



Review on Steam distillation: A Promising Technology for Extraction of Essential Oil

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Abstract: Steam Distillation is a process used to recover the volatile compounds with high boiling point from solid or liquid, using saturated or superheated steam. Steam distillation is the most common process for extraction of essential oils from plants. The advantage of this method is that the volatile components can be distilled at temperatures lower than the boiling points of their individual constituents and are easily separated from the condensed water. This paper focus on the study of constituents of essential oil, effect of pH, potential of oil towards repellency and insecticidal activity, effect of different parameters such as water to water ratio, extraction time, effect of antibiotic material. Supportive research has been mentioned in this paper which use steam distillation for extraction of essential oil from various plant materials.

Keywords: Steam Distillation, Extraction, Essential oil

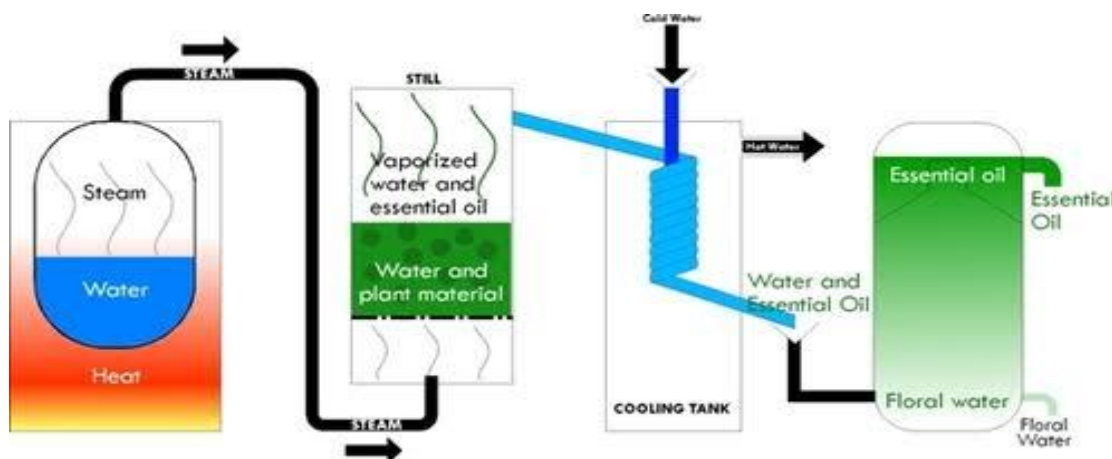
1. Introduction

A large number of herb materials contain Essential Oils with extensive bioactivities. Research has confirmed centuries of practical use of essential oils, and we now know that the 'fragrant pharmacy' contains compounds with an extremely broad range of biochemical effects. There are a variety of methods for obtaining volatile oils from plants. Steam distillation method was found to be one of the promising techniques for the extraction of essential oil from plants as reputable distiller will preserve the original qualities of the plant [7]. Steam distillation is the widely used extraction processes due to following reasons

- (1) Higher oil yield.
- (2) Components of the volatile oil are less susceptible to hydrolysis and polymerization (the control of wetness on the bottom of the still affects hydrolysis, whereas the thermal conductivity of the still walls affect polymerization).
- (3) If refluxing is controlled, then the loss of polar compounds is minimized.
- (4) Oil quality produced by steam distillation is more reproducible.
- (5) It is energy efficient.
- (6) Amount of steam can be controlled.
- (7) Most widely accepted process for large scale oil production.

2. Process

When steam distillation is used in the manufacture and extraction of essential oil, plant material is placed in a still and steam is forced over the material. The hot steam helps to release the aromatic molecules from the plant material since the steam forces open the pockets in which the oils are kept in plant material. The molecules of these volatile oils escape from the plant material and evaporate into steam. The temperature of the steam needs to be carefully controlled –just enough to force the plant material to let go of the essential oil, yet not too hot as to burn the plant material or the essential oil. The steam containing oil is then passed through a cooling system to condense the steam, which forms liquid from which the essential oil and water is separated. The steam is produced at greater pressure than atmosphere and therefore boils at above 100°C which facilitates the removal of essential oil from plant material at a faster rate and in doing so prevents the damage to the oil.



