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## Green Energy Technology : Economical And Environmentally Novel Methods For Extraction Of Medicinal And Aromatic Plants In India.

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### ABSTRACT

Solvent define a major part of the environmental performance of processes in industry and also impact on cost ,safety and health issues . The idea of “green solvent express the goal to minimize the environmental impact resulting from the use of solvent in chemical production .Extraction is the first common step for research of medicinal plant because the formulation of natural concentrate extract from plants it is the initial process for the separation of chemical constituent in pure form which are present in plants .So far extraction step remain often a neglected area , which throughout the year has collect less extract . Modern method of extraction and processing of medicinal plants such as solid liquid extraction (soxhlet ), steam distillation or cold press are used in India. These method of extraction lack selectivity ,because give less production and it use more volum of organic solvent it present environmental risk. Now this time many new extraction technique are replaced the old method of extraction for improving efficiency. Al though, latterlytransport of medicinal product from India to other countries are becoming more and more restricted due to the presence of undesirable level of contaminants and also presence of heavy metal and pesticide that attributed to the drawback of modern extraction method .Novel extraction method such as supercritical fluid extraction (SCFE),Counter current extraction , these are reduced solvent consumption and required less time for extraction .

**Keywords:** Innovative Green Techniques , Subcritical water extraction (SWE), Accelerated Solvent Extraction (ASE), Microwave Assisted Extraction (MAE), Ultrasopund extraction method, Supercritical Fluid Extraction.

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## INTRODUCTION

Generally green energy technique extraction is the invention. In relation to green extraction of natural medicinal product definition can be given below: "Green energy technology is based on the discovery and design of extraction processes which will reduce energy consumption and allows use of alternative solvents and renewable medicinal products, and ensure a safe and high quality extract / product [1].

Three major solutions have been identified to design and demonstrate green extraction on laboratory and industrial scale to approach an optimal consumption of raw materials, solvents and energy: (1) improving and optimisation of existing processes; (2) using non-dedicated equipment; and (3) innovation in processes and procedures but also in discovering alternative solvents [2].

Medicinal plant is used from a very ancient time as a source of remedies. This remedies is used in the treatment of various diseases. Doctor does help of sick person by providing of medicament. The ancient Indians used many herbal drugs for the same purpose which are used today [3, 4].

Medicinal plant production are important source of income from many years because export from India have been a greater business. India have a very a good position at international level market through the production and cultivation of fennel, peppermint, chamomile and essential oil etc [5-7].

Medicinal plant have been the source of potential remedial agent for living being. Whereas many active phytoconstituents have been discovered from plant and research is being done to reduce the problem of quality and safety [8, 9].

The modern method of solvent extraction of plant material are based on the correct choice of solvent and the use of heat. Generally the traditional method require longer extraction time then at this time face a severe risk of thermal degradation for most of the phytoconstituent [10].

Now this time used novel extraction method such as microwave assisted extraction (MAE) [11].

### The Principles of Green Extraction Technology

The listing of the "principles of Green Extraction of medicinal Products" should be viewed for industry and scientists as a direction to establish an innovative and green label, charter and standard, and as a reflection to innovate not only in process but in all aspects of solid-liquid extraction:

- **Principle 1:** Innovation by selection of varieties and use of renewable plant resources.
- **Principle 2:** Use of alternative solvents and principally water or agro-solvents.
- **Principle 3:** Reduce energy consumption by energy recovery and using innovative technologies.
- **Principle 4:** Production of co-products instead of waste to include the bio-and agro-refining Industry.
- **Principle 5:** Reduce unit operations and favour safe, robust and controlled processes.
- **Principle 6:** Aim for a non denatured and biodegradable extract without contaminants.

The principles have been identified and described not as rules but more as innovative examples to follow, discovered by scientists and successfully applied by industry [12].

