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Classical inferences, Botanical identity, Chemical composition and Therapeutic efficacy of *Dineśavallī* – An important Ayurvedic drug.

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ABSTRACT

Dineśavallī or *Vēṁpāta* is a very popular Āyurvēda herb used in South India for skin related ailments. In Kerala it is used in different formulations either as single drug or in combinations. There are no direct references to *dineśavallī* or *Vēṁpāta* in any *bṛhatrayī* or *laghutrayī*. From the previous studies it is confirmed that *dineśavallī* of south India is equated with *'Ratanjot'*- a herbal dye of North India and from the literature review, roots of *Arnebia* and *Alkanna* which is sold as *'Ratanjot'*. *Dineshavallī (Vēṁpāta)* is assumed to be sourced from *Ventilago madraspatana* Gaertn. belonging to Rhamnaceae family. But some allied species such as *Ventilago bombaiensis* Dalzell.and *Ventilago denticulata* Willd. are also termed as *Vēṁpāta* locally. Present study reviews the major classical texts of Ayurveda and peer reviewed articles to reveal the botanical identity, chemical constituents, pharmacological properties and its therapeutic efficacy of *dineśavallī* or *Vēṁpāta* for the better knowledge.

Keywords: Dinesavalli, Vempata, Ventilago, Ratanjot, Ayurveda, Controversy

I. INTRODUCTION

Ayurveda is considered as one of the oldest healing sciences. In Sanskrit, Ayurveda means "The Science of Life". Ayurveda knowledge originated in India more than 5,000 years ago and is often called the "Mother of All Healing." It stems from the ancient Vedic culture and was taught for many thousands of years in an oral tradition from accomplished masters to their disciples. Ayurveda places great emphasis on prevention and encourages the maintenance of health through close attention to balance in one's life, right thinking, diet, lifestyle and the use of herbs.

A large number of medicinal plants are mentioned in the ancient classical Ayurveda texts, *Carakasaṃhitā, Suśrutasaṃhitā* and *Aṣṭāngahṛdaya.* But many of them still remain to be properly identified. During the process of urbanization, contact with plants in their natural habitat was lost, creating confusion about the correct identity of many plants. The indiscriminate use of Sanskrit names and synonyms in later publications that are not given in the ancient treatises added to this problem. Moreover, many irregularities are there in the identity of raw materials due to wrong interpretations. Therefore, medicinal plant sources differ according to the practitioners.

India is a country having a variety of languages and populations dependent on different tribal and folklore medicine. The variation in the language is sometimes responsible for confusion in the nomenclature of different plants having similar names. Moreover, the descriptions of a plant in ancient literature are found in verses with various synonyms. These synonyms have caused controversy in the identification of plants, and hence the correct source is sometimes misleading with a fictitious plant. It has become an important task to generate parameters of identification as well as differentiation among different plant sources having similar names. Since herbal products are prepared using the extracts of plants known for particular activities, the controversial source sometimes leads to inefficacious preparations.[1,2]

Dineśavallī (vēṁpāta) is a popular drug that is mainly used in South India especially for skin related ailments in the form of external applications. When we go to a market requesting

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for this drug *dineśavallī* or *vēṁpāta,* samples from varied herbal sources are reported to be obtained. There for, here focusing the botanical identity, chemical composition and therapeutic efficacy of *dineśavallī* (*vēṁpāta)*, It will be useful to identify the different botanical identities and also know the therapeutic utility of various formulations of *dineśavallī* (*vēṁpāta)* in traditional books of Kerala, irrespective of its varied sources.

II. METHODS

All the major *samhitās* and some selected traditional books of Kerala were thoroughly reviewed to compile the formulations containing the *vēṁpāta*.

