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Yield Dependency Parameters for the Extraction of Essential Oils from different Techniques: A Review

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Abstract: ***Due to the presence of the biological active ingredient in the essential oil it is widely used in the pharmaceutical, insecticides and perfumery industries. Demand of the essential oils are also continuously increase in food industries. Today, various methods like hydro distillation, steam distillation, cold pressing, solvent extraction and super critical extraction are used in which hydro distillation and steam distillation are conventional methods. Numerous studies carried out previously which prove that the yield of essential oil is completely influence by the parameters like time, temperature, type of raw materials, size and solvent to feed ratio etc. has been review.***
Keywords: Essential oils, Hydro distillation, Parameters, Steam distillation and Solvent extraction

I. INTRODUCTION

Essential oils are natural products derive from variety of plants and its different parts. The essential oil components are greatly influenced by genetic, environmental and geographical conditions [4]. They are delicate and unstable volatile compounds and could be easily degraded by the action of heat, light and oxidation. Therefore, essential oils need to be stored in a cool and dry place tightly stoppered. They contain pertinent and diverse biological ingredients. As a result, they are used in pharmaceutical and perfumery industries. They have palatial antibacterial, antifungal, antiyeast, insecticidal and insect repellent activities for a long time. They also contain anticancer, allopathic, free radical scavenging and other useful biological activity [4]. Production and consumption of the essential oils are increasing very fast now a day. They are commercially called as deterpenated, desesquiterpenated, rectified according to 7thedition of the European Pharmacopoeia. Food industry also consume a great quantity of essential oil because of their important applications as food preservatives [3], innovation in food packaging and the fight against pathogens generating dangerous food poisoning. Nowadays the combination of essential oils and active molecules is attracting special attention in order to obtain colloidal particles mainly for dermatology, local skin therapy and now cosmeto-textile as new application [5]. There are more than 250 types of essential oils. A number of countries produce different kinds of essential oils. India ranks second in the world trade of essential oils [12]. Number of techniques is taken in account for the extraction of the essential oil like hydro distillation, steam distillation, cold pressing, soxhelt extraction, solvent extraction and super critical extraction. Hydro-distillation and steam distillation are conventional methods whereas solvent extraction, soxhelt extraction and CO_2 super critical extraction are considered as advanced technique for the extraction of the essential oils [8].

II. CHEMICAL CONSTITUENTS OF ESSENTIAL OILS

Essential oils are mainly consisting of two types of hydrocarbon terpenoids and terpenes. The first one called isoprenoids, they are oxygenated derivatives of hydrocarbon terpenes such as alcohols, aldehydes, ketones, acids, phenols, ethers and esters [1]. They comprise both oxygenated mono- and sesquiterpenoids. Some essential oil contains another class of oxygenated molecules which are phenylpropanoids and their derivatives. They are found in special plants like Sassafras, Cinnamon bark, vetiver, clove. Terpeneshave very huge category of natural hydrocarbons. [2] The second compound monoterpenes contain more than 80 % of essential oils composition and sesquiterpenes. They could present hydrocarbon acyclic structures.

III. DIFFERENT TECHNIQUES FOR EXTRACTION

Production technology is an essential element to improve the overall yield and quality of essential oil. Currently Varieties of methods are for the extraction of essential oil. Hydro distillation, steam distillation, solvent extraction, super critical extraction, enfleurage, cold pressing and soxhelt extraction etc. where hydro distillation and steam distillation are traditional methods and commonly used for extraction of essential oil. These two methods deal with the two phase system. An azeotropic mixture is from during the separation process.

A. *Steam distillation*

Most commonly, the essence is extracted from the plant using a technique called distillation. One type of distillation places the plants or flowers on a screen. Steam is passed through the area and becomes "charged" with the essence. The steam then passes through an area where it cools and condenses. This mixture of water and essential oil is separated and bottled.

B. *Hydro distillation*

In these method plant materials are mix with the sufficient quantity of water and allow it to boil. Due to hot water and steam the essential oil is free from its glands. The vapours are formed during the process which allow to condense by cool water (indirect mode). now distillate is separate simultaneously oil gets separated from water. A comparative study was conducted on hydro-distillation and steam distillation by using mint areal part. It was found that extraction started in hydro-distillation earlier than Steam Distillation methods (about 34 min for HD and 42 min for SD). This may be due to faster temperature increase in hydro distillated mint areal parts in comparison with steam distillated mint areal parts since mints in Hydro distillation process are in contact with heat transfer medium (water) while in Steam distillation they are in contact with a secondary form of heat transfer medium (steam) [7].

