one ensure the solvent attachment directly with the cytoplasm of the targeted bioactive cells using different enzymes to hydrolyze plant polysaccharides and cell walls like cellulose, α am- ylase and pectinase. This type of extraction may be aided by aqueous extraction or enzyme assisted cold pressing; that the first one usually used for extracting oil from various seeds containing oils, while the second is in use mainly to extract biologically active materials from oil seeds only [28].

4. Future Demands and Recommendations

In spite of their beneficial yields, the extraction techniques are facing a sever diffi- culty in spread globally to diffuse green production, in low cost, short time and high qual- ity by maintaining the beneficial bioactive compounds after extraction. Therefore, re- searches and studies are needed to focus on producing new techniques for the extraction using low energy during the processes leading to low expenses and protect the natural beneficial materials [29].

5. Conclusion

According the need for all the benefits of the oils and the bioactive compounds con- tained at the targeted extraction material, a demand for the novel methods of extraction raised and varied methods generated; however, researches proceed in inventing new ef- fective green methods of novelty. This could be aided by the previous techniques and their yields quality and amount with less time, cost, energy, human interference, leading to thinking about hybridization between the known methods for investigation when output received for its efficiency especially in consumption of foods.

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