

CHEMICAL EXAMINATION OF THE ESSENTIAL OIL OF *OCIMUM SANCTUM* LINN.

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Ocimum Sanctum LINN. or *Tulsi* as it is known in Bengali and Hindi is a strongly scented low shrub with erect stems belonging to the natural order of *Labiatae*. When carefully cultivated, *Tulsi* plants have been known to grow to a height of nearly five feet and the lower stems become quite woody under such circumstances. Throughout India, the plant is regarded as sacred amongst the Hindus and in all religious affairs and devotional worships, the leaves of *Tulsi* are essential and used as offerings to deities along with flowers and Bel (*Aegle marmelos*) leaves. In almost every Hindu household, at least one *Tulsi* plant is grown for this purpose, and in many parts of the country the plant is held in such veneration and devout esteem that it is actually worshipped as a deity.

The leaves of *Tulsi* have very interesting medicinal properties, for which purpose also they are almost indispensable in every household. The juice of the leaves have strong expectorant properties, and on account of this, is used in catarrh, cough, bronchitis and other ailments of the respiratory system. A thick paste of the leaves ground up with water is used in various cutaneous affections, like ringworm, itch, scabies, eczema, etc. An infusion of the leaves is very beneficial in digestive disturbances of the children and in hepatic affections. The leaves have been successfully employed in many cases of jaundice and liver disorders. According to Kirtikar and Basu,¹ the dried and powdered leaves are employed as snuff in ozæna. The leaves have very strong antiseptic and disinfectant properties. Cuts, burns, bruises and sores when treated with a paste of the leaves, heal very quickly without becoming septic. The juice of *Tulsi* leaves is also supposed to be a specific against earache, and a decoction of the leaves is efficacious in disorders of the genito-urinary system. Woollen and silk clothes and also furs when kept in closed vessels interspaced with *Tulsi* leaves, are not at all attacked by destructive insect pests which are such a terrible nuisance in India during the hot months of the year. The leaves of the *Tulsi* plant are also reputed to have the property of warding off the mosquito.

A full description of the *Tulsi* plant has been given by Roxburg,² and so it is omitted here. Two photographs of the plant are however appended.

The essential oil of *Tulsi* which is presumably responsible for all the medicinal properties of the plant, is very easily removed from the leaves in which it is mainly present, by distillation with steam, and from the distillate, the oil can be extracted with petroleum ether. The proportion of essential oil in the leaf varies according to the kind and quality of the plant and the mode of its cultivation, but the average of a large number of experiments has come to about 0.7 per cent. The dark variety of *Tulsi* contains more essential oil than the lighter variety.

The crude essential oil of *Tulsi* gives a deep bluish green coloration with alcoholic ferric chloride and is strongly phenolic in nature. It was resolved by aqueous sodium hydroxide into phenolic and non-phenolic constituents. The phenolic portion on distillation and rectification was resolved into a very small fraction consisting of carvacrol and a large fraction consisting of eugenol. The non-phenolic portion on similar treatment was resolved into a main fraction consisting of eugenol methyl ether. The constituents were identified by preparation of suitable derivatives and also by direct comparison with authentic specimens. In addition to eugenol methyl ether, the non-phenolic portion contained a high boiling terpene hydrocarbon which appeared to be caryophyllene from qualitative reactions, but it could not be definitely identified for want of sufficient material.

In this connection it is rather interesting to note that both eugenol and eugenol methyl ether have been found together in *Cinnamomum pedatinerium* of Fiji by Goulding³ and also in the oil of *Asarum canadense* by Power and Lees.⁴ Eugenol together with its methyl ether has also been found in the essential oils of Acacia, Bay, Culilaban, Laurel, Pimento and Massory according to the report of Allen.⁵

Experimental

Essential Oil of Tulsi.—For the preparation of the essential oil of *Tulsi*, the fresh leaves in lots of three kilos each time were distilled with water from a large distilling apparatus made of copper and fitted with a copper worm condenser, until the distillate which was opalescent in the beginning began to run perfectly clear. The distillate (5 litres) was shaken with petroleum ether in a large separator, and the upper petroleum ether layer after dehydration with anhydrous sodium sulphate was distilled from a water-bath until the petroleum ether no longer came over.

The crude essential oil of *Tulsi* thus obtained is a clear bright yellow oil with a characteristic odour of the plant admixed with a strong note of cloves. With alcoholic ferric chloride, the substance gives an intense greenish blue coloration. It reduces ammoniacal silver nitrate, but not Fehling's solution. It is soluble in an aqueous solution of sodium and potassium hydroxide to the extent of over 70 per cent. by volume. This method of treatment was therefore utilised in the separation of the phenolic and non-phenolic constituents of the oil.