Vēṁpāta – Classical View

Vēṁpāta or red creeper, despite its name, has nothing visibly red about the creeper. It is widely used to make medicinal oils. When the root of this plant is immersed in coconut oil, it gives away a red colour, hence the name. The drug *Vēṁpāṭa* is often referenced in Ayurvedic texts originating from Kerala in its Sanskritized form of *dineśavallī*. Still, there are no direct references of *dineśavallī* in any *bṛhattrayī* (the primary three Ayurvedic texts, viz., CS, SS and AH) or *laghutrayī* (the minor three texts viz., the *Mādhavanidāna, Śārṅgadharasaṃhitā* and the *Bhāvaprakāśa*). Warrier et al. 2004 lists synonyms of *vēṁpāta* as *dineśavallī*, *arkavallī* and *raktavallī* in which it is interesting to note that the words *dinēśa* and *arka* are the synonyms of sun. It has properties like *kaṣāya*, *tikta rasa, guru guṇa, uṣṇa vīrya* and *karma* like *dīpana, pācana, agnivardhana* and *kaphahara* properties. It is helpful in conditions like dyspepsia, colic, flatulence, erysipelas, leprosy, scabies, pruritus and other skin diseases, fever and general debility.[3]

With these synonyms, while going through the *bṛhattrayī,* there are some references in the name of *sūryavallī* and *tāmravallī* in the *Suśrutasaṃhitā* and the *Aṣṭāṅgahṛdaya.* In the name of *sūryavallī,* there are references in *Suśrutasaṃhitā sūtrasthāna, cikitsā sthāna* and *kalpa sthāna*. In *sūtra sthāna*, the oil of *sūryavallī* and other drugs have *madhura rasa* and *vipāka*, *sītavīrya*, which pacifies *vāta* and *pitta*.[4] In *cikitsā*[5] and *kalpasthāna*[6] it is described as *patola sadṛśavallī.* There is a reference in the name of *tāmravallī* in the *Suśruta saṃhitā śārīrasthāna*, but in Ḍalhana's commentary, it is glossed as *manjiṣṭhā*.[7]In the *Aṣṭāṅga hṛdaya śārīra sthāna & Sūthra sthāna,* there are references in the name of *tāmravallī*[8] and *sūryavallī*[9] respectively. As per both Aruṇadatta & Hēmādrī, *tāmravallī* is considered as *manjiṣṭhā.*[10] As per the commentary of Hēmādrī on the *Aṣtānga hṛdaya*, *sūryavallī* has *patōlasadṛśa patra*[11] and as per Aruṇadatta it has *karavīrākārapuṣpa*.[11]While going through the *kairalīvyākhyāna* on *Aṣtāngahṛdaya*, the *sūryavallī* mentioned in *kośātakyādiyavāgu* is glossed as *vēṁpāṭa,* which could be considered as the first direct reference of the name *vēṁpāṭa*.[12] Also, in a much later Malayalam *vyākhyāna* on *Aṣtāṅga hṛdaya* by Ceppāṭṭ AcyutaVarier, the drug named *sūryavallī* is translated as *vēṁpāṭa*.[13]The direct reference of *vēṁpāta* can be seen in Malayalam books like *Cikitsamañjari, Sahasṛayōgaṃ, Vaidyamanōrama, Yōgāmṛtaṃ, Yōgasāraṃ, Âlatturmanipravālaṃ, Sarvarōgacikitsāraṭnam* etc.

Important Medicinal Preparations

Nisāditailaṃ,Mātuluṅgāditailam,Kaccūrāditailam, Dineśavallyaditailam,Sārasvataghṛta, Venapaccādi tailam, Neeli tailam.

International Journal of Pharmaceutical Research and Applications
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Table 1: Uses of Vēṁpātain traditional books of Kerala

