# THE STUDY OF VOLATILE OILS EXTRACTED FROM HAWTHORN (CRATAEGUS MONOGYNA) USING MICROWAVES

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REVIEW, RESEARCH ARTICLE

**Abstract**

The objective of this paper was to find a solution to extract essential oils from hawthorn leaves using the microwave oven, without affecting its biological properties.

**Keywords**: ***microwave, essential oil, hawthorn (crataegus monogyna), resonance cavity, variables power, bioactive compounds affections***

## INTRODUCTION

Medicinal plants are of great value in the pharmaceutical industry and are increasingly used in the prevention and cure of many diseases affecting humans. In Romania there is a real tradition of producing herbal medicines [1]. Due to the wide variety of climatic conditions in Romania there are over 300 species of medicinal plants. Hawthorn is a member of the Rosaceae family and the genus Crataegus [2].

The species Crataegus L. is one of the most important of the Rosaceae family and is currently considered to comprise between 150 and 1200 species [3]. A medicinal plant showing sedative, hypotensive, vasodilatory and cardio-tonic actions.

The hawthorn plant are traditionally used to treat diseases such as hypertension and atherosclerosis.

Essential oils are a by-product of plants obtained by several methods, such as traditional steam distillation, hydro-distillation, microwave-assisted extraction.

Currently hydro-distillation is the main approach for essential oil extractions. This approach has disadvantages such as: time consuming, extensive power consumption and low efficiency.

Microwave oil extraction is a technique in which microwaves are used to accelerate the extraction of compounds from hawthorn leaves. The use of microwaves leads to a higher extraction speed with lower processing costs.

Subjecting the biological material to inappropriate experiments can lead to the loss of bioactivity of the resulting product [4]. The essential oils resulting from the experiments are concentrated solutions of complex mixtures and contain a lot of bioactive compounds.

Essential oils are lipophilic compounds, they are compounds that do not combine with water and therefore have the property of being well absorbed through the dermis, lungs and intestine [5]. Due to these properties they are used in many products with medical and cosmetic applications.

An oven with an adjustable power magnet was used in the experiments, and it operated in pulses throughout the experiments. During the experiments, the systems were monitored with the help of measuring devices for the detection of electromagnetic radiation leaks [6].

## RESULTS AND DISCUSSIONS

The experimental material used was hawthorn leaves. The leaves were harvested in May, after which it was chopped and allowed to dehydrate for 60 days in a hot stream of warm air [7]. The solvent used in the experiments was $70^0$ ethyl alcohol.

The purpose of the experiments presented in this paper was to extract the volatile oil from

hawthorn leaves using different strengths of the high-frequency electromagnetic field and to separate the oil from the solvent [8].

The system used for heating the solvent consists of a 1kW electrical source, which is variable, the round-bottom flask [9], [10], being placed in a nest made of a non-absorbent textile material [11].

Fig.1 shows a system designed for the extraction of volatile oils from hawthorn plants, in which hawthorn leaves were treated using different intensities of the high-frequency electromagnetic field.

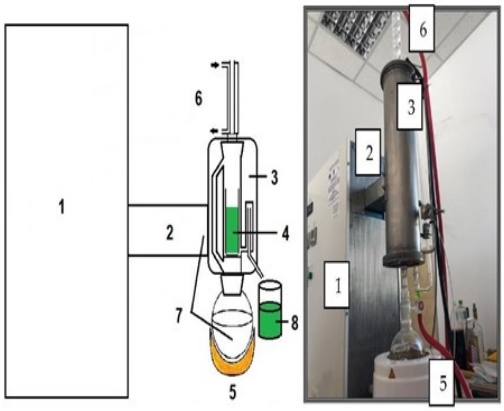


**Fig. 1. System designed for the extraction of volatile oils**
**1—microwave generator; 2—microwave guide; 3—applicator; 4—hawthorn sample; 5—extraction solvent heating nest; 6—steam condensers; 7—extraction solvent; 8—extract. [12]**

Next, we will present the experimental results for the initial value (50W) of the high-frequency electromagnetic field and for the microwave power value (150W) for essential oil extraction.