Separation of the phenolic and non-phenolic constituents of the essential oil of Tulsi.—The crude oil (100 c.c.) was taken in a separating funnel and diluted with an equal volume of petroleum ether. Aqueous caustic soda (5 per cent. 100 c.c.) was added and the mixture vigorously shaken. On allowing to stand for a short time, two layers separated out, and the lower dark red aqueous layer was removed. Two more extractions of the upper petroleum ether layer with aqueous caustic soda were done in the same way as before, using half the previous volume of alkali each time. The combined alkaline extract was acidified with concentrated hydrochloric acid, and the separated dark red oil taken up with petroleum ether. After dehydration with anhydrous sodium sulphate, the petroleum ether was distilled off from a water-bath when the phenolic constituent of the essential oil of *Tulsi* was left behind as a dark red heavy oil (A) with an intense smell of cloves

The non-phenolic constituent of the essential oil of *Tulsi* left behind in the petroleum ether layer in the above extraction process, was freed from petroleum ether on the water-bath and was obtained as a bright yellow oil having a characteristic odour resembling that of the leaves of the plant (B).

Rectification of the Phenolic Constituent (A)

This was done by fractional distillation under ordinary pressure, using a distilling flask of about 150 c.c. capacity with a rectifying neck of four bulbs blown below the delivery tube. The following fractions were collected, the mercury thread of the thermometer shooting up in between the different ranges of temperatures indicated :

TABLE I

Total quantity taken = 77 c.c.

Fraction No.	Boiling range °C.	Quantity of distillate in c.c.
1	upto 130	10.0
2	232-236	3.0
3	245-248	62.0
4	255-260	1.5
5 (residue)	..	0.5
	TOTAL ..	77.0

Fraction No. 1 was the higher boiling fraction of petroleum ether and was quite colourless and chemically non-reactive.

Fraction No. 2 was a pale yellow oil with a characteristic odour of thyme or horse mint, and gave an intense green coloration with alcoholic ferric chloride. It yielded a liquid acetyl and a benzoyl derivative. The substance was identified to be *carvacrol*.

Fraction No. 3 was a pale yellow thick and heavy oil with an intense smell of cloves. It had a specific gravity of 1.069 at 25° C., and gave a blue coloration with alcoholic ferric chloride. It reduced ammoniacal silver nitrate, but not Fehling's solution. The benzoyl derivative prepared by the action of benzoyl chloride on the substance dissolved in excess of 5 per cent. solution of sodium hydroxide, on recrystallisation from dilute alcohol, melted sharp at 69° C. and the melting point was not depressed on admixture with an authentic specimen of benzoyl-eugenol, specially prepared for this purpose from Merck's pure eugenol.

Fraction No. 4 was a yellow thick oil, but lighter than water. On account of the small quantity available, it could not be definitely identified, but as far as it could be seen from qualitative reactions, it appeared to be a terpene ketone or phenol of complex composition.

Rectification of the Non-phenolic Constituent (B)

This was also done by fractional distillation under ordinary pressure exactly in the same way as the phenolic constituent (A). The results are summarised in Table II :

TABLE II

Total Quantity taken = 24 c.c.

Fraction No.	Boiling range °C.	Quantity of distillate in c.c.
1	upto 130	4.0
2	246-249	18.0
3	258-265	1.4
4 (residue)	..	0.6
	TOTAL ..	24.0

Fraction No. 1 was only the higher boiling fraction of petroleum ether used in the extraction of the oil.

Fraction No. 2 was a pale yellow oil, which on redistillation boiled completely between 248-249° C. It had a peculiar characteristic odour resembling to a great extent the odour of the leaf, with a strong note of betal-leaf. It had all the properties of *eugenol methyl ether*, and on oxidation with alkaline potassium permanganate, yielded veratric acid melting at 179° C. The melting point of the veratric acid obtained in this way did not get depressed on admixture with an authentic specimen of veratric acid obtained from Messrs. Schuchardt.

Fraction No. 3 was a yellow oil, lighter than water, and with a characteristic resinous smell. The quantity obtained was too insufficient for carrying out any systematic tests, but from qualitative reactions, it appeared to be *caryophyllene*.

Summary and Conclusions

1. The essential oil of *Ocimum Sanctum* Linn. or *Tulsi*, is a pale yellow oil obtained from the leaves of the plant in an yield of 0.7 per cent. by steam distillation.



Ocimum Sanctum Linn. View of entire plant



Ocimum Sanctum Linn. Near view of the leaves and branches

2. The oil has the characteristic odour of the leaves together with a strong note of cloves and is strongly phenolic in nature.

3. The oil was resolved into phenolic and non-phenolic constituents by aqueous sodium hydroxide, and from the phenolic portion, carvacrol and eugenol were definitely isolated and identified. From the non-phenolic portion, eugenol methyl ether was definitely identified, and the presence of caryophyllene was tentatively shown.

4. The essential oil of *Tulsi* contains over 71 per cent. of eugenol and 20 per cent. of eugenol methyl ether together with about 3 per cent. of carvacrol. As it is, the oil is an excellent source of eugenol which is used in the preparation of vanillin.

REFERENCES

1. Kirtikar and Basu .. *Indian Medicinal Plants*, p. 1015.
2. Roxburg .. *Flora Indica*, p. 463.
3. Goulding .. *J.*, 1903, T. 1079.
4. Power and Lees .. *Ibid.*, 1902, T. 67.
5. Allen .. *Commercial Analysis*, 4, p. 253, *et. sec.*