



Extraction of *Ocimum basillicum* Oil by Solvents Methods

KHALID M. ABED^{1,*}, BADOOR M. KURJI² and BASMA A. ABDULMAJEED¹

¹Department of Chemical Engineering, College of Engineering, University of Baghdad, Baghdad, Iraq

²Department of Chemical and Petrochemical Engineering, College of Engineering, University of Anbar, Anbar, Iraq

*Corresponding author: E-mail: khalid.chemical82@gmail.com

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The extraction of Basil oil from Iraqi *Ocimum basillicum* leaves using *n*-hexane and petroleum ether as organic solvents were studied and compared. The concentration of oil has been determined in a variety of extraction temperatures and agitation speed. The solvent to solid ratio effect has been studied in order to evaluate the concentration of *Ocimum basillicum* oil. The optimum experimental conditions for the oil extraction were established as follows: *n*-hexane as organic solvent, 60 °C extraction temperature, 300 rpm agitation speed and 40:1 mL:g amount of solvent to solid ratio.

Keywords: Extraction of essential oils, *Ocimum basillicum* oil, Solvents extraction methods.

INTRODUCTION

Essential oils are groups that have natural compounds. They are considered major source of flavouring chemicals and aromatics in pharmaceutical products, food and industries [1]. Plants produce essential oils, which are considered concentric volatile compounds. They are the source of nice scents of plants since they are easily evaporated. Concentrated volatile aromatics which are produced by plants are the constituents of essential oils. The nice and different scents of the plants obtained from the easily evaporating essences of the essential oils.

Basil oil is categorized as high essential oil, which means the aroma will evaporate after 24 h when it is applied to the body. It is useful in arthritis or therapeutic message as well as in refreshing the body. It can also reduce the intensity of digestion problem [2].

In perfume industry, the most known technique is extraction of aromatic compounds by organic solvents. These desired compounds in addition to wax pigments are extracted from the mixing of raw materials (special part of the plant) with a special solvent. These solvents have suitable boiling point and are capable of dissolving the desired compounds and are easily removed at the end of process. Examples of these solvent are benzene, hexane, acetone, petroleum ether, ethyl alcohol, etc. [3-7]. The industrial application of solvent extraction method is increasing day by day because of their direct application to a wide range of raw materials with low oil content [8-10].

Extraction by organic solvent has several advantages. It gives higher purity, yield and less turbid oil than extraction by machine. The cost of operation is low relatively if compared with supercritical fluid extraction.

Essential oil easily evaporates compound and it is not soluble in water. Distillation or extraction processes are used to isolate essential oil from the plants. Parts of the plant that include essential oil are leaf, stems, flower, seed, branch and roots.

In this study the method of solvent extraction was used to extract the Basil oil from leaves. The parameters affecting such process are solvent to solid ratio, agitation speed and temperature so this study will investigate these parameters. Petroleum ether and hexane were used as solvents.

EXPERIMENTAL

Ocimum basillicum leaves were obtained from middle Baghdad city, Iraq. The solvents used were *n*-hexane (95 % ALDRICH) and petroleum ether (BDH).

The leaves of Basil were dried in oven at 50 °C. After the drying, the leaves samples were weighted in a digital balance with four decimal points (Sartorius BL 2105). The dry leaves and solvents were placed in the extraction reaction flask. The extraction flask (0.5 L) was immersed in water bath to control the temperature. It was equipped with electrical mixer to homogenize the mixture. *n*-Hexane and petroleum ether were used at the ratio of 40/1 (mL solvent/g solids), considered an effective ratio for reaching equilibrium between the oil con-

centration in the solid and liquid phase. UV-visible spectrophotometer SP-3000 (OPTIMA INC) was used to determine the essential oil concentration in the solvent at wavelength (λ) = 254 nm.

RESULTS AND DISCUSSION

Effect of extraction time: The time of extraction of essential oil was continued until reaching equilibrium (no further change is noticed) at 60 °C with the following condition: solvent to solid ratio 40:1 (mL:g) and mixing speed 300 rpm for each solvent (*n*-hexane and petroleum ether). The results obtained are shown in Fig. 1. Using of *n*-hexane gave more concentration than petroleum ether. The solubility of oil in hexane was high because of the strong solute-solvent interactions [11].