3. Related work

Essential Oil Composition of *Ocimum basilicum* L. and *Ocimum minimum* done by Musa Ozcan and Jean-Clause Chalchat [1]. Four different formulations from the combination of the essential oil from six plant samples of different families have been evaluated by H. O. Lawal, G. O. Adewuyi, A. B. Fawehinmi, A. O. Adeogun, S. O. Etatuvie. The mosquito bite deterrent effect of 8% and 10% essential oil formulations are very promising for topical use [2]. Successful extraction of orange oil and pectin, providing potential benefits for industrial extraction of pectin from an economic and environmental point of view done by Shekhar Pandharipande, Harshal Makode [3]. Hydrodistillation and Soxhlet extraction with different solvents which are hexane, dichloromethane and petroleum ether were successfully carried out to obtain the cinnamon essential oil yield from bark of *C. cassia* by NurNasulhah Kasim, Syarifah Nursyimi Azlina Syed Ismail, N. D. Masdar, Fatimah Ab Hamid, W. I. Nawawi [4]. The potential of microwave assisted hydrodistillation (MAHD) method in the extraction of essential oil from *Cinnamomum Cassia* (cinnamon) was investigated by Nitthiyah Jeyaratnam, Abdurahman H. Nour and John O. Akindoyo [5]. The essential oil of *Murraya Koenigii* leaves was extracted successfully and repellency test of the essential oil towards *Blattaria* was successfully done in order to provide the strong evidence to prove that the essential oil has a potential to be a natural-based insect repellent by Jamil R., Nor Natashah Nasir, Hafizah Ramli, Isha R. and Nur Aminatulmimi Ismail [6]. Steam distillation method was found to be one of the promising techniques for the extraction of Essential Oil from plants by K. Satishkumar [7].

4. Effects of parameters

Effect of pH- the study of the effect of pH of the medium on the yield of pectin extracted is as shown in graph [3]

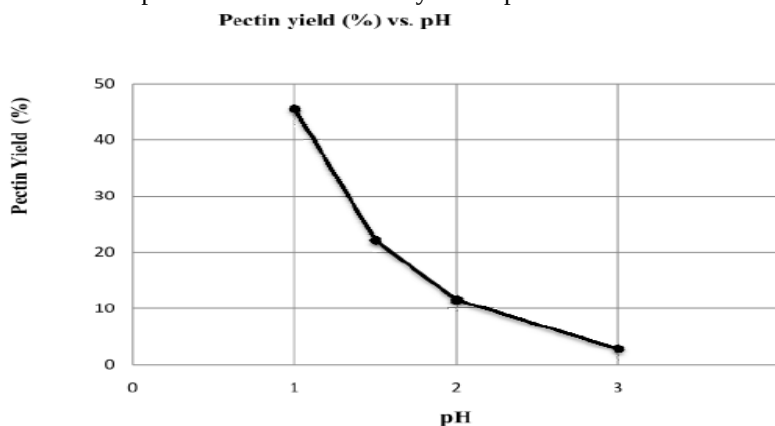


Fig1: Pectin yield at different pH of extracting medium [3].

Potential of oil towards repellency and insecticidal activity- Four different formulations from the combination of the essential oil from six plant samples of different families have been evaluated in this study. The mosquito bite deterrent effect of 8% and 10% essential oil formulations are very promising. However, the 10% formulation has more repellency effect than 8% formulation and also competes favorably when compared with the commercially available standard (*Odorous mosquito*

repellent cream) [2]. In both repellency and insecticidal activity of ants, cinnamon essential oil shown a positive result which can repel and kill ants at certain concentrations. The highest concentration of cinnamon essential oil gave the highest mortality and repellency percentage and will be the effective and environmentally benign agents in ants control [4].

Effect of water to raw material ratio on yield-The effect of different water to cinnamon powder ratio on yield of cinnamon oil at specific power level of 250 W is shown in Figure.

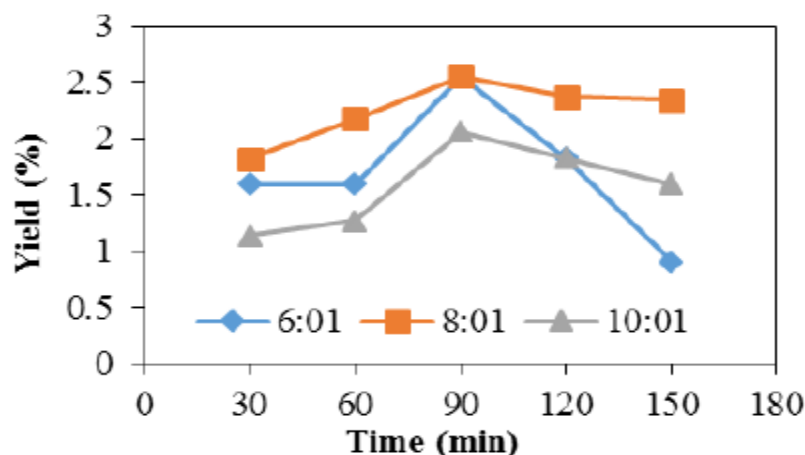


Fig2: Variation of essential oil yield of cinnamomum cassia (cinnamon) with time in different water to rawmaterial ratio at 250 W [5].

