

# Extraction of Essential Oil from Iraqi *Eucalyptus Camadulensis* Leaves by Water Distillation Methods

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**Abstract.** The extraction of Eucalyptus oil from Iraqi Eucalyptus Camadulensis leaves was studied using water distillation methods. The amount of Eucalyptus oil has been determined in a variety of extraction temperature and agitation speed. The effect of water to Eucalyptus leaves (solvent to solid) ratio and particle size of Eucalyptus leaves has been studied in order to evaluate the amount of Eucalyptus oil. The optimum experimental condition for the Eucalyptus oil extraction was established as follows: 100°C extraction temperature, 200 rpm agitation speed; 0.5 cm leave particle size and 6:1 ml: g amount of water to eucalyptus leaves Ratio.

**Keywords:** Extraction, Eucalyptus Camadulensis, Essential Oil, Distillation Methods

## 1. Introduction

Essential oils are a diverse set of natural products that are important sources of flavoring chemicals and aromatic in pharmaceutical products, food, perfume and industrial [1, 2]. Essential oils are concentrated volatile aromatic compounds produced by plants - the easily evaporated essences that give plants their wonderful scents. Each of these complex precious liquids is extracted from a particular species of plant life. The chemistry of essential oils is very complex; in nature essential oils have many chemical ingredients. Some of them play a major part and others a minor part. The ingredients found in essential oils are organic due to their molecular structure which is based on carbon atoms held together by hydrogen atoms. Oxygen atoms and sometimes nitrogen and sulphur atoms are also present [3, 4].

Iraqi Eucalyptus oil C10H18O is an important essential oil. It is extracted from fresh and dried leaves, in addition to branch tips [4]. Eucalyptus oil has many biological effects, antiviral, antifungal and antibacterial components and the long history of use against the effect of influenza, cold, arthritis message other respiratory infection, rhinitis and sinusitis [5]

Extraction by solvent is the most common technique for extracting aromatics in the modern industry of perfume. Raw materials are submerged and agitated in a solvent that can dissolve the desired aromatic compounds as well as wax and pigments. Generally; extraction solvents that dissolve the precious compounds, have a necessary boiling point and easily removed at the end of the process. A lot of solvent are used to extract essential oils such as methanol [6, 7], ethyl alcohols, benzene, acetone, hexane, petroleum ether and water, etc. [2, 8, 9, 10]. The industrial application of these methods are increasing over a wide range because its can be applied directly to any low oil content raw materials [10, 11, 12]. Extraction by solvent has many advantages. It gives higher yield, purity and less turbid oil than extraction by mechanical process, and relative low operating cost compared with others extraction process[2].

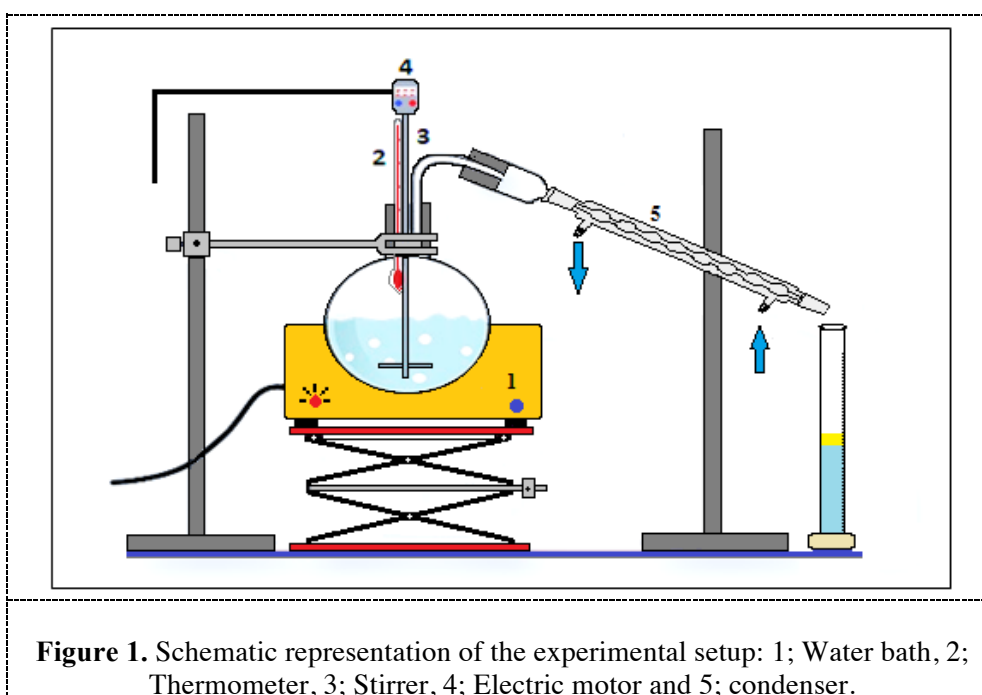
In this study, Eucalyptus oil extraction from Iraqi Eucalyptus Camadulensis leaves by water extraction process has been studied experimentally. Various extraction conditions including such as extraction



