

Extraction of Essential Oil from Turmeric Rhizome

Ajay.P. Pardey¹, Dr.V.S.Sapkal², Mayur. A. Dhote³, Deeksha.K.Dhundele⁴

Asst.Professor & Head, Dept. of Chemical, J.D.I.E.T, Yavatmal, Maharashtra, India¹

Professor & Head, UDCT, SGB Amravati Uni. Amravati, (Former Vice-Chancellor, RTM Nagpur Uni. Nagpur),
Maharashtra, India.²

III rd Yr.Student, Dept. of Chemical Engg., J.D.I.E.T, Yavatmal, Maharashtra, India³

III rd Yr.Student, Dept. of Chemical Engg., J.D.I.E.T, Yavatmal, Maharashtra, India⁴

ABSTRACT: The distillation process was used to obtain the essential oil from turmeric rhizomes. The distillation process is the combination of continuous water circulation, steam distillation and a packed bed for turmeric rhizomes. Chemical constituents of various tissues of turmeric (*Curcuma longa* L.) have been extensively investigated. Fresh rhizomes were collected from local market of Patiala and Chandigarh. The present process is lead to reduced wastage of water soluble components and the continuous operation provides the short exposure of the heat sensitive components. The obtained turmeric oil was analysed using Gas Chromatography-Mass Spectroscopy (GC-MS). It has been observed that Ar -turmerone, Curlone, Turmerone, Zingiberene and Ar-curcumene are present as major component of the turmeric oil. Approximately ~35% components of turmeric oil were remained unidentified. The components of turmeric oil are having antifungal, antibacterial and antioxidant properties and uses in various medical treatments. The essential oils from leaves and flowers are usually dominated by monoterpenes while those from roots and rhizomes primarily contained sesquiterpenes. The contents of curcuminoids in turmeric rhizomes vary often with varieties, locations, sources, and cultivation conditions, while there are significant variations in composition of essential oils of turmeric rhizomes with varieties and geographical locations. Further, both curcuminoids and essential oils vary in contents with different extraction methods and are unstable with extraction and storage processes.

KEYWORDS: Turmeric oil; Essential oil; *Curcuma Longa* L.; Curcumin; distillation; rhizome;

I. INTRODUCTION

India is considered as the “Land of species” and approximately 65 species/medicinal plants/ herbs are being grown in the country at present. It is cultivated extensively in India, Sri-Lanka, China, Pakistan, Haldi, Jamaica, Peru, Bangladesh, El Salvador, Thailand, Taiwan and Indo-China. Turmeric is considered and used as spice/herbs/medicinal plant. India is the largest producer of turmeric in the world and contributes almost 80% of total world production. In India, Andhra Pradesh is the largest producer of turmeric and having more than 60% share of total production in the country. According to one of the international report, other than India, China contributes about 8% of world’s turmeric production, Myanmar with 4%, Nigeria and Bangladesh with 3% share of the total turmeric production of the world. The Indian turmeric is considered as one of the best turmeric in the world because of its high curcumin. Its botanical name is *Curcuma longa* L. and it is also known as Haridra in Sanskrit and Haldi in Hindi. It has great religious importance in the Indian subcontinent science ancient era. In Hinduism and Buddhism, turmeric is linked to fertility, luck and sun. Turmeric has several health beneficial properties as exceptional medicine used for chronic anterior uveitis, conjunctivitis, skin cancer, chicken pox, small pox, urinary tract infections and liver ailments etc.

Turmeric has anti-inflammatory choleric, antimicrobial, antioxidant and antifungal properties which makes compatible for a variety of biotechnical applications. Besides these, the turmeric are commonly used as natural dye, spices and curry powder in the form of powder, oleoresin and essential oil. Steam distillation, super critical fluid extraction, solvent extraction, hydro distillation are common methods for obtaining essential oil from turmeric rhizomes. The essential oil of turmeric is a mixture of ~75 compounds, some of them are identified and some not. The chemical composition of turmeric oil has been carried out various researchers. According to the available literature, the curcumin is the major compound present in turmeric oil. The essential oil can also be extracted from the leaves of turmeric. Praia et al. was extracted the turmeric oil from leaves of the *Curcuma Longa* L. and they show that

sequiphellandrene (22.8%) and terpinolene (9.5%) are the major components present in the leaf oil of the turmeric. They also proposed that the turmeric oil is capable of retarding oxidation reaction and is free radical mediated damage.

