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Study on Estimation and Seasonal Variation of Essential Oil in Tea Tree by Hydro Distillation Method

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ABSTRACT

Background: Tea tree (*Melaleuca alternifolia*) oil is an essential oil that is steam distilled from the leaves of the tea tree, native to Australia. The oil has fresh and pleasant odour and some medicinal properties of odour eliminating as well as antibacterial and antiseptic action. Tea tree oil has found increasing use in certain consumer products including cosmetics. Tea tree oil components will vary depending on the growing environment including air and sunlight conditions.

Methods: The present study on estimation and seasonal variation on essential oils from different plant parts of tea tree was carried by hydro distillation method.

Result: The study reveals that, the needle leaves and flowers have the higher oil content of 2.30% and 2.25% respectively. The effect of months on different plant parts showed that the oil recovery from needle leaves and flowers were higher during the month of July and August.

Key words: Clevenger's apparatus, Essential oil, Leaves, Seasonal effect, Tea tree.

INTRODUCTION

Melaleuca alternifornia Cheel (Family: Myrtaceae), commonly known as Australian tea tree and Melaleuca tree, grow fast and can be harvested as early as six months. It is also known as narrow leaved paper bark tree/snow in summer due to its white spring and summer flowers. Leaf is the economic part yielding essential oil. Historically, the leaves were used as a substitute for tea, which is how tea tree oil got its name. The major component of tea tree oil was found to be terpenes and sesquiterpenes. They have been used medicinally for centuries by Australian aboriginal people. Tea tree oil (TTO) that comes from their leaves, contains over 100 components (mostly monoterpenes, sesquiterpenes and terpene alcohols). The leaves of the tea tree give an essential oil (1-3%), which is an economically commercial product with unique antimicrobial and organoleptic properties (Penfold and Marrison, 1950; Southwell and Stiff, 1989). Anti-microbiaal properties of oil are primarily attributed to terpinen-4-ol which is well tolerated by skin. Oil also contains significant levels of 1,8 cineole (3-17%), terpinolene and γ terpinene (25%) and limonene (5%). Main constituent terpinen-4-ol varies from 25-45%. Due to the high commercial oil value, this study aims at estimating the oil content in different plant parts of tea tree and also the effects of months on the oil recovery.

MATERIALS AND METHODS

Estimation of oil content (%) in different plant parts

The plant parts of tea tree were sourced from Warwick Estate, Kotagiri. Five different plant parts like twigs, needle leaves, fine stem, flowers, bark and fruits were collected from five trees of 7 year old of *Melaleuca alternifolia*. Essential oil was extracted from pooled samples of each of the plant parts by Hydro distillation methods. This experiment is done by adopting CRD consisting of five replications.

Experimental set-up

The experiment was conducted in a Clevenger's apparatus. Apparatus consists of one round bottom flask of 500 ml which holds raw material. And further it is connected with a glass tube condenser through the connecter. The separating funnel is used for the separation of essential oil and water.

Sample preparation

Fresh tea tree branches were collected from the field and fresh and healthy twigs was selected and washed with tap water to remove the dust and dirt over its surface. After draining water, twigs, needle leaves, fine stem, flowers, bark

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and fruits were separated for estimation. The samples were chopped to small pieces with a sharp edged knife.

Plant material was placed in a 500 ml round bottomed flask with distilled, deionised water (250 ml for 20 g fresh material) and the essential oil was extracted by water distillation using a Clevenger's apparatus (ASTA, 1968).

Hydro-distillation procedure for laboratory experiment

- Firstly distilled water was taken into a round bottom flask.
- Then prepared sample was placed in round bottom flask for distillation.
- After this the round bottom attaching the connecting pipe to the condenser and a mercury thermometer was inserted in hole of the flask so as to touch the top of the leaves bed.
- Then heating mental was switched on and kept in a pre-selected position to obtained desired rate of heating.
- Observations of cumulative extracted oil volume, temperature of extraction chamber and energy meter reading were recorded at every 30 minutes time interval.
- The distillation period was 3.00 hours and oil recovery from different plant parts is calculated in percentage using the formula:

Oil content in percentage =

$$\frac{\text{Oil extracted in volume (ml)}}{\text{Weight of the fresh sample (g)}} \times 100$$

Effect of season on oil recovery (%) from different plant parts

The oil recovery from different plant parts during different months was carried out to check the monthly variation in oil recovery. Oil extraction was done in twigs, needle leaves, flowers and fruits during the month of July, August, September, October, November and December. Hydro distillation was done in the above described manner adopting factorial completely randomized block in three replications.