### Economically and Environmentally positive effect of green energy technology

- Green energy technology are protect our environment and consumers, and in the mean time, hence competition of academia and industries to be more ecologic, economic and innovative.
- Green extraction processes will reduce more energy consumption and solvent, while ensuring a safe extract and quality.
- They work at high temperatures and pressures in inert atmospheres.
- It is needed to create a green process than reduce the processing time and cost.
- The pursuit of global sustainability and "green industry" requires real solutions that can minimize environmental impact, while maintaining product quality

### Economically and Environmentally negative effect of green energy technology

- Economically high cost of equipment
- Requirement of high pressure
- High capital investment
- Pressurized liquid extraction is not suitable for thermo labile compounds
- Decline of power with time
- In solid liquid extraction chances of impurities
- Filtration required

Name of various plant extract which are given below in the table

Serial no.	Name of extract	Medicinal use
1.	vaillin	It is used in treatment of fever and Spasms.
2.	Curcumin	Curcumin can help in the treatment of arthritis and inflammation. treatment of arthritis and inflammation.
3.	Caffeine	Caffeine is used to treat drowsiness.
4.	Opium	It is used for surgical analgesia.
5.	Eugenol	It is used in toothache.
6.	Digoxin	It is used to treat arrhythmias.
7.	Digitoxin	It is used to treat heart failure
8.	Catechin	It is used in inflammatory bowel disease
9.	Artemisinin	It is used in treatment of infecton

### Extraction of Aromatic Plants

The types of volatile isolates that are obtained commercially from aromatic plants are essential oils, concretes, absolutes, pomades and resinoids. Essential oils are isolated from plant material by distillation whereas other volatile isolates are obtained by solvent extraction. Essential oils are used in a wide variety of consumer goods such as detergents, soaps, toilet products, cosmetics, pharmaceuticals, perfumes, confectionery food products, soft drinks, distilled alcoholic beverages (hard drinks) and insecticides. The world production and consumption of essential oils and perfumes are increasing very fast. Production technology is an essential element to improve the overall yield and quality of essential oil. The traditional technologies pertaining to essential oil processing are of great significance and are still being used in many parts of the globe. Water distillation, water and steam distillation, steam distillation, and maceration and are the most traditional and commonly used methods [13, 14]. Maceration is adaptable when oil yield from distillation is poor. Distillation methods are good for powdered almonds, rose petals and rose blossoms, whereas solvent extraction is suitable for expensive, delicate and thermally unstable materials like jasmine, tuberose, and hyacinth. Water distillation is the most favored method of production of citronella oil from plant material [15].

### Innovative Extraction Techniques

Several new extraction techniques for improving efficiency and selectivity are now replacing the traditional methods of extraction. These novel extraction methods include Accelerated Solvent Extraction (ASE), Subcritical Water Extraction (SWE), Supercritical Fluid Extraction (SCFE), Microwave Assisted Extraction (MAE) and Ultrasound Assisted Extraction (UAE).

**Accelerated Solvent Extraction (ASE):** Accelerated solvent extraction (ASE) are also known as pressurized solvent extraction (PSE) or pressurized liquid extraction (PLE) is a technique which has been developed as different to current extraction methods such as Soxhlet, maceration, percolation or reflux,

offering advantages with respect to extraction time, solvent utilization, extraction yields and reproducibility. It uses organic solvents at elevated pressure and temperature in order to rise the capability of the extraction process. Rise temperature accelerates the extraction kinetics and elevated pressure hold on to the solvent in the liquid state, thus enabling safe and rapid extractions [16-19]. Furthermore, high pressure forces the solvent into the matrix pores and hence, should ease extraction of analytes. High temperatures reduce the viscosity of the liquid solvent, allowing a better penetration of the matrix and weakened solute matrix interactions. Also, elevated temperatures enhance diffusivity of the solvent resulting in increased extraction speed. Solvents can be selected based on the polarity of the analyte and compatibility with any post-extraction processing steps and quantification equipment. In addition, ASE technology is automated. For rapid and efficient extraction of analytes from solid matrices such as plant materials, extraction temperature is an important experimental factor, because elevated temperatures could lead to significant improvements in the capacity of extraction solvents to dissolve the analytes, in the rates of mass transport, and in the effectiveness of sample wetting and matrix penetration, all of which lead to overall improvement in the extraction and desorption of analytes from the surface and active sites of solid sample matrices. To achieve all these advantages, elevated pressure is required to maintain the extraction solvents as in liquid state at high temperatures (usually above their boiling points) [20,21].