TABLE I. INITIAL EXPERIMENT

| | Initially |
|---|---|
| Cartridges weight for samples [gr] | 4.90 |
| Test sample weight [gr.] | 10.00 |
| Solvent used - ethyl alcohol [ml.] | 500.00 |
| Cartridges + sample value [gr] | 14.90 |

In table 1 we presented the initial measurements, and the experimental results for 50 W of magnetron power are presented in table 2.

The amount of samples subjected to experiments was measured with a digital balance and the same amount of experimental material and the same amount of solvent (ethyl alcohol) were used.

The experimental material was left to macerate for a period of one hour. The ratio being 10g of hawthorn leaves with 90ml of $70^0$ alcohol.

TABLE II. EXTRACTION OF THE VOLATILES OILS FROMHAWTHORN USING ETHYL ALCOHOL $70^0$ AS SOLVENT, INITIAL POWER OF MICROWAVES 50W

| Syphoning no. | Time [min] | Micro wave power [W] | Initial temp. [°C] | Final temp. [°C] | Obtained oil [ml] |
|---|---|---|---|---|---|
| Syphoning no.1 | 225 | 50 | 15.9 | 79.3 | 179 |
| Syphoning no. 2 | 215 | | 62.3 | 79.1 | 170 |
| Syphoning no. 3 | 190 | | 62.2 | 79.0 | 163 |
| Syphoning no. 4 | 172 | | 62.3 | 79.2 | 151 |
| Syphoning no. 5 | 168 | | 62.2 | 79.1 | 133 |

The initial and final temperatures of both the experimental material and the solvent were monitored with optical fiber; this method was adopted to monitor the temperature during high frequency electromagnetic field emission.

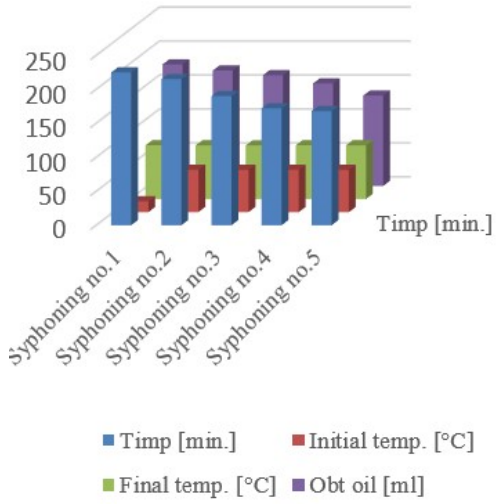


**Fig. 2. Extraction of volatile oils from hawthorn using ethyl alcohol $70^0$ as solvent, initial power of microwaves 50W**

Remarks:

- The amount of oil extracted is acceptable at the expense of the periods to which it was subjected experimentally
- The quality of the oil is not affected by the final temperature.

A clear difference between the amounts of oil in the resulting samples was observed with the OPTIKA microscope in the laboratory.

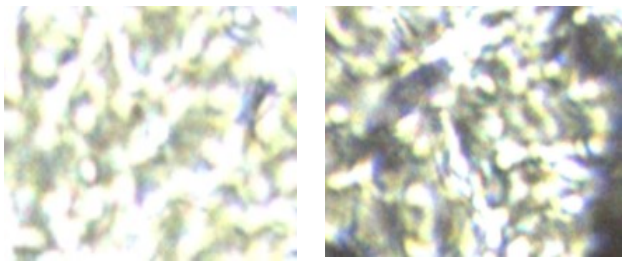

**Fig. 3. Microscopic view of the solvable obtained in the 1,5 syphonings**

TABLE III. EXTRACTION OF VOLATILE OILS FROM HAWTHORN USING ETHYL ALCOHOL $70^0$ AS SOLVENT, INITIAL POWEROF MICROWAVES 150W

| Syphoning no. | Time [min.] | Micro wave power [W] | Initial temperature [°C] | Final temperature [°C] | Obt. oil [ml |
|---|---|---|---|---|---|
| Syphoning No. 1 | 175 | 150 | 14.7 | 79.3 | 224 |
| Syphoning No. 2 | 167 | | 62.5 | 78.7 | 212 |
| Syphoning No. 3 | 154 | | 62.3 | 78.4 | 197 |
| Syphoning No. 4 | 145 | | 62.2 | 77.9 | 171 |
| Syphoning No. 5 | 137 | | 62.1 | 77.5 | 158 |