The total curcuminoids was obtained as $7.57 \pm 0.04\%$ w/w. For antibacterial activity they were evaluated against medically important bacteria by Agar diffusion method and it showed better results as compared to volatile extracted from turmeric. In another study, solvent extraction method is used by Jain et al. for isolating herbal medicament from rhizomes of curcuma longa. GC-MS and HPLC analysis were done for identification and standardization of herbal medicaments. The approximate 50-90% curcuminoids were found in herbal medicament.

II. RELATED WORK

II.A) EXPERIMENTAL WORK:

FEED INPUT (RAW MATERIAL):-

- 200gms of wet rhizome per batch
- 900 ml water per batch

UNIT OPERATION CARRIED OUT:

- HEATING
- DISTILLATION
- EVAPORATION
- SEPERATOR
- FILTRATION
- WEIGHING & PACKING

GENERAL REACTION:

FEED INPUT=PRODUCT OUTPUT

TURMERIC RHIZOME+WATER \Rightarrow RHIZOME OIL (DESIRED PRODUCT) + WATER

APPARATUS REQUIRED:

2000ml Round bottom flask, heating mantle assembly, 1000ml measuring cylinder, Glass thermometer, Separating funnel, Paper Filter cloths, Beaker.

II.B) EXPERIMENTAL METHODOLOGY:

In this project our methodology is to make organic essential oil by using basic raw materials found from various different species of turmeric plant with their rhizome roots. In addition we use water with rhizome powder in wet form with the help of references, we studied the main constituents present in the above plant rhizome is benefited for making useful essential oil. The stepwise procedure we conducted from basic raw materials to final desired product are as follows: Firstly we collect all the basic fresh rhizome from turmeric plant plants. Then wash with normal water, the purpose of washing rhizome is to remove the dust and pollution externally stick on the surface of rhizome. After complete washing of each rhizome, it is cut or chopped into fine size having size up to 3 to 4 mm or in powder form by grinding, the purpose of cutting rhizome into small size is to increase the surface area for better extraction for distillation process. Then we weigh it up to 200 grams of each batch, after weighing this measured quantity of material we insert this chopped rhizome into five litres of round bottom flask and adding 900ml of water in the same container.



Fig.1: Fresh Turmeric Mother and Their Fingers

Keeping this material in round bottom flask for distillation process and observe the changes takes place in the process of distillation. The important implementation of distillation process is that extracting the essential oil with

required constituent present in the rhizome. For distillation process, we need continuous cool water supply to condenser for condensation of the steam or vapour of rhizome and water mixture.



Fig.2: Distillation setup (before installation)

After condensation process, all condensate is comes to the beaker then it sends to separating funnel. After distillation process the distillate with water is kept in separator and then using this separating funnel we were separate the oil of rhizome from water due to density difference. Finally the solution is collected in the separator where 80-85 % of pure essential rhizome oil is obtained. The pure oil of rhizome is send for dehydration process to remove the water content present in the oil base on boiling point of oil and water. As the boiling point of water is less than essential oil, so that the water get dehydrates and we get the pure essential oil.

II.C) EXPERIMENTAL PROCEDURE:

Take a known amount (200gms) of turmeric plant rhizome, cut or chopped into smaller size (3-4 mm) or in powder form. Put the known amount (200gms) of leaves in measured amount of water (900ml) per batch. Start the distillation process by adding water in rhizome and mix it in round bottom flask. Cover the round bottom flask and the set up with an air tight packing. Set the distillation timing minimum of 210 min using heater. At specific time and temperature the evaporation takes place. After the evaporation process, separate the oil from the solution and goes to the condenser. After condensation the oil and water both get come to the container and then settle to the upper side of water. Due to less density, the essential oil get float on the water surface. Then it sends to the separating funnel, here water get removed from the funnel and oil get keep in bottle. Then store the product in an air tight container or store it in a glass or plastic bottle directly for use.