### Subcritical water extraction (SWE)

Subcritical water extraction (SWE), i.e., hot water is used during extraction under pressure, has recently emerged as a useful tool to replace the traditional extraction methods. SWE is an environmentally-clean technique that, in addition, give higher extraction yields to extract solid samples [22]. SWE is carried out using hot water (from 100 °C until 374 °C, the latter being the water critical temperature) under excessive pressure (usually up to 10 bar) sufficient to maintain water in the liquid state. The most important factor to take into account in this type of extraction procedures is the dielectric constant ( $\epsilon$ ). This parameter can be regulated easily, within a broad range of values, by only tuning the extraction temperature. Water is a very polar solvent at room temperature, with a dielectric constant close to 80. However, this level can be significantly decreased to values close to 27 when water is heated up to 250 °C, while maintaining its liquid state applying pressure. This dielectric constant value is similar to that of ethanol being for that reason suitable to solubilize less-polar compounds [23].

Example - Extraction of essential oil from coriander (*Coriandrum sativum* L.) seeds.

**Microwave assisted extraction (MAE):** Microwaves are non-ionizing electromagnetic waves of frequency between 300 MHz to 300 GHz and positioned between the X-ray and infra-red rays in the electromagnetic spectrum [24]. Unlike ordinary heating which depends on conduction convection phenomenon with eventually much of the heat energy being lost to the environment. Whereas in case of MAE, heating occurs in a selected and choosy manner with practically no heat being lost to the environment as the heating occurs in a closed system. This unique heating mechanism can importantly decrease the extraction time (usually less than 30 min) as compared to Soxhlet.

**Ultrasound Assisted Extraction (UAE):** The mechanical effect of ultrasound accelerates the discharge of organic compounds contained within the plant body due to cell wall disruption, mass move increase and easier access of the solvent to the cell content. Ultrasonic-assisted extraction is one of the important techniques for extracting the valuable compounds from the vegetal materials [25], and it is quite adaptable on a small or large scale (i.e. on a laboratory or industry scale) [26]. The general ultrasonic devices are ultrasonic cleaning bath and ultrasonic probe system. The former is suitable to sample preparation for analytical purpose and the latter is efficient in large-scale extraction [27,28].

**Counter current extraction:** In the counter current method, wet raw material is pulverised using toothed disc disintegrator to produce a fine slurry.

### Advantage of this method

- A unit quantity of the plant material can be extracted.
- It process is generally done at room temperature.
- The pulverization of the drug is done under wet condition.

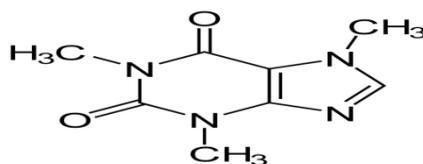
- The extraction procedure has been rated to be more efficient and effective than continuous hot extraction .

**Supercritical fluid extraction :-** Supercritical fluid extraction is an different sample preparation method with general aim of lessen use of organic solvent an rise sample throughput . A supercritical fluid is an element or compound greater than its critical pressure and temperature [29]. In this state, it is compressible and carry both the properties of a gas and a liquid, delivering the supercritical fluid with improved solvating power and has an edge over conventional liquids. The main attraction of SCFE is the use of carbon dioxide (CO<sub>2</sub>) as the solvent. Unlike most organic solvents, CO<sub>2</sub> is not as dangerous environmentally and has been described as a “green solvent”. It is an inexpensive, relatively inert and non-inflammable gas of low toxicity, with easily achievable supercritical conditions (T<sub>c</sub> =31.3°C, P<sub>c</sub> = 73.8 bar) . Supercritical CO<sub>2</sub> has virtually no surface tension, thereby allowing better penetration into botanical matrices compared to liquid solvents. An added advantage is the possibility of conducting solvent less extraction with SCFE, as CO<sub>2</sub> would simply depressurize, subsequently depositing the extract into the collection vessel. However, CO<sub>2</sub> is a nonpolar fluid and has no permanent dipole moment. Thus, there is limited ability to dissolve polar or high molecular weight compounds [30,31,32]

## Caffeine

### Caffeine is mainly obtained by extraction method

It is act as a stimulant to central nervous system which are the class of methylxanthine . It is psychoactive drug and most widely consumed . There are several known mechanism of action to explain the effect of caffeine . It is reversibly blocks the action of adenosine on it's receotor and prevent the onset of drowsiness induced by adenosine . It is also s stimulates the certain portion of autonomic nervous system .