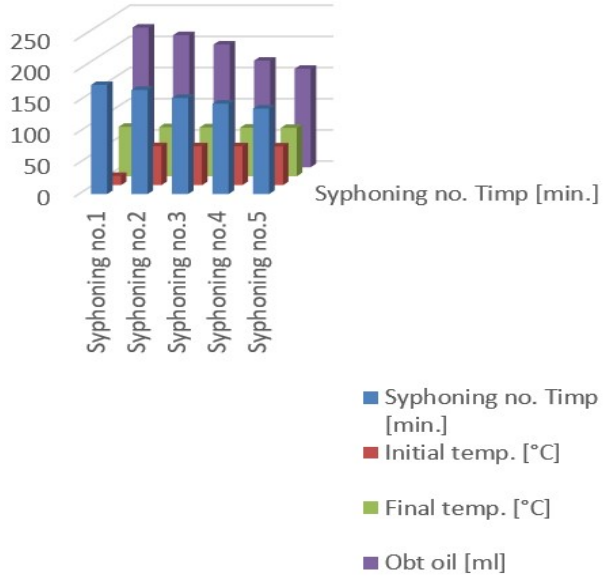


**Fig. 4. Extraction of volatile oils from hawthorn using ethyl alcohol $70^0$ as solvent, initial power of microwaves 150W**

Remarks:

- The final temperature is kept within normal limits and does not affect the quality of the extract;

- Times for experiments must be shorter;

- At this power the amount of oil extracted was not affected by the high frequency electromagnetic radiation;

- The amount of oil extracted was maximum.

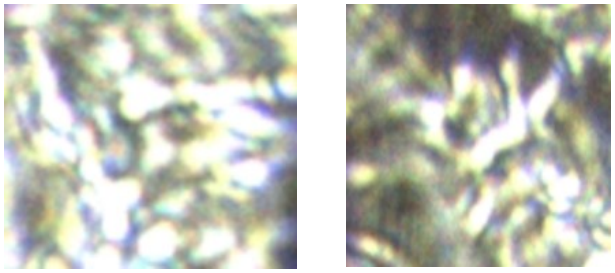

**Fig. 5. Microscopic view of the solvable obtained in the 1, 5 syphonings**

The amount of oil extracted at 150W is much higher in all five siphoning's and of a much more intense color, and in the spectral analysis it is observed that the oil extracted at the higher value of microwaves differs from the one extracted at lower values, being also of high quality clearly superior.

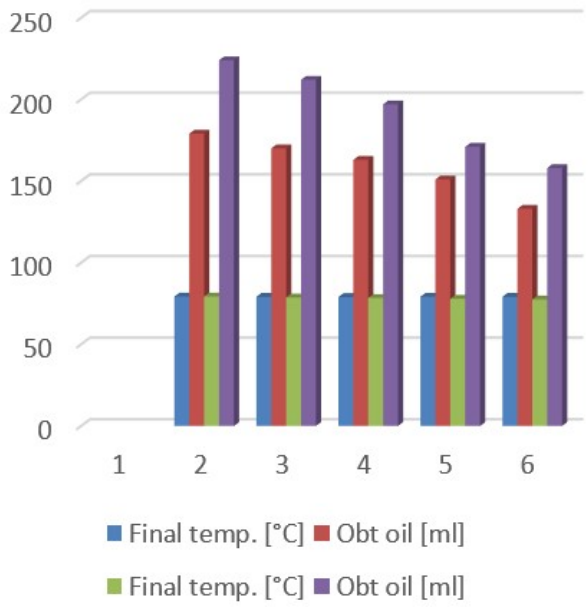


**Fig. 11. Report power – final temperature**

## III. CONCLUSIONS

Based on the results of the conducted studies, the following conclusions were drawn:

- After analyzing the results obtained, we can say that as long as the extraction times are long enough, it is recommended to use high power values until the temperature in the experimental material reaches the maximum allowed value.

- It is observed from the analysis of the experimental results that the amount of oil obtained is much higher using the high

frequency electromagnetic field and ethyl alcohol.

- Experimental time is substantially reduced by using microwave energy, but using this method requires careful and real-time monitoring of electrical and thermal parameters.

- The microwave extraction method is versatile, being able to be applied both at the laboratory level and at the industrial scale, adapting the equipment and the correlation between the microwave power density and the amount of material.

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