time, extraction temperature; agitation speed particle size of eucalyptuses leaves and water to solid ratio were studied.

## 2. Experimental

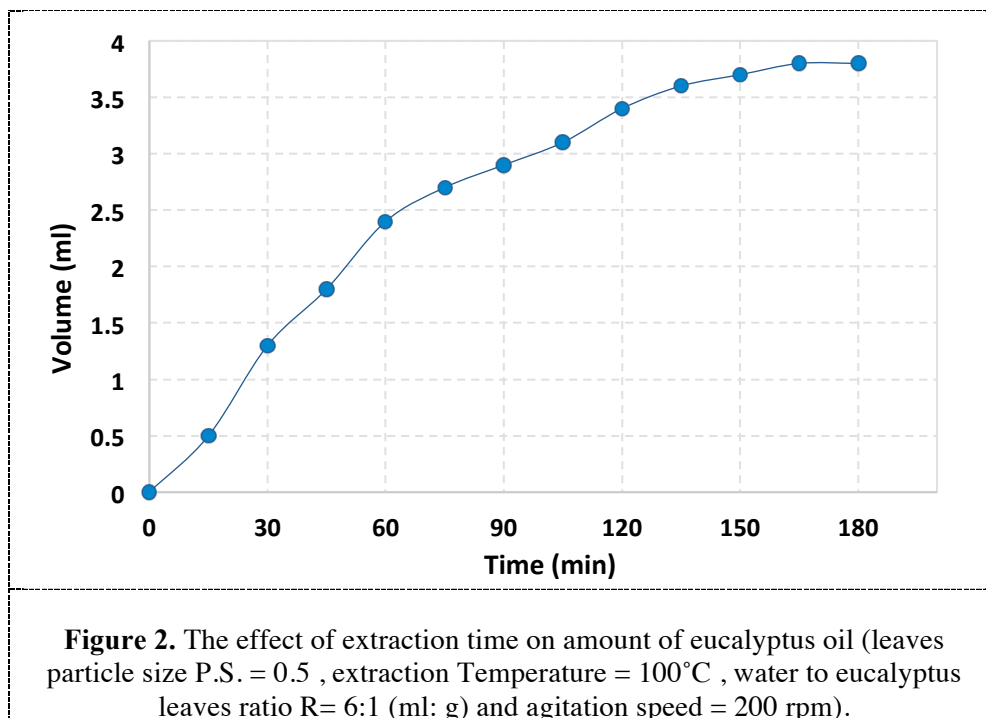
The materials used are: Iraqi Eucalyptus Camadulensis leaves (obtained from eucalyptus trees in College of Agriculture, University of Baghdad, Iraq), aqueducts, and distilled water. Fifty grams of air dried Eucalyptus leaves and 300 millilitre of distilled water were placed in the Pyrex extraction flask, equipped with electrical stirrer and controlled water bath to regulate the extraction temperature. The amount of eucalyptus oil were determined every 15 minutes, until the equilibrium was reached. The schematic diagram of the equipment used is shown in figure 1.