Structure of caffeine

**Natural source of caffeine :-** The common source are the “beans” (seed) of the two cultivated coffee plants *Coffea Arabica* ana *Coffea canephora* and of the co ca plant *Theobroma cacao* and the leave of the tea plant and kola nuts .(33)

**Properties:-** Caffeine is a bitter in taste .  
It is white crystalline in nature .  
In its purine is also present .

It is present in the seeds fruits , nut or leaves of a plant . The well known source of caffeine is the coffee bean which are obtain from the coffea plant . Many people may drink beverages which contain caffeine to prevent drowsiness and to improve cogn itive performance . For the preparation of these drinks . Caffeine is extracted by stee ping the plant product in water by the process infusion .

Caffeine containing drinks such as – coffee , tea , cola .

Caffeine can have both helpful and harmful health effect . It can treat and prevent the pr emature infant breathing disorders . Tolerance to the autonomic effect of increased b lood pressure , heart rate and also increased urine output .

If any adult take more than 10 gram per day caffeine then it produce toxic effect and much higher than the typical dose of under 500 mg per day . If pregnant and lactating women intakes caffeine upto 200 mg per day then it does not raise safety concerns for the fetus or the breast fed infant . A cup of coffee contains 80 – 175 mg of caffeine which depend on what type of bean (seed) is used [34-36].

Medicinal use : Caffeine is used in\_

- It may improve weight gain during therapy .
- Bronchopulmonary dysplasia in premature infant for both treatment and prevention .
- It is used in Apne a treatment but not prevention .
- It is used in the tr eatment of asthma .
- It is used as stimulant but reduced fatigue and drowsiness .
- It is used for improvement of muscular strength and power .
- It increases basal metabolic rate in adult .

#### Product containing caffeine include

- Soft drink – It is also a common ingredients of soft drink such as cola .
- Energy drinks – By contrast energy drinks such as red bull can start at 80 mg of c affeine per serving .
- Chocolate - Derived from coca beans contains a small amount of caffeine .
- Caffeine tablet – No-Doz 100 mg
- Oral product – Another intake route is spazzstick a caffeinated lip balm .
- Beverages – Mate is drink popular in many part of south America .

#### Discussion

The need for development of existing methods of extraction and the introduction of the new technique in Indi a will give rise to the discovery of new biologically active compounds from phyto-pharmaceutical sources . More research is needed to improve the understanding of extraction mech anism , remove technical barriers , modified the design and scaleup of the new extraction syste m for their better industrial application through .

**Establishing novel technology :-** For the extraction of medicinal plant in India needs;

- Organizing workshops, swminars , training course for research institutes , universities and emph asizing the attendance and contribution of the industrial sector interested in this technolo gy .
- Value a ddition of the medicinal plant can be achieved either directly by improving the quality of the of plant material or indirectly by quality assurance of the plant material or the semi processing of the material to a value added product (extraction process) through intro ducing novel and innovative techniques for the extraction of medicinal and plant to indi a and improving selectivity and efficiency of exytracting the Indian medicinal plant .
- Establishing standard operating procedure for extraction , new method for herbal product sta ndardization and establishing quality assurance and quality control protocol according to the obtained results the assuring that existing Indian essential oils and medicinal plant extract meets specification and requirements .

#### CONCLUSION

Several work have been done on medicinal plant either to investigate and prove a reported claim of biological activity or to mimic its traditional medicinal use based on ethnomedicinal survey . Large numbers of medicinal plants have been extracted , fractionated ,and compounds compound isolated su ccessfully . In addition , compounds opbtained were tested for biological or pharmacological activity , and in most cases , they were found to be active . Nonetheless , the rate of success and the authenticity of success of these findings depends on the accuracy in selection of solvents , fractionation and identification techniques . Finally , proper understanding and implementa tion of these techniques are indispensable . Advancement and modification of these methods periodically will ease review process and improve the outcome . In this review best avanceme nt and modification are defined.

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