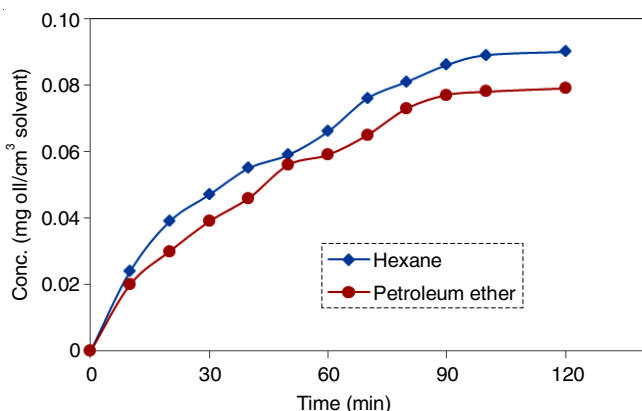


Fig. 1. Extraction time effect on oil extracted

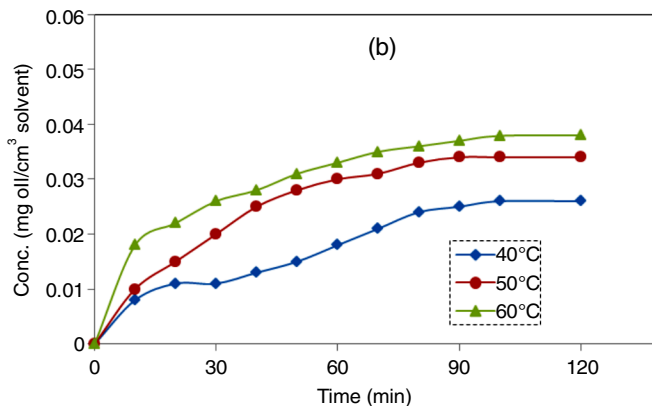
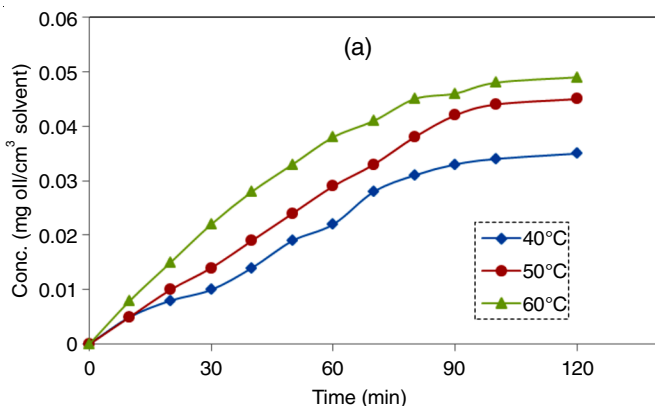


Fig. 2. Temperature effect on *Ocimum basillicum* oil extracted by (a) *n*-hexane and (b) petroleum ether

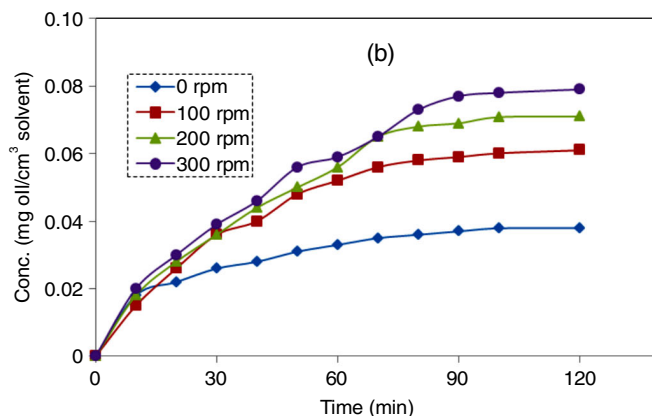
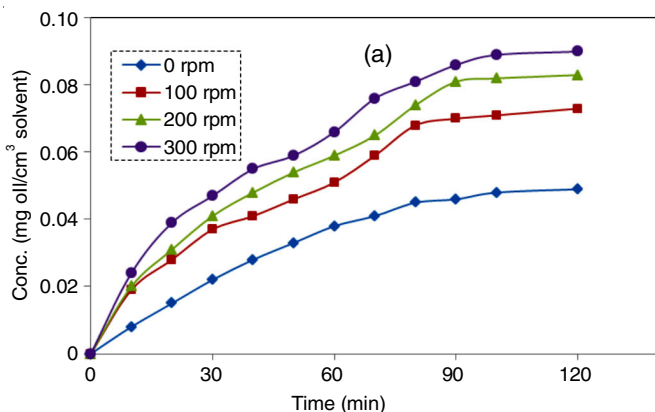


Fig. 3. Mixing speed effect on oil extracted using: (a) *n*-hexane and (b) petroleum ether

Effect of temperature: The extraction temperature effect was studied, using different temp. 40-60 °C for both solvents, under the following conditions: solvent to solid ratio 40:1 (mL:g), mixing speed 300 and extraction time and 120 min. The results are shown in Fig. 2 for hexane and petroleum ether respectively. From Fig. 2, it can be seen that the oil concentration was increased as the extraction temperature increased.