## 3. Results and Discussion

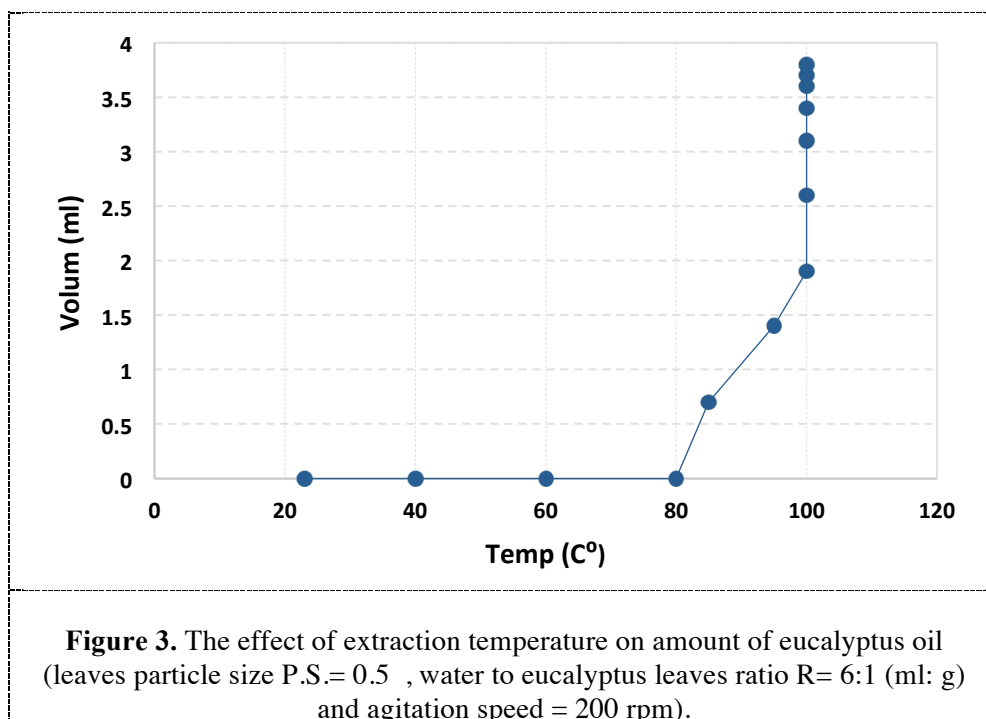
### 3.1 Effect of Extraction Time

The effect of extraction time on eucalyptus oil extraction was studied until the equilibrium was reached at 100°C with water to eucalyptus leaves ratio 6:1 (ml: g) and mixing at 200 rpm. The obtained results are plotted in Figure 2. It can be seen from this figure, the amount of eucalyptus oil increased with time and can be observed that the oil extraction rate is fast at the first of extraction process but gets slow gradually because of the free oil on the surface of eucalyptus leaves particles gets extracted quickly inducing a fast increase in the oil extraction rate when the meal is exposed to the fresh solvent. Furthermore, since the concentration of oil is low in the solvent at the first of the extraction process, the oil diffuses quickly from the meal to the liquid phase due to the effect of mass transfer. As the time passes by, the oil concentration increases in the solvent resulting in a decrease in the rate of diffusion [13]. These results are in agreement with the results which obtained by Cassel and Vargas (2006) [14].



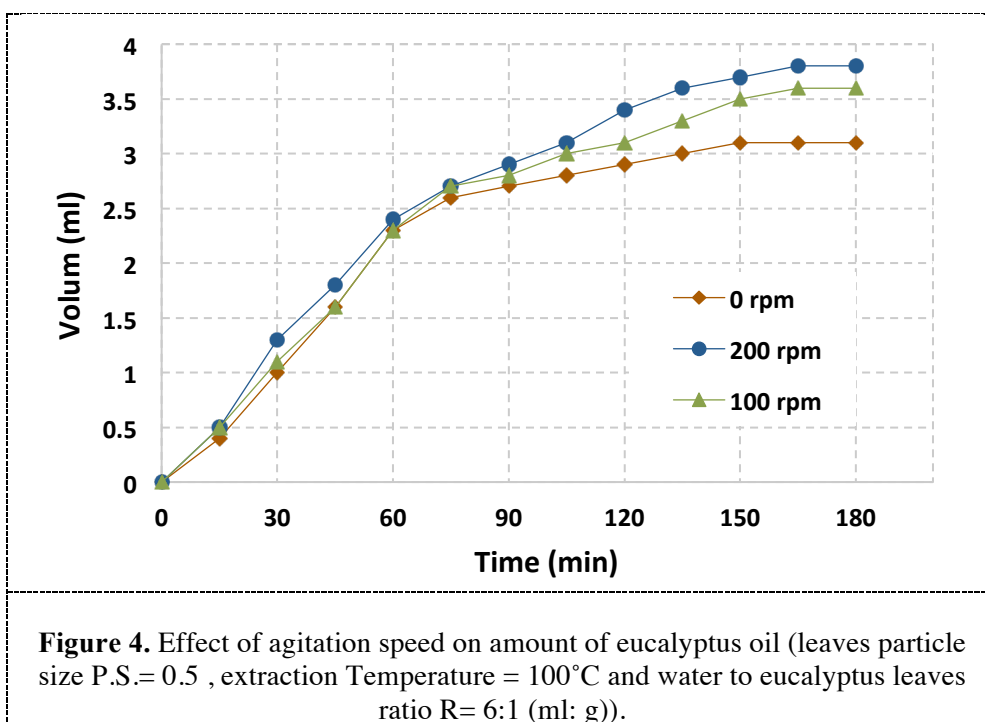
### 3.2 Effect of Extraction Temperature

