

VARIATIONS IN THE RESIN CONTENT OF VARIOUS PARTS OF *PODOPHYLLUM EMODI* L.

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Podophyllum emodi (Syn. *P. hexandrum*, Royle) is approximately 4 times more active, due to higher resin content and more active principle in the resin, than the drug obtained from *P. peltatum* L. Its distribution extends from Sikkim to Afghanistan. In Pakistan it is found in Kashmir, Murree hills, Hazara, Gilgit Agency, Kurram Agency, Indus Kohistan and States of Swat, Dir and Chitral, where it forms undergrowth of the temperate forests from the altitudes of 6,000 to 11,000 feet, but in the alpine zone it may be found in the open at moist places up to 14,000 feet. It is a shade plant commonly found on cooler aspects associated with *Viburnum nervosum*, D. Don., in forests rich in humus.

DESCRIPTION OF THE PLANT

It is an erect glabrous herbaceous plant with a perennial underground rhizome. The annual aerial parts appear from April to May, depending on the melting of snow, and attain a height of about one foot before the leaves are fully developed. In the young plants only leaves with long petioles are formed from the rhizome but after some years of growth one or more reddish stems are sent up, depending on the size of rhizome. The mature plants generally have 2 to 5 stems. Each stem bears 2 to 3 leaves which in their young stage are curiously reflexed, and generally bears a solitary floral bud at the tip. The leaves are long petioled, alternate, peltate, round, 6 to 10 inches in diameter, often purple spotted, 3 to 5-lobed sharply toothed with deep incisions to the middle or base. The pinkish white, solitary flower, apparently supra-axillary arising from the leaf stalk appears along with leaves from underground with the melting of snow. The flowers have 3 sepals, 6 petals rarely 4, 6 stamens, and one superior carpel. The fruit ripens from June to August when the leaves start fading and the aerial portion dies by November. It is an edible, ellipsoid berry of bright orange colour, 1 to 2 inches in length with many seeds embedded in its pulp. The seeds are dispersed by birds which eat the fruit. The rhizome is irregular, tortuous, knotty, somewhat flattened dorsi-ventrally with narrow internodes. The cup-shaped scars of the previous annual stems or petioles are visible along the upper surface of the rhizome. A rough idea of age of the plant can be had by counting these scars. The rhizome varies in size depending on age and growth conditions but a full grown plant may have a rhizome 6 inches or more in length with a maximum diameter of not more than 1 inch. Numerous tender succulent adventitious roots arise from all sides of the rhizome and attain a length of 5 to 10 inches. The roots and rhizome

RESIN CONTENT OF *PODOPHYLLUM EMODI* L.

at present forming the source of medicinal resin are very bitter and have a foetid odour.

REVIEW OF LITERATURE

Hooper, working under the direction of Dymock, found 12 per cent. of resin in the specimens of the rhizome and roots of *Podophyllum emodi* supplied by Watt¹, who collected it from Kullu in November, 1888, when the plant was in the withered stage. Another sample collected from Simla by him in 1889 was found to contain 6 per cent. of resin. It was, therefore, concluded that it must be collected when the plant is in fruit. Puran Singh² examined samples of root (rhizome and roots) from different localities collected in the different seasons, and found that the content of resin varied from 10 to 20 per cent. according to the locality and season of collection. He found the month of May to be the best time for collection, when the plant was in flower. According to Smythies³ 10 to 20 per cent. w/w of resin is found in the dried roots. Chopra⁴ analysed material from Kulu, Bāshahr and Chamba and found 9.55 per cent., 9.0 per cent., and 11.12 per cent. of resin respectively. He stated that Dymock and Hooper found 10 per cent. of resin, Umney 12 per cent., and Chopra and Ghosh 10.02 per cent. The generally accepted figures are from 8 to 13 per cent.

The anatomy of its rhizome and root has been investigated by Wallis and Goldberg⁵ and Datta and Mukerji⁶.