As illustrated in figure 2, the highest yield was obtained at ratio of 8:1 followed by 6:1 and 10:1. The highest yield at 6:1, 8:1 and 10:1 for cinnamon oil were 2.55%, 2.55% and 2.06% respectively [5].

Effect of Extraction Time on Yield- fig3 illustrates the yield of essential oil extracted from Cinnamomum Cassia (cinnamon) at different extraction time at a constant microwave power of 250 W

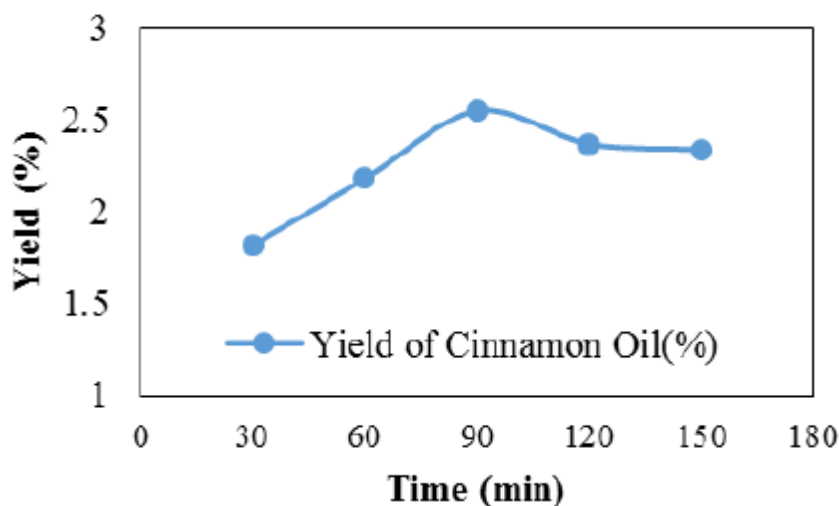


Fig 3: Extraction yield of essential oil from cinnamomum cassia (cinnamon) at different extraction time by 250 W in water to raw material ratio of 8:1

From the graph, it can be seen that the amount of yield increases as the extraction time was increased from 30 min to 90 min. The yield obtained at 30, 60 and 90 min are 1.82%, 2.18% and 2.55% respectively. MAHD was able to produce the highest yield of 2.55% w/w when the extraction time was 90 min. However, as the extraction time was increased beyond 90 min, the yield can be seen to be notably reduced [5].

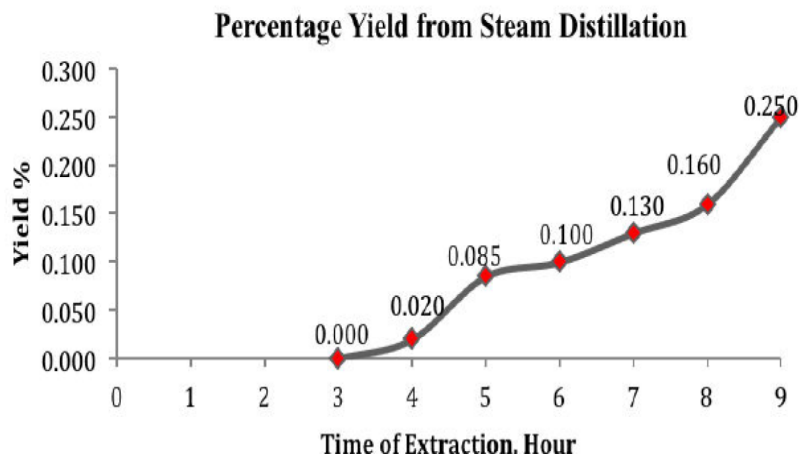


Fig 4: Percentage yield of essential oil using steam distillation for *Murrayakoenigii* essential oil [6]

As shown in Figure-4, the trend of the graph was increasing over the time starting at 3 hours extraction and the highest yield was obtained at 9 hours extraction. 9 hours of extraction was found to be the time for the highest yield of essential oil by steam distillation method [6].