Increasing the coefficient of diffusion and the solubility of the oil are increased with the increase in temperature of diffusion and the oil solubility in the solvents [3]. This enhancement improves the rate of extraction. This behaviour has been reported for oil extraction processes from oil seed such as sunflower [12,13] and Jatropha [14,15] and using *n*-hexane as a solvent.

Mixing speed effect: Mixing speed effect on extraction of oil was examined at a range 100-300 rpm and compared with the oil extraction at 0 mixing speed for *n*-hexane and petroleum ether and the same other conditions. The results are shown in Fig. 3 for *n*-hexane and petroleum ether respectively.

As seen in Fig. 3 the concentration of oil increases by increasing the mixing speed and there are obvious differences between use of agitation and without agitation.

Eddy diffusion is increased by mixing of the solvent; hence the material transfer from the surface of particles to the bulk of the solution is increased. Otherwise, the dense materials will tend to agglomerate, settle down on the bottom and finally can be degraded thermally [3].

Solvent to solid ratio effect: Solvent to solid ratio effect on extraction of oil by petroleum and *n*-hexane petroleum ether

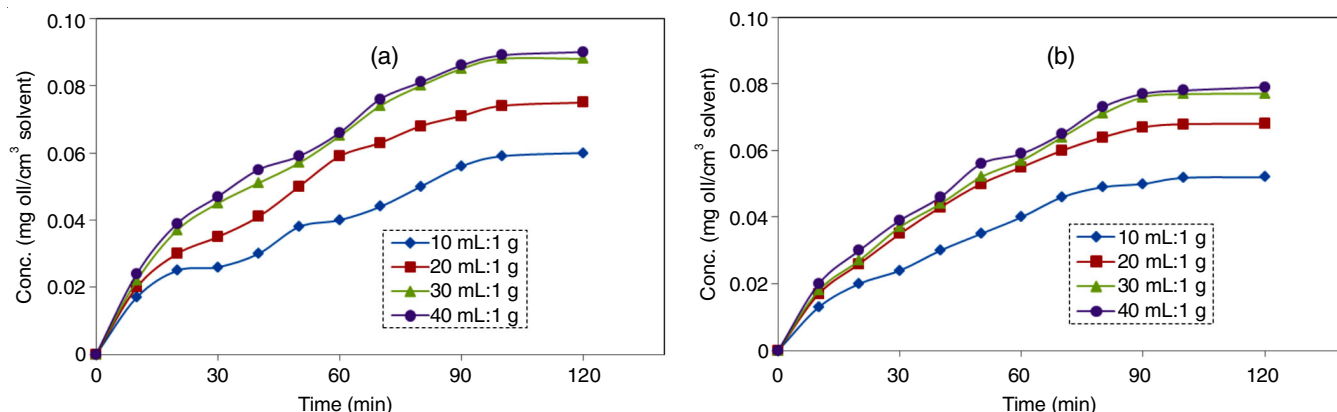


Fig. 4. Solvent to solid ratio effect of oil extracted using: (a) *n*-hexane and (b) petroleum ether

was examined at 10:1, 20:1, 30:1 and 40:1 (mL:g). The results obtained are shown in Fig. 4 for hexane and petroleum ether respectively under the conditions of 300 rpm mixing at 60 °C for petroleum and *n*-hexane ether until the equilibrium was reached.

A certain and specific limit of solvent to solid ratio is reached, where up to this limit, an increase in the oil concentration will be determined. Good mass transfer is favoured because of a concentration gradient between liquid phase and solid particles are likely to be greater.

An explanation for the extraction process is that it consists of three different steps. Step-1: where the substrate is removed from the outer surface of the particle. This is an approximate constant velocity process. Step-2: a transition state to diffusion where at the solid-liquid interface, a resistance to mass transfer appears. Mass transfer by convection and diffusion dominates. Step-3: the solute must diffuse in the solvent. The last one is low, irreversible and may be considered as the limiting step. When the time of extraction increases the rate of diffusion decreases. This is because of the increased solute concentration in the liquid through the last stage [16,17].

Conclusion

The results of this study can be summarized as follows:

- Extraction of Basil oil by *n*-hexane is higher in concentration and extraction ratio compared with extraction by petroleum ether.
- The rate of extraction is enhanced by the increase in the temperature. This increase in temperature increases both the diffusion coefficient and the solubility in the oil.
- The concentration of oil is increased by increasing the mixing and there are obvious differences in the case of using mixing or not. This will increase the eddy diffusion leading to increase in the mass transfer. The diffusion happens from the surface of particle to the solution bulk. Agglomerates appear in the case of no mixing. These agglomerates of the dense material can settle down to the bottom and the thermal action can cause their degradation.
- Increasing the ratio of solvent to solid up to a certain limit will increase the oil concentration that is extracted. The gradient of concentration between the liquid phase and solid becomes greater. This will favour good mass transfer.

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