Extraction of Essential Oil from Eucalyptus *Umbellata* Leaves through Microwave Assisted Extraction with Optimize the Operating Conditions

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**ABSTRACT**

Microwave assisted extraction is an advanced technique of extraction process. This technique developed for the extraction of oil from natural plants using the microwave energy at atmospheric pressure. Microwave assisted extraction process used for the extraction of eucalyptus oil from Eucalyptus umbellata leaves, which was optimize with using full factorial design to find out the optimum conditions. Three parameters are involved in MAE, like extraction time, microwave power and drying period for optimization. For experimental procedure, four microwave powers such as 250W, 500W, 750W, and 1000W required with extraction time at higher level for 150 min. The result of this study is that the higher percentage of the yield is 0.49% (w/w) delivered at the 1000W with optimum 130 min. And also observed that the yield% directly proportional to the microwave power and dryness of leaves. This study concluded that the microwave assisted extraction gives the higher eucalyptus essential oil with shorter extraction time.

**Keywords----** MAE, Extraction, essential oil, eucalyptus

**I. INTRODUCTION**

Essential oils are volatile, natural base products, which are found in spices, aromatic and medicinal plants. The Extraction of essential oils is well known from old ages when pure essential oil and crude extract of essential oil bearing plants, herbs and grasses were in use for various medicinal and fragrances, flavors, preservatives and insect repellents purposes. Essential oil is used medicinally and cosmetically to make our body more efficient. The most effective way to use essential oil is not orally, as one might think, but by external application or inhalation [1, 2, 3, 4].

Eucalyptus is a tall, evergreen tree, native to Australia and Tasmania, successfully introduced worldwide, belongs to Myrataceae family and comprises about 900 species. The leaves used in this study, which is eucalyptus Umbellata leaves (botanical name). Eucalyptus oils are volatile oil and its extract from the fresh leaves of eucalyptus through the different extraction techniques. Cineole and α-terpene are the main constituents of the Eucalyptus oils, which gives the antiseptic properties and its very active ingredients of Eucalyptus oil [5, 6, 7].

Extraction process is the separation process, which separate the effective portion of the natural plants or eliminate the undesired compounds with the help of the solvents. Different techniques are used in the extraction process like conventional techniques, conventional hybrid techniques and other new techniques. Generally, extraction process is used for extraction of the essential oils. The conventional techniques based on the liquid-solid extraction process, included the solvent extraction, distillation, maceration, supercritical fluid extraction, steam distillation, hydrodistillation, soxlet, supercritical water extraction, and direct thermal desorption etc. But, using these extraction methods, some volatile compounds is losses, low extraction efficiency, it causes long extraction time, or hydrolytic effects and toxic solvent residue in the extract. So the new technique is Microwave assisted extraction (MAE) is used for extract the essential oil [8].

The new separation technique is microwave assisted extraction (MAE). In 1986, Ganzler et al first describes the microwave heat for extraction of essential oils [9]. MAE process is the advanced and green technology for the extraction of essential oils. This process is several advantages to the extraction process for industrial purpose. The MAE provides the improved yield and quality of the product, lower energy consumption, less solvent consumption, and low cost device compared to the conventional methods.
II. MATERIAL AND METHODS

Raw Material:
Fresh leaves of eucalyptus were collected from our Madhav Institute of technology and science collage and other different places of Gwalior city in Madhya Pradesh. The Botanical name of this leaves is Eucalyptus Umbellata and also called the Eucalyptus tereticornis. The variety of the leaves was verified by Botany Department of Jiwaji University in Gwalior. After the collection, leaves were cleaned and dried in a dark room at 25°C temperature. The solution prepare with the double distilled water.

Microwave Assistant Extraction:
Microwave assisted extraction performed at atmospheric pressure. Microwave oven produced electromagnetic waves with frequency between 300 MHz to 300 GHz. Microwave oven produce the electric and magnetic field, which were worked on the perpendicular to each other. The principle of microwave assisted extraction is dependent on the ionic conductance and dipole rotation. Domestic microwave oven operated at frequency 2450 MHz Microwave oven connected to the Clevenger-type apparatus for extraction of oil with the help of microwave heating. The microwave oven operated at 400 W to highest 1000 W for extraction of essential oil and sufficient time required for extract the all essential oil from sample. The microwave assisted extraction is advanced and mechanically modified of the hydrodistillation techniques [10, 11, 12].