Comparison of steam distillation and hydro-distillation- Figure-5 shows a complete comparison of the yield obtained by both methods. The total yield obtained from steam distillation is 0.745% while for hydrodistillation is 0.170% from 3 to 9 hours extraction. This result shows that since hydro-distillation is the simplest method compared to steam-distillation, thus the extraction of essential oils is less efficient. In steam distillation method, there were no contacts between biomass (*MurrayaKoenigii* leaves) with the boiled water so there would be no loss of essential oil when it flows to the condenser. 99% of essential oil may flow with the steam to the condenser [6].

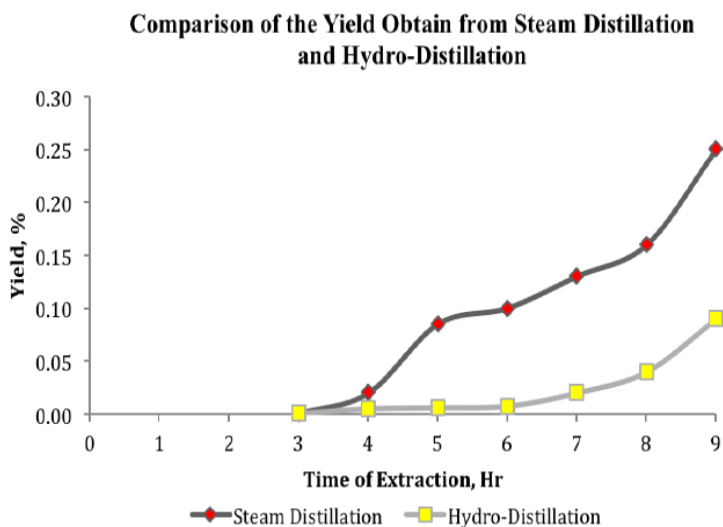


Fig 5: The comparison of the yield from steam distillation and hydro-distillation [6].

Effect of temperature- Volume of Essential Oil obtained from a particular plant material was different for different temperatures.

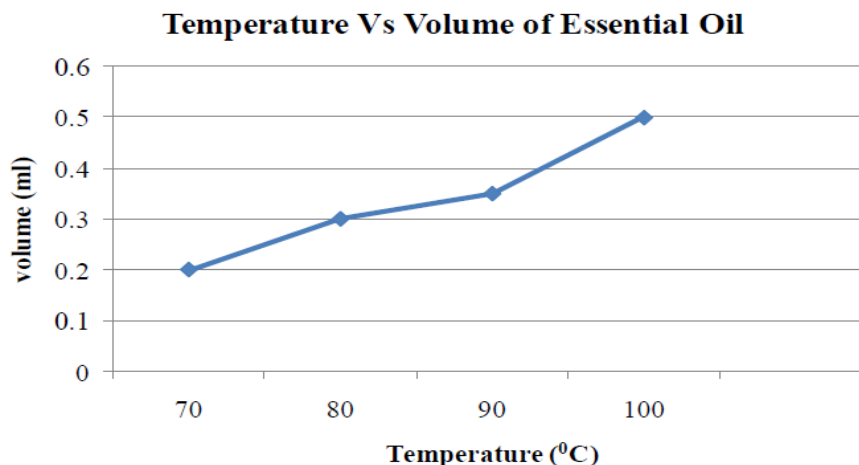


Fig 6: Graph showing variation of volume of essential oil with time of heating, obtained from Orange peels [7].
 From the graph we can observe that volume of Essential Oil obtained from orange peels is almost increasing linearly with Temperature, if we ignore the slight decline in volume at 90°C. The decline may be due to leakage of vapor during Steam Distillation or because of improper decantation [7].

5. Conclusion

The review paper presents general idea concerning the concept of catalyst extraction of essential oil by steam distillation for better results. The effect of extraction time on yield, pH value, water to raw water ratio, effect of temperature was studied by different researchers using a variety of plant material. Also a comparison between steam distillation and hydro-distillation was studied. Steam distillation is a special type of distillation or a separation process for temperature sensitive materials like oils, resins, hydrocarbons, etc. which are insoluble in water and may decompose at their boiling point (which can be prevented using Steam Distillation method). Extraction of Essential Oils using Steam Distillation can be used on industrial scale to make various finished products which includes body oils, cosmetic lotions, baths, hair rinses, soaps, perfumes and room sprays.

6. References

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