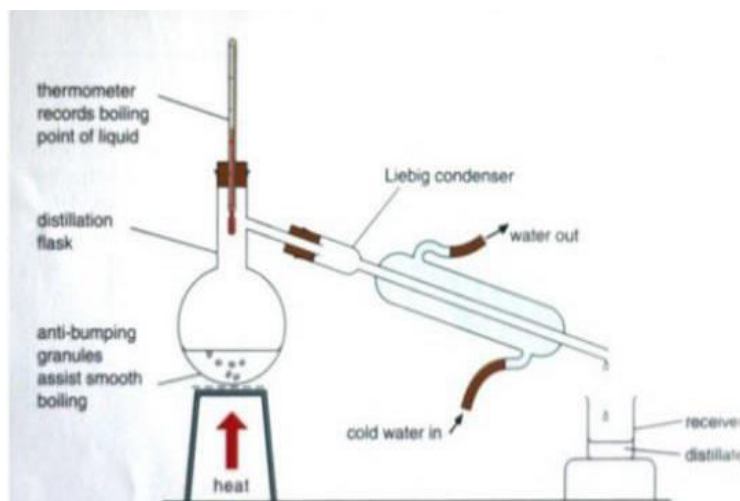


Fig.3: Simple Distillation

II.D) PROPERTIES OF ESSENTIAL OIL OF RHIZOME:

Table no.1: Properties Of Essential Oil Rhizome:

Sr.no	Name of properties	Value
1.	Color	Golden yellow
2.	Odour	Pungent, bitter flavor
3.	Boiling point	Approx. 121.67 °C
4.	Density	960mg/mL
5.	Specific heat	10.45-16.26 kJ/kgK



Fig. 4: Team Members Carrying Research Work With Setup

III. METHODOLOGY

III.1) CHEMICAL CONSTITUENT OF TURMERIC RHIZOME OIL:

The essential oil from turmeric is obtained from proposed modified distillation process. All the experiments were performed at room temperature and atmospheric pressure. The room temperature was observed in between 20-30 °C during the experiments.

III.2) EXPERIMENTAL OBSERVATIONS:

1. Initial quantity of feed (rhizome) taken = 200gm
2. Initial amount of water taken = 900 ml
3. Overall amount of mixed feed solution (before heating) = 200gm of rhizome+900 ml water
4. Heating time taken = Appx. 210 min
5. Overall amount of solution (after heating) = 0.726 lit

OBSEVATION TABLE

Table no.2: Experimental Observation Table:

<i>Sr no.</i>	<i>Time (min)</i>	<i>Temp (°C)</i>	<i>Level of volume (ml)</i>	<i>Final volume after heating (ml)</i>
1.	00	32 °C	1100	2/3 of total volume is evaporated. $1100 \times 2/3 = 726 \text{ ml}$
2.	30	50 °C	1090	
3.	60	60 °C	1070	
4.	90	70 °C	1050	
5.	120	80 °C	1000	
6.	150	90 °C	960	
7.	180	100°C	900	
8.	Above180	110°C	700-800	

IV. EXPERIMENTAL RESULTS



Fig.5: Final (rhizome oil) product bottle and Oil layer formation

Table No. 3: Turmeric Oil Composition

Sr. No.	Identified compound	Composition
1	ar-turmerone	36.66%
2	Curlone	10.17%
3	Turmerone	4.4%
4	Zingiberene	4.01%
5	ar-curcumene	4.01%
6	Dehydro curcumene	2.0%
7	Unidentified	34.71%

V. CONCLUSION

In present investigation the emphasis was laid on the feasibility of the distillation process to obtain essential oil from plant origins. A simple design has been used for the entire experimental work. This design can be used efficiently for obtaining essential oil from plant materials/spices. The oil yield obtained from rhizomes ranges between 2.09-2.50% (v/w). The GCMS analysis of turmeric oil was used to obtain the chemical composition of turmeric oil. Overall, the present method (distillation method) is feasible technique for the essential oil extraction from plant origins with minimum losses. It can be considered as eco-friendly technique. In addition, the data obtained from this study provide a scientific basis for the use of this rhizome oil in the treatment of cancer-related diseases. Turmeric (*Curcuma longa* L.) is one of the most extensively phytochemicals investigated plant species. At least 235 compounds have been isolated or detected from leaves, flowers, roots, and rhizomes of *C. longa*, including 22 diarylheptanoids and diarylheptanoids, eight phenyl propene and other phenolic compounds, 68 monoterpenes, 109 sesquiterpenes, five diterpenes, three triterpenoids, four sterols, two alkaloids, and 14 other compounds. Having in mind the obtained results, use of turmeric is not just reasonable but it should be even favored in the nutrition, as well as in food and pharmaceutical industries processing.