S. no	Disease	Therapeutic use/name of the formulation	kalpana	Mode of administration	Reference
1	*Pāmakuṣṭha*	*Nisāditailaṃ (Sūryavallī -Vēṁpāta)*	*Kalka,*	*lēpana* E/A	V. M[14]
2.	*Suptavāta.*	*Mātuluṅgāditailam: (Suryāvarthaka-Vēṁpāta)*	*Taila Ghṛta*	E/A For 3 days Oral	V.M[15]
3.	Scabies on the skin.	*Nalpāmaraṃ, triphala, citraka,* and root of *arka*, the bark of *Śirīṣa, ñāratoli, āragvadha, haridṛa,* the bark of *Vēṁpāta* and *tila* are to be taken in equal parts.	*Kalka*	E/A once in a day	A.M[16]
4.	Kitibha kuṣṭha wrinkling, scaling of the skin	Powdered *Vēṁpāta* bark is mixed With Niṃbu swarasa along with *āmalaki, payaninpaśa, lakṣā, snuhi, biḍalavana* mixed in *dhānyamla* to be used all over the body.	*Cūrṇa*	*Uḍvartana*	A.M[17]
5.	*Visarpa.*	*Kathir (Vēṁpāta), niṃbatvak, patōlavallī*	*Kaṣāya.*	*Dhāra*	A.M[18]
6.	*Jaṭhara vraṇa.*	*Swarasa* of *duḥsparśa* added with the *kalka* of *Vēṁpāṭa* and *haridra.*	*Taila*	Internal	C.M[19]
7.	All types of skin diseases and *kuṣṭha.*	*Swarasa* of *haridra, dūrvā,Vēṁpāṭa* etc. with *kalka* of *elādigana* and *maravaṭṭi oil.*	*Taila*	E/A	C.M[20]
8.	Itching.	*Kalka* of *nalpāmaratvak, triphla,Vēṁpāta etc* with milk The people who are heat intolerant should avoid the use of *Vēṁpāṭa.*	Paste	*lēpana*	C.M[21]
9.	All type of *kuṣṭha.*	In *kaccūrāditailam (Arkavalli-Vēṁpāṭa)*	*Taila*	*lēpana*	S.Y[22]
10.	All type of *twakrōga.*	*Dineśavallyaditailam (Dineśavalli- -Vēṁpāṭa)*	*Taila*	*lēpana*	S.Y[23]
11.	Increase the intelligence, protects from evil spirit and *vishabādha.*	In *sārasvataghṛta (Ravervallī -Vēṁpāṭa)*	*Ghṛta*	*Āhāra lēpana*	S.Y[24]
12.	*Sannirōga*	*Venapaccāditaila (Vēṁpāṭa)*	*Taila*	E/A	S.Y[25]
13.	Scabies	The oil prepared from *malayamukki(triparni)/(aparājitha), karalakam (pāthālagaruti), haridṛa, kodiyāvanak (bhūmierendaṃ)* and root of *pārindi* are added with *kalka* of *vēṁpāṭa, upakunjika (karinjeerakaṃ)*	*Taila*	E/A	Y.S[26]
14.	*Kṣaya,* Bone pain, Wound generated after *kuṣṭha. Vātarōga* It	In *Neelitaila, Vēṁpāta* is used as *kalka dravya*	*Taila*	*lēpana Pāna Naṣya.*	Y. S[27]

International Journal of Pharmaceutical Research and Applications
Volume 9, Issue 3 May-June 2024, pp: 590-605 www.ijprajournal.com ISSN: 2456-4494

	has *brṃhaṇa* property.				
15.	*Antar vṛana.*	*Ghṛta* prepared from *Vēṁpāta* and *haridra.*	*Ghṛta*	Internal	Y. S[28]
16.	*Kuṣṭha.*	*Taila* prepared from *Vēṁpāta, haridra, arkamūla* and *āragvadhatvak.*	*Taila*	E/A	Y. S[29]
17.	*Vātaja kuṣṭha*	*Taila* prepared from stem bark of *nalpāmara, arka, (Nishata-Vēṁpāta),sāriba, &nirgunţi.*	*Taila*	E/A	Y.M[30]
18.	*Manḍalī Viṣacikitṣā*	*Kalka* of *Mṛṇāla, Daśapuṣpa, Vēṁpāṭa,amṛtā, haridra* etc. mixed with *dhānyamla.*	Paste	*lēpana*	V.J[31] P.S[32]
19.	*Vṛanaśōdhana -Rōpaṇa*	*Svarasa* of *Daśapuṣpa* added with *kalka* of tender leaves of *Kupīlu, haridra, Vēṁpāṭa* etc	Paste	*lēpana*	V.J[33] P.S[34]