The effect of extraction temperature was examined at different temperature under the condition with water to eucalyptus leaves ratio 6:1 (ml: g), particle size of Eucalyptus leaves 0.5 cm and mixing at 200 rpm. As can be seen from figure 3, the amount of eucalyptus oil increase with increasing the temperature of extraction as a result of increased eucalyptus oil vaporization in the process at higher temperature. In addition, higher extraction temperatures increase the diffusion coefficient of the oil, resulting in an increase of the eucalyptus oil diffusion rate [15].



### 3.3 Effect of Agitation Speed

In order to excess the effect of the agitation speed on eucalyptus oil extraction though water distillation method, the study was conducted at different agitation speed in the range 0 – 200 rpm, keeping the extraction temperature constant (100 C<sup>0</sup>). Under these conditions, water to eucalyptus leaves ratio 6:1 (ml: g) and particle size of eucalyptus leaves 0.5 cm. Figure 4 shows the effect of agitation speed on the evolution in time of eucalyptus oil extraction. The extraction of eucalyptus oil was found to increase with the increase of agitation speed. In addition, higher agitation speed increase the diffusion coefficient of oil because it increases the eddy diffusion and therefore increases the transfer of material from the surface of the particle to the bulk of the solution., resulting in an increase of mass transfer rate [2].



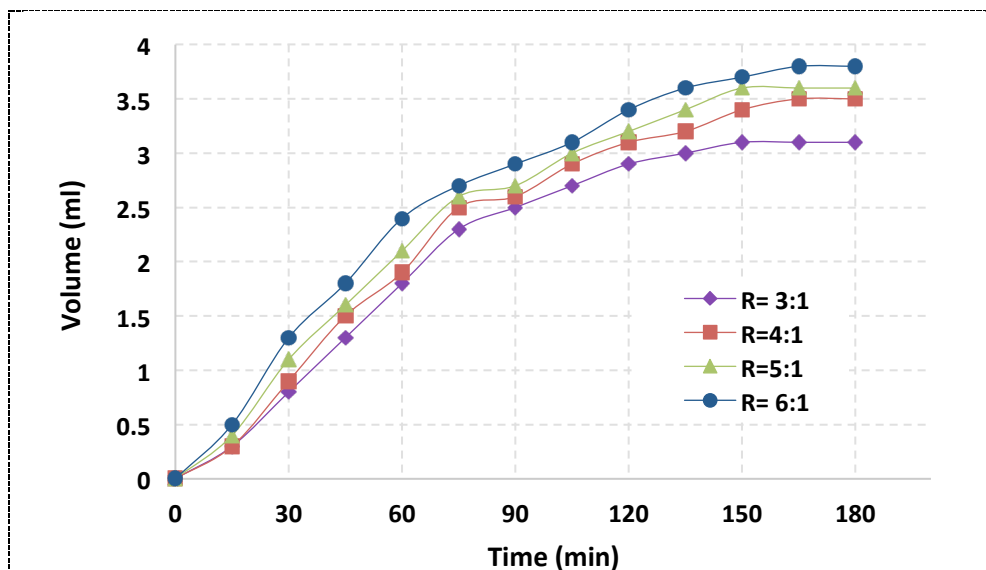
### 3.4 Effect of Water to Eucalyptus leave Ratio

Figure 5 shows that the amount of eucalyptus oil at four different solvent (water) to solid (eucalyptus leaves) ratios (R). This figure shows that the eucalyptus oil amount increases with increasing the water to eucalyptus leaves ratio. The effect of water to eucalyptus leaves ratios is very essential consideration to exploit maximum extractability while scaling down or up the sample preparation method. The procedures become more complex when larger water volumes were used. In addition, if smaller water volumes were used, it can make the target extraction incomplete. Therefore within the extraction time investigated, adequate amount of water to eucalyptus leaves ratio need to be identified for the extraction process. By increasing water to eucalyptus leaves ratio up to a specific limit, the eucalyptus oil amount increase [13]. This is resulted by the gradient of concentration between the liquid phase and eucalyptus leaves becomes greater that enhance good mass transfer.