C. *Solvent extraction*

Separation of compounds in the solvent extraction is depends on the solubility of raw materials (plants parts). It is also called liquid-solid extraction process. Solvent like acetone, alcohol, ether and ether and variety of hydrocarbon are used during the extraction process. A hydrocarbon solvent is added to the plant material to help dissolve the essential oil. When the solution is filtered and concentrated by distillation, a substance containing resin (resinoid), or a combination of wax and essential oil (known as concrete) remains. Solvent extraction is considered better than other method because it gave more oil than any other method. Steam distillation method yielded less oil compared to the solvent extraction this is because most volatile content gets lost during the heating process [8]. Three process i.e. solvent extraction, hydro distillation and enfleurage were used for extraction of lemon grass oil. It was observed that solvent extraction method yielded 2.07% essential oil followed by enfleurage method with 1.957% and hydro distillation with 0.946% yield of essential oil respectively. It can be seen that solvent extraction gives the highest yield because of the less exposure to air and heat [14].

IV. FACTORS AFFECTING YIELD

There are following parameters which affect the yield of the essential oil i.e. time, temperature, size, solvent to feed ratio and type of raw materials.

A. *Time*

Time is one of the important parameter which affects yield. As the time increases during the extraction process mass transfer rate also increases which directly increases the yield of essential oil. The sufficient time must be providing to extract the all the important component present in the feed material because some component release more frequently than others. The previous studies carried out on solid-liquid extraction (solvent extraction) process of essential oils from orange rinds done under conditions of utilizing a mixture of 50% alcohol in water having a heat treatment at 175°C for 105 min so that the yield could be maximum and a quality product could be obtained [11].

The influence of time on yield was investigated over the peppermint lemongrass and palmarosa experiments by using steam distillation. Distillation time of 240 min led to 25–40% reductions in oil yield compared to yields at 20–160 min. This study demonstrated that distillation time can be used as a tool for obtaining essential oils with specific targeted composition from peppermint, lemongrass, and palmarosa Shorter distillation may save producers and processors energy costs and other resources [9].

B. *Temperature and Pressure*

High temperature during process destroyed or altered components. Whereas, lower temperature causes retention of constituent in the feed because some component requires high temperature to extract out from the tissue than others. Therefore, optimum temperature must be maintained to enhance yield during extraction same as for pressure. The effect of temperature and pressure were observed on yield of ginger oil where acetone is use as solvent. It shows that increasing temperature from 56 to 85^0c and pressure from 14.69 to 45.19 psi during extraction decrease yield from 16 ml to 7ml which also faded colour [13].

C. Size

Size of the raw material is also affecting the extraction of essential oil. Smaller size of raw material increases surface area for the diffusion to be carried out which results better mass transfer and increases yield for the process. Study revealed that yield of essential oil is dependent on the size. Essential oil of freshly harvested 12-month mature ginger rhizomes of different size having yield of big 3.2±0.148%, medium 4.1±0.489% and small 5.1±0.208% by using hydro distillation. The concentration of the essential oil constituents was highest in small rhizomes followed by medium and big rhizomes [6].

D. Solvent to Feed Ratio

For yield of essential oil, optimum quantity of solvent to feed ratio must be required. Higher raw material weight decreases the yield of essential oil. The reason behind this may be less energy availability per particle leading to less heating effect with increase in raw material loading. Also the volume of water to be added should be select in such a way that after complete rehydration of dried material during distillation, water should remain in sufficient amount so that it can act as a barrier to prevent overheating of raw material and no charring of plant material can occur. From the analysis, we can conclude interaction of water ratio and particle size interaction contributes significantly for production of high ginger oil. From the optimize value, to obtained maximum ginger oil yield of 1.34%, the optimal water ratio to sample value is 2660 mL to 100 g, at 23.15 h using medium size particles via hydro-distillation.

E. Type of raw Material

One of important parameter to influence the yield is raw material used in the extraction process. Yield of essential oil differs when different section of plant to be used. The loose packing and the wet material in raw material in distillation still enhances the yield of oil from the raw lemongrass material [10]. Yield of the essential oil was increased from 23 to 28.5 ml by using dry to fresh ginger in solvent extraction process and keeping the time same [6].