RESULTS AND DISCUSSION

The extraction of tea tree oil from different plant parts by hydro distillation method revealed that, the oil content was higher in needle leaves (2.30%) followed by flowers (2.25%). The oil content from these two parts was on par with each other. Other plant parts like twigs and fruits recorded 1.85% and 0.95 % respectively. No oil was observed in the bark of the tree (Table 1). This is because; the concentration of essential oil glands in plant parts is highly species-dependent (Croteau, 1986). Favorito (2009) explained that young leaves have more trichomes, the morphologic structures that produce EOs.

Werker *et al.* (1985) reported that the content of oil was always higher in flowers than leaves in four chemotypes of *Origanum vulgare.* The results are in line with the findings of Sayonara *et al.* (2011) in eucalyptus, Ali Azizi *et al.* (2009) in Oreganum. Arraiza *et al.* (2012) reported the highest yield of oil in *Salvia officinalis* was obtained in the period of full flowering and the highest concentration of alpha thujone in the period of initial flowering.

The oil recovery was high in the plant parts during the month of July and August while November month yielded the least (Table 2). The effect of months on the oil recovery

Table 1: Oil recovery from different plant parts of tea tree (%).

Plant parts	R_1	R_2	R_3	R_4	R_5	Mean
Twigs	2.00	1.50	2.00	2.00	1.75	1.85
Needle leaves	2.50	2.00	2.00	2.50	2.50	2.30
Fine stem	0.50	0.50	0.50	0.75	1.00	0.65
Flowers	2.00	2.50	2.50	2.00	2.25	2.25
Fruits	1.00	0.50	1.25	1.00	1.00	0.95
Bark	0.00	0.00	0.00	0.00	0.00	0.00
		SE (d)				0.1443
		CD (0.05)				0.2979
		CD (0.01)				0.4059

Table 2: Effect of months on the oil recovery (%) from different plant parts in tea tree.

Plant parts	July (M_1)	August (M_2)	September (M_3)	October (M_4)	November (M_5)	December (M_6)	Mean
Twigs (P_1)	1.96	1.93	1.80	1.83	1.83	1.73	1.84
Leaves (P_2)	2.41	2.25	2.08	2.25	2.08	2.00	2.18
Flower (P_3)	2.75	2.50	1.83	1.91	1.75	2.25	2.16
Fruit (P_4)	1.16	1.08	0.66	0.41	0.41	0.41	0.69
Mean	2.07	1.94	1.59	1.60	1.52	1.60	2.07
	P		M			PM	
SE(d)	0.066		0.081			0.162	
CD (0.05)	0.133		0.163			0.327	
CD (0.01)	0.178		0.218			0.436	

shows that, the oil recovered from flowers during the month of July (2.75%) and August (2.50%) was maximum followed by needle leaves. Murtagh (1992); Murtagh and Smith (1996) reported that the oil concentration is generally highest in summer and lowest in late winter/early spring. William and Home, (1988); Murtagh and Etherington (1990) also opined that oil fluctuate in response to various climatic conditions.

Verma *et al*. (2011) reported that the yield of essential oil (% v/w) in *Thymus serpyllum* L. during different seasons varied from 0.07 to 0.28% with the highest in summer season, at vegetative stage. Thyme possessed a higher oil yield and the oil was richer in oxygenated compounds when harvested in the spring (Atti-Santos *et al.,* 2004). Similar reports on seasonal variation of essential oil in *Rosmarinus officinalis* leaves in Sardinia were given by Melito *et al.* (2019). The essential oils yields vary considerably from month-to-month and is also influenced by the micro-environment (sun or shade) in which the plant is growing. These findings will be useful to efficiently select the best season for the qualitative and quantitative composition of tea tree essential oil.

SUMMARY

Studies on the oil recovery from tea tree revealed that the needle leaves and flowers have the higher oil content of 2.30% and 2.25% respectively. The effect of months on different plant parts showed that the oil recovery from needle leaves and flowers were higher during the month of July and August.

Conflict of interest

All authors declare that they have no conflict of interest.

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