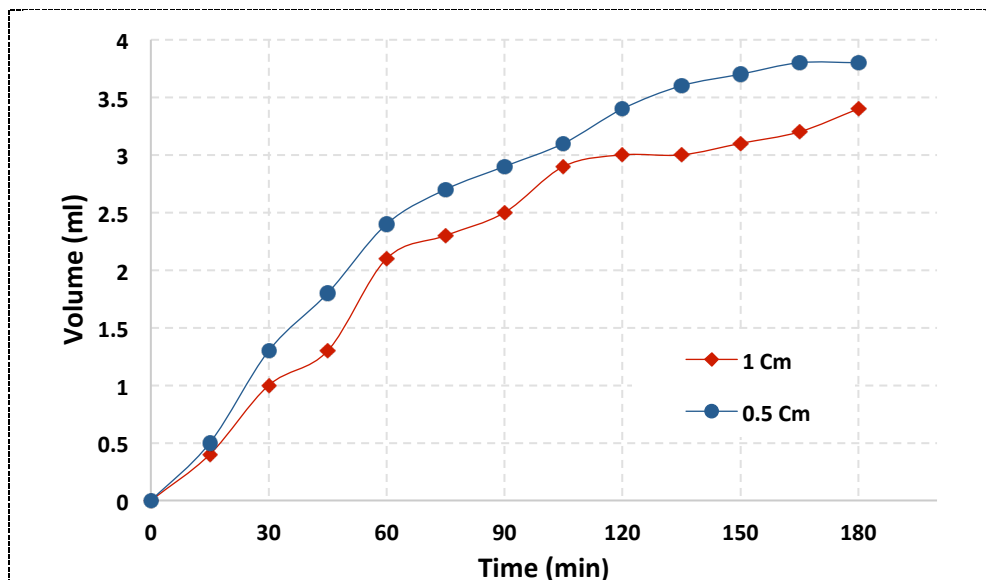
### 3.5 Effect of leaves particle Size

The effect of particle size was examined two different size (0.5, 1 cm), under condition of water to eucalyptus leaves 6:1(ml/g), agitation speed 200 rpm and extraction temperature 100°C until the equilibrium was reached. Figure 6 shows that less amount of eucalyptus oil is extracted from the eucalyptus leaves particles compared to the smaller size particles. The reason is the smaller size is greater in the interfacial area between the leaves and liquid phase. Therefore, less amount of

eucalyptus oil will be transferred from inside the larger leaves particles to the surrounding solution in comparison with the smaller particles.



**Figure 5.** Effect of water to eucalyptus leaves ratio on amount of eucalyptus oil (leaves particle size P.S. = 0.5, extraction Temperature = 100°C and agitation speed = 200 rpm).



**Figure 6.** Effect of leaves particle Size on amount of eucalyptus oil (extraction Temperature = 100°C, water to eucalyptus leaves ratio R= 6:1 (ml: g) and agitation speed = 200 rpm).

#### 4. Conclusions

In the present study, different extraction conditions were investigated in extraction of eucalyptus oil from eucalyptus leaves. The results show that the amount of eucalyptus oil increases with extraction time. In addition the oil extraction rate is faster at the beginning of process and gets slow gradually when the equilibrium is reached. The current study concluded that the increase of the extraction temperature increases the diffusion coefficient and the solubility of the oil in the water, thus improves the extraction rate. Moreover, the productivity of eucalyptus oil can be enhanced by increasing the agitation speed, while there are significant differences between use and without use of the mixing process. In fact increasing water to eucalyptus leaves ratio up to a specific limit increases the yield, since the concentration gradient between the eucalyptus leaves and the liquid phase is greater due to good mass transfer. Finally, lowest production level of eucalyptus oil was obtained from the eucalyptus leaves particles compared to the smaller size particles. The main reason was because of the low transfer rate of oil from inside the larger leaves particles to the bulk solution.

#### 5. Acknowledgments

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