From the above table, it's evident that most of the formulations are mainly indicated for pacifying skin ailments and also in conditions of *vātakapha* origin. It is widely used as an external application like *lēpana* with *kalķa, taila, uḍvartana* with *cūrṇa,* and *dhāra* with *kaṣāya.* For internal purpose, it is mostly used as *Ghṛta kalpana.* Various synonyms of *Vēṁpāṭa* were also mentioned in this table. In *Vaidyamanōrama* synonyms like *Sūryavallī, Sūryāvartaka* are mentioned and in the *Ālattūrmaṇipravalaṃ* the term *katir* is used for *Vēṁpāṭa.* In *Sahasṛayoga* the names like *Arkavallī, Dineśavallī, Ravervallī* for *Vēṁpāṭa* which are the synonyms of 'sun' are used and there is a term called *Niśāta* for *Vēṁpāta* in the *Yōgamanjari.*

PROPERTIES AND ACTION

Table No. 2: *Rasadipañchakas* of *Vēṁpāta*[35]

Rasa	***Guṇa***	***Vīrya***	***Vipāka***	***Karma***
Kaṣāya, Tiķta	*Laghu*	*Sīta*	*Kaṭu*	*Tvagrōgahara*

Table No. 3: *Rasadipañchakas* of *Dineśavallī*[3]

Rasa	***Guṇa***	***Vīrya***	***Vipāka***	***Karma***
Kaṣāya, Tiķta	*Guru*	*Uṣṇa*	*Kaṭu*	*Dīpana, Pāchana, Varnya, Kaphahara.*

THERAPEUTIC INDICATION[3]

Gulma, Śūla, Visarpa, Kuṣṭha, Kaṇḍū, Pāma, Viṣa. In the text *'Oushadasasyangalude Lokam'* by Dr. S. Neshamani, the author has mentioned about *Vēṁpāta* with *kaṣāya, tiktarasa* and *laghu sīta guṇa.* Whereas, in the book 'Indian Medicinal Plants' *Vēṁpāta* is mentioned by the name of Dineśavalli with kaṣāya, tiķtarasa and guruguṇa and uṣṇa vīrya.[36]

BOTANICAL SOURCE

Dineśavallī (vēṁpāta) is assumed to be sourced from *Ventilago madraspatana* Gaertn.[36] belonging to Rhamnaceae family.[3] As per

International Journal of Pharmaceutical Research and Applications
Volume 9, Issue 3 May-June 2024, pp: 590-605 www.ijprajournal.com ISSN: 2456-4494

Ayurvedic classical texts, Stem bark of *Ventilago madraspatana* is the source plant of *dineśavallī.* But some allied species such as *Ventilago bombaiensis* Dalzell. and *Ventilago denticulata* Willd. are also termed as *Vēṁpāta* locally. The availability of Ventilago is reported to be restricted to deciduous forests only, hence allied species are also being used due to unavailability of genuine one.

DISTRIBUTION

It is distributed in forests of low elevations in South Greece, India, Indonesia, Myanmar and Srilanka, Andaman Is., Assam, Bangladesh, Cambodia, China South-Central, Jawa, Lesser Sunda Islands., Thailand.[37] In South India it is distributed in Western Ghats and Eastern Ghats.[38-40]