V. CONCLUSION

Essential oils are plant based products having volatile in nature which is made up of different chemical compounds. Major constitutes found are esters, ketone and hydrocarbons. They have wide application in pharmaceutical, cosmetic, agricultural and food industries. Numerous techniques have been developed for the extraction of the essential oil. Some parameters like size, time, temperature, solvent to feed ratio, solvent used, technique of extraction and type of raw material on which yield of essential oil is depends. Studies reveal that optimum temperature and pressure is necessary for the yield of essential oil same as for the solvent to raw material ratio.

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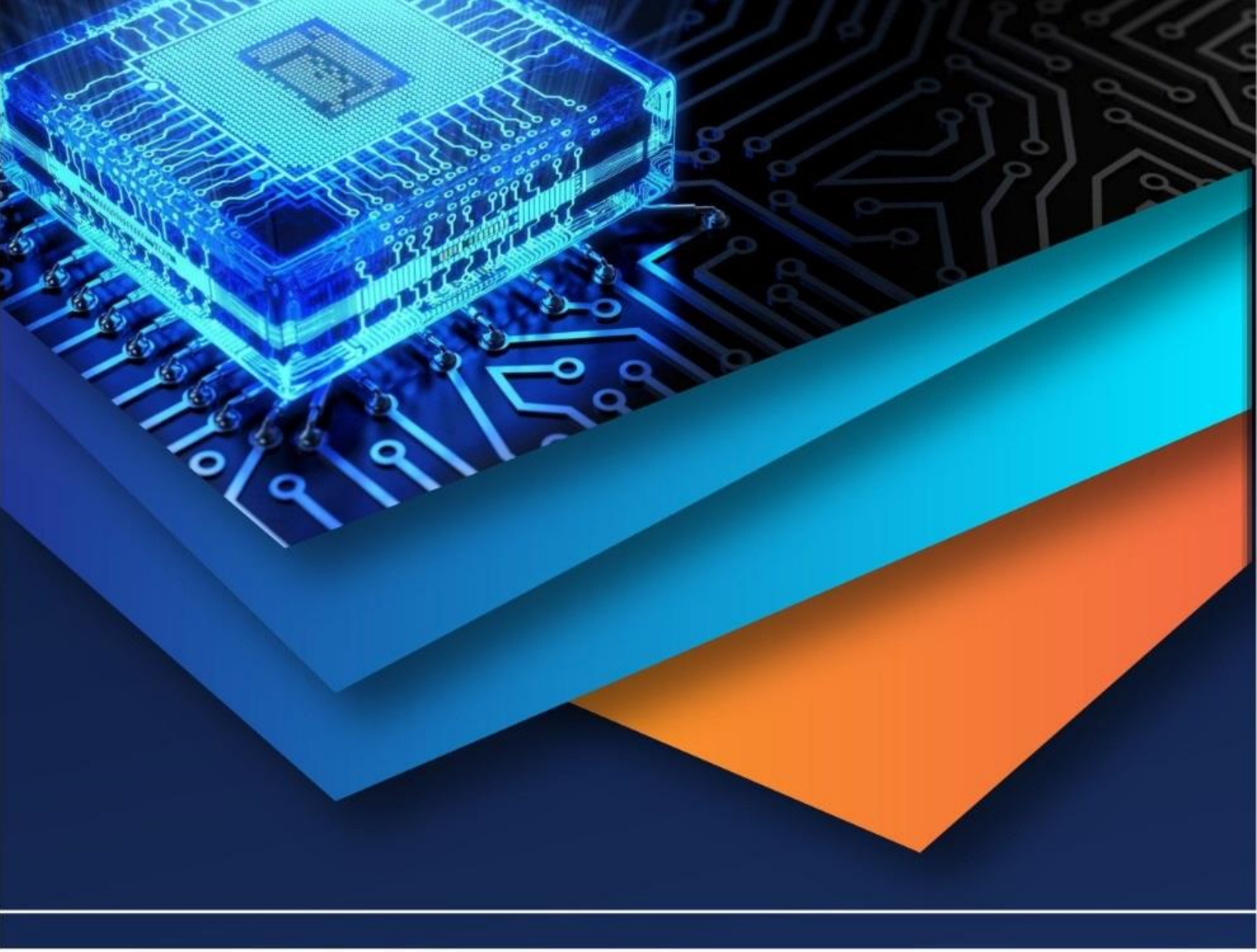

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