Chopra⁴ mentions that after 2 years of cultivation the rhizome is fit to be collected but according to Troup⁷ at least 12 years are required to produce marketable rhizome of good size from plants raised from rhizome cuttings, and in the case of seedling plants, the period is likely to be longer. Troup found that rhizome did not commence to form before 6 years from the date of sowing of seeds. According to him, under natural conditions the seeds sown in July or August immediately after ripening lie dormant through two winters and germinate in the second spring. The number of stems appears to vary with the age of the plant and size of the rhizome. Generally speaking a rhizome of average size produces about 3 stems and a large rhizome about 5, a fact which is useful in indicating the size of plants suitable for collection for the market.

EXPERIMENTAL

All the samples were collected from the Kashmir Point forests of Murree Hills, Punjab, during April, July and September, 1951. All the parts of the plant were separately analysed to investigate whether in addition to rhizome and root, other parts contain workable percentage of resin or not. To investigate the effect of age on the resin content the flowering and non-flowering plants were collected separately and were dried under uniform conditions. All the samples were dried in an electric drying chamber at a temperature of about 41° C. The total resin contents were determined according to the method of Allport⁸.

RESULTS

Sample number	Date of collection	Description	Resin per cent.	Remarks
1	20.4.1951	Flowering plants :		Flowers had just opened and leaves were not yet fully expanded.
		(a) Roots	16.78	
		(b) Rhizomes	15.43	
		(c) Stems	4.77	
2	20.4.1951	Non-flowering plants :		The leaves had not yet fully expanded.
		(a) Roots	16.36	
		(b) Rhizomes	18.01	
		(c) Leaves	9.14	
3	11.7.1951	Flowering plants :		Fruits had matured and in most cases had fallen. Leaves were fully mature.
		(a) Roots	10.92	
		(b) Rhizomes	15.51	
		(c) Stems	1.96	
4	11.7.1951	Non-flowering plants :		Leaves were fully mature.
		(a) Roots	4.57	
		(b) Rhizomes	15.03	
		(c) Petioles	1.05	
5	5.9.1951	Flowering plants :		Leaves had become reddish and had started to dry up. The whole of the aerial portion would die up to November when the rains decrease.
		(a) Roots	10.89	
		(b) Rhizomes	12.73	
		(c) Stems	2.18	
6	5.9.1951	Non-flowering plants :		Leaves had become reddish and had started to dry up. The whole of the aerial portion would die up to November when the rains decrease.
		(a) Roots	10.54	
		(b) Rhizomes	12.32	
		(c) Petioles	2.93	
		(d) Leaves	7.83	

DISCUSSION AND CONCLUSIONS

The results of chemical analyses clearly indicate that roots and rhizomes have the maximum resin percentage in spring when the aerial parts of the plant are just emerging from the ground. The resin percentage continues to fall gradually throughout the growing season. The best period for the collection of rhizome and roots seems to be early spring, which is supported by the work of Puran Singh² but is contrary to the findings of Watt who based his conclusion only on two samples collected from different localities.

The leaves have not been employed for the extraction of resin so far and no mention has been made by the previous workers regarding resin percentage in them. The chemical analyses of leaves show that they contain 7.83 to 9.7 per cent. of resin throughout the growing season

RESIN CONTENT OF *PODOPHYLLUM EMODI* L.

which is a high percentage as compared to the rhizomes and roots of *P. peltatum* of American origin yielding only 3 to 5 per cent. of resin and containing at the same time less active principle. It is, therefore, suggested that in future the leaves should form the main source of the drug in view of the very slow growth of the rhizome and roots, the rapidly diminishing quantities of this drug in the forests, and the absence of any active steps for its regeneration.

The comparison of resin contents of different samples of flowering and non-flowering plant parts seems to show that the age factor has no significant effect on the resin percentage.

SUMMARY

1. The various parts such as roots, rhizome, stem, petiole and leaves of the flowering and non-flowering plants of *Podophyllum emodi* were collected separately during April, July and September, 1951, from the Kashmir Point Forests Murree Hills, Punjab, and were analysed for their total resin contents after drying them at a temperature of about 41° C.
2. The various parts of the plant were found to have maximum resin percentage during spring, which period is thus most suitable for collection of the drug.
3. The leaves were found to contain between 7.83 to 9.7 per cent. of resin and should also be employed as a source of resin.
4. The age does not seem to have any significant effect on the resin content, as can be seen from the comparison of resin percentages in different parts of the flowering and non-flowering plants.

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