VERNACULAR NAMES

English: Red creeper; *Sanskrit:* Dinēśavallî, Raktavallî; *Malayalam:* Vēṁpāta; *Hindi:* Pitti, Kenwti, kalibel; *Tamil:* Veṁpāṭaṃ, Śuruḷbattaikkoṭi, Surul, Pappili; *Telugu:* Eṛṛasurùguḍi, Suralatîge, Ettashirattalativva, Papri, Putika, Surabhi, Surugudu[42]; *Marathi:* Sakalvel, Khandvel, Lokhandi[41]; *Kannada:* Haruge, Kanvel.[41]; *Bengal:* Raktapita[42], *Bombay:* Kanvel, Lokhandi[42],Canarese: Haruge, Kubbila, Malamaitra, Pappali, Poppli[42]; *Deccan:* Surichakka[42], *Dun:* Kalibel[42]; *Gujerati:* Ragatarohado[42]; *Hyderabad:* Chorgu[42]; *Kolami:* Bongasarjom[42]; *Konkani:* Kanvel[42]; *Mundari:* Bongasarjomnari[42]; *Sinhalese:* Yakkaṭuvel[42]; *Tagalog:* Salupao, Silipo[42]; *Uriya:* Roktopitto, Sajumalo, Toridi.[42]

MARKET SAMPLES

The availability of *Ventilago madraspatana* is reported to be restricted to deciduous forests only, hence allied species are also being used due to unavailability of genuine one. As per earlier reports plants of the family Boraginaceae which is called as *'Ratanjot'* in north Indian markets are often marketed as *Dineśavallī.* The vernacular name Ratanjot is attributed to at least 15 plant species of four different families. Eight species of *Alkanna, Arnebia, Maharanga* and *Onosma* of Boraginaceae are used as Ratanjot due to their red coloured root.

BOTANICAL COMPARISON OF SOURCE PLANTS

Ventilago madraspatana

A large, much branched, woody climber reaches to the top of the highest trees in the forests where it grows. **Bark:** Dark grey with vertical cracks exposing the inner vermilion surface. Young branches are grey. Pubescent and older branches are dark grey and glabrous. **Leaves:** Pale green, alternate, oblong lanceolate or elliptic ovate to orbicular, pubescent beneath when young, base generally rounded, apex acute or sub-acuminate, margins or crenate; coriaceous and shining. Lateral nerves 4-8n pairs ascending and covering near the margin. **Inflorescence:** Are axillary and terminal panicles minutely grey pubescent, occasionally with leafy bracts. **Flowers:** Small greenish-yellow, fascicled on leafless branches with an Offensive odour, Unisexual flowers, 5-15cm, calyx tube pubescent; numerous 3 to 5. Reproduction is through pollination. **Fruits:** Samaroid yellow to grey, subglobose nut 5 to 7 mm in diameter, yellow to grey, enclosed in a persistent calyx rim to about the middle and prolonged in to a linear pubescent wing. **Seeds:** 1-seeded, seed-chamber distinctly set apart from the wing by a constriction, globose, 2.0-2.5 mm in diameter, thin-walled brown in colour[43].

Ventilago denticulata

Lianas; stem 10-25 cm across; branches pubescent; bark fissured, grey or dark brown, usually red in fissures. Leaves alternate, 3-15 x 2-6 cm, ovate-lanceolate, oblique at base, crenate-serrate at margin, obtuse or subacute at apex, subcoriaceous, pubescent; lateral nerves 5-8 pairs; petioles 3-10 mm long, furrowed, pubescent. Flowers greenish-yellow; pedicels 1-4 mm long. Calyx lobes deltoid, 2-2.5 mm long, hairy. Petals spathulate, emarginate at apex, 1-1.5 mm long. Stamens 1-1.5 mm long; connectives prolonged. Disc 5- lobbed. Ovary villous, 2-loculed; stigmas 2, divergent.[44]

Smythea bombaiensis

Woody climbers, stem ribbed, branchlets looping. Leaves simple, alternate, 6-9 x 3-4 cm, elliptic-oblong, acute at both ends, crenulate; nerves 6 pairs, nerve-axils hairy, nervules parallel. Flowers 4 mm across, 20-30 together, in axillary clusters; pedicels to 5 mm long. Sepals 5, triangular. Petals 5, obovate, emarginate to 2-lobed, glabrous. Stamens 5, disk cup-shaped. Ovary 2-celled, densely hairy. Fruit 1-seeded, winged, wing to 6 x 1.5 cm, flattened.[44]

MARKET SAMPLE ANALYSIS

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Volume 9, Issue 3 May-June 2024, pp: 590-605 www.ijprajournal.com ISSN: 2456-4494