Experimental procedure:
The eucalyptus leaves were cleaned, washed through the water and cut into the approx 2 cm in size. The cut leaves dried at the room temperature with different levels. The moisture of sample is removing at 24 hrs. The 100 gm leaves of eucalyptus mixed into the 500 ml water, which is double distilled water. The sample placed into the microwave oven, which is connected to the Clevenger type apparatus

Start the microwave oven and applied the microwave power to the sample. After some time, the evaporation will start and generate the fumes of the sample. These fumes are passed through the condenser, which condense the fumes with help of cold water. Condensation will be complete; the sample is taking into the separator, which is used to separate the oil. This oil is light yellow in colour with a Comphoraceous odour. The moisture of the oil is removed with addition of the minimum amount of the anhydrous sodium sulphate.

For experimental procedure, the microwave powers such as 250W, 500W, 750W, 1000W required for extraction of oil from leaves. The required extraction time for each process at different level of microwave powers is 30, 50, 70, 90, 130, 150 min and each power will take the leaves with different level of dryness. After 150 min the oil is not extracted and also the burn the leaves. The leaves were dried at different level such as 30, 46, 67, 88%, to the extraction of oil for high yield percent.

Percentage of yield:
The percentage of the yield determined of mass of the extracted oil from each sample on the basis of the mass of the eucalyptus leaves. The extracted oil yield percentage was estimated as follows:

\[ \text{Yield} \% = \frac{M_{eo}}{M_{ls}} \times 100 \]

Where, \( M_{eo} \) is the mass of extracted oil through each sample of eucalyptus leaves and \( M_{ls} \) is the mass of eucalyptus leaves [13, 14].

III. RESULTS AND DISCUSSIONS

Effect on yield percentage with extraction time at different levels of microwave powers:
The oil was extracted by microwave assisted extraction process with the help of heating media, which was microwave power. The microwave starting power adjusts to the 250W, at this power level; the beginning of evaporation time is 20 min. The MAE process takes the different level of microwave powers such as 250, 500, 750, 1000W for extraction of oil from leaves. At 250W, the total extraction time is 150 min and the total yield is 0.3% (w/w). When the microwave power increase from 250 to 500W, the evaporation time is decrease and yield% was increases up to 0.35% (w/w) with respect to extraction time. From fig.2, at the microwave power increases from 500W to 750W, the yield percentage also increases up to 0.4% (w/w). Again increases the microwave power from 750W to 1000W, the extraction time of oil is decreases from 150 min to 130 min and yield % increases up to 0.49% (w/w) of total extraction. The higher percentage of eucalyptus oil is 0.49% (w/w) extract at higher microwave power. The microwave power is 500W, 750W and 1000W, the evaporation time or induction time is also decreases such as 14min, 8 min, and 5 min respectively.
In this present study, the evaluated the yield% increases with increases the microwave power with respect to the extraction time. The result of this study concluded that the shorter extraction time can be achieved with the variation in the microwave heating. Maximum yield percentage achieved at higher level of microwave power. The Chain and Spiro described that higher microwave heating power transferred to the water in the form of waves, was absorbed by heating and disrupted rate of the cells of the matrix increases, so the extract the higher essential oil from material [15]. In MAE, Higher power was damage the matrix of the sample, so achieved the optimum yield% (0.49%) at optimum time (130 min) and avoid the burning of the leaves. The reduction in evaporation or induction times with the increases the microwave power. So the result was described, in MAE process the yield% is directly proportional to the microwave heating and extraction time. And evaporation time is inversely proportional to the microwave power. It can also include, MAE was time saving device.

**Effect on yield percentage with extraction time at different levels of dry leaves:**

To study of the effect of dryness of the eucalyptus leaves on the yield of eucalyptus umbellata essential oil. The eucalyptus leaves were dried at the room temperature from 0% to the 88% (w/w). For dry leaves, the total extraction time is needed up to 150 min with the fix microwave power.

The fresh leaves extract the oil is only 0.095% (w/w). From the fig.3, the yield% increases with increasing the dryness of the leaves with respect to extraction time. From the fig, the higher percentage of the dryness is 88%, and extract yield % is also increasing up to 0.49% (w/w) with 150 min extraction time.

**IV. CONCLUSION**

This study concluded that the microwave assisted extraction gives the higher eucalyptus essential oil with shorter extraction time of process. The yield percentage of the essential oil is directly proportional to the dryness of the eucalyptus umbellata leaves. MAE was the best technique for industrial purpose, because of its simplicity. The more important advantage of this process gives the maximum yield with reduce the time consumption for extraction of essential oil. The results show that the essential oil extract from the leaves was at optimum microwave power for efficient extraction. This MAE operation was performed for extract the all type of essential oil, which is used in medicinal, industrial and Aromatherapy.

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