ACKNOWLEDGEMENT

We are very much thankful to Head of Institute Dr. R. S. Tatwawadi and Dr.V.S.Sapkal, Professor & Head, UDCT, SGB Amravati Uni. Amravati, who guided and provided us all the facilities to carry out this research work and all the staff of Chemical Engineering Department for their technical and academic support.

REFERENCES

- [1] Gujrati D.B., I.N.T., Continuous Water Circulation Distillation (CWCD). *J. of chemical education*, 1993. 70(1): p. 86.
- [2] Guenther, E., *The essential oils*, volume I. 1948, Van Nostrand Company Inc., New York.
- [3] Viasan, A., et al., Chemical analysis of some cultivars of *Curcuma longa* linn. *Journal of food science and technology*, 1989. 26(5): p. 293-295.
- [4] Reverchon, E., Supercritical fluid extraction and fractionation of essential oils and related products. *The Journal of Supercritical Fluids*, 1997. 10(1): p. 1-37.
- [5] Garg, S., et al., Variation in the rhizome essential oil and curcumin contents and oil quality in the land races of turmeric *Curcuma longa* of North Indian plains. *Flavour and fragrance journal*, 1999. 14(5): p. 315-318.
- [6] Pfeiffer, E., et al., Studies on the stability of turmeric constituents. *Journal of Food Engineering*, 2003. 56(2): p. 257-259.
- [7] He, X.-G., et al., Liquid chromatography–electrospray mass spectrometric analysis of curcuminoids and sesquiterpenoids in turmeric (*Curcuma longa*). *Journal of Chromatography A*, 1998. 818(1): p. 127-132.
- [8] Li, S., et al., Chemical composition and product quality control of turmeric (*Curcuma longa* L.). 2011.
- [9] Tomaino, A., et al., Influence of heating on antioxidant activity and the chemical composition of some spice essential oils. *Food Chemistry*, 2005. 89(4): p. 549-554.
- [10] Singh, G., et al., *Curcuma longa*-chemical, antifungal and antibacterial investigation of rhizome oil. *Indian perfumer*, 2003. 47(2): p. 173-178.
- [11] Chandra A., S. Prajapati, S.K. Garg, A.K. Ratore, Extraction of Turmeric Oil by Continuous Water Circulation Distillation Method. *International Journal of Scientific Engineering and Applied Science (IJSEAS)*, 2016. 2(2): p. 2395-3470.
- [12] Adams, R. P. (2007). *Identification of essential oil components by gas chromatography/ mass spectrometry* (4th Ed.). Illinois: Allured Publishing Corporation.
- [13] Velayudhan, K.C., Muralidharan, V.K., Amalraj, V.A., Gautam, P.L., Mandal, S., Kumar, D. (1999). *Curcuma Genetic Resources*. Scientific Monograph No. 4. National Bureau of Plant Genetic Resources. New Delhi.
- [14] Kumar, S., Singh, J., Shah, N.C., Ranjan, V. (1998). *Indian Medicinal Plants Facing Genetic Erosion*. CIMAP: Lucknow. 219.
- [15] Khare, C.P. (2007). *Indian medicinal plants: an illustrated dictionary*. Springer (India) Pvt. Ltd, New Delhi.
- [16] Craker, L.E., Simon, J.E. (1996). *Herb, spices and medicinal plants: recent advances in botany, horticulture and pharmacology*. Food Products Press, New York.
- [17] Sasikumar, B. (2005). Genetic resources of *Curcuma*: diversity, characterization and utilization. *Plant Genetic Resources: Characterization and Utilization*. 3: 230-251.



- [18] AGGARWAL, B.B., SURH, Y.J. and SHISSHODIA, S. 2007. The Molecular Targets and Therapeutic Uses of Curcumin in Health and Disease, p. 360, Springer Science & Business Media, US.
- [19] GOEL, A., KUNNUMAKKARA, A.B. and AGGARWAL, B.B. 2008. Curcumin as “Curecumin”: From kitchen to clinic. *Biochem. Pharm.* 75, 787–809.
- [20] P. Tongnuanchan, S. Benjakul, Essential oils: extraction, bioactivities, and their uses for food preservation, *Journal of Food Science*, 79(7) (2014) R1231 - R1249.
- [21] J. Lal, Turmeric, Curcumin and Our Life: A Review, *Bulletin of Environment, Pharmacology and Life Sciences*, 1 (2012) 11 - 17.