In the past, roots of *V. madraspatana* were collected from Western Ghats, as the only source of 'Ratanjot'. However, that has not been practiced now. It is clearly known that *Arnebia euchroma* var. *euchroma* is the present source. Similarly, is in yielding a red dye, *Arnebia euchroma* substitutes *V. madraspatana.* Recently *V. madraspatana* was not found in market. Whatever is available in the market, in the name of 'Ratanjot' is originated from *Arnebia euchroma.* On systematic comparison of the market samples with the authenticated materials it was revealed that all the market samples were the mixture of two or three botanical taxa except the Amritsar samples which showed very resemblance with *Arnebia nobilis* in its morphological and chemical parameters. *A.euchroma* var. *euchroma* is adulterated/.substituted with *A. benthamii*(wall. ex G. Don) Johnston, *Maharanga emodi* (Wall.) DC. and *Onosma hispidum* Wall. ex D. Don. *A.euchroma* var. *Euchroma* can be identified by the presence of suberized and crushed parenchymatous cells of cortex, phloem and xylem, which readily exfoliate in the form of papery layers.[45]*A.euchroma* var. *euchroma* contains naphthazarins viz., arnebin-1 to 7 and the stereo-isomers of arnebin- 1 and 4[46] while *Onosma hispidum* does not have arnebin-6. Likewise, in *Maharanga emodi* arnebin-1, 3, 7 and isomers of arnebin-4 are not present, similarly in *A. benthamii* arnebin-1, 2, 4, 5 are absent.[47] The vernacular name Ratanjot is attributed to at least 15 plant species of four different families. Eight species of *Alkanna, Arnebia, Maharanga* and *Onosma* of Boraginaceous are used as Ratanjot due to their red coloured root.[48]

PHYTOCHEMICAL COMPARISON

Root bark of *V. madraspatana* shows secondary metabolites such as, various anthraquinones, including ventinone A and B, Chrysophanol, physcion, emodin, islandicin, xanthorin and xanthorin-5-methyl ether[49]. Naphthalene derivatives and naphthoquinones, such as ventilaginone, ventilagol, maderone, cordeauxione and isocordeauxione are also reported in root bark of this plant[50]. Root bark also has benzisochromanquinones, ventilaquinones A, B, C, D, E, F, G and H from acetone extract.[51]The plant V. madraspatana is constituted with isofuranonaphthaquinones, ventilone-C, ventiloquinones E and G, Jelenthrin and enautiopure 1, 3.[52]

Arnebia euchroma

Naphthaquinones, arnebin-1to 7 and their isomers.[53]**Root:** Acetylshikonin, alkannin, β,β[1]-dimethylacrylate, shikonofurans B and C, de-O-methyl-lasiodiplodin, arnebinone, arnebinol.[54] Shikonin, deoxyshikonin,acetylshikonin, β,β-dimethylacrylshikonin, β,β-dimethylacrylalkanin, βhydroxyisovaleryalkanin,βhydroxyisovalerylshikonin, β-acetoxyisovalerylalkanin, tetracrylshikonin, arnebifuranone.[55] Two caffeic acid tetramers (I & II), Three phenolics, arnebiol,Twoquinones-arnebinone and arnebifuranone, tormentic and 2α-hydroxyursolic acids, O^7 and O^9-angeloyl retronecines, four anticomplementary polysaccharides-LR-2IId-1a,LR-2IId-1b,LR-2IId-3a,and LR-2IId-5a consisting mainly of mannose, galactose, glucose and polysaccharide fraction (LR-2).[56]

Arnebia nobilis

PHYTOCHEMICAL CONSTITUENTS[57]

Three new naphthoquinones-5,8-dihydroxy-2-(1'-β,β-dimethylacryloxy-4'- methylpentyl)-1,4-naphthoquinone (I), 5,8-dihydroxy-2-(4'-hydroxy-4'-methylpentyl)-1,4-naphthoquinone(II) and 2-(1'-acetox1'-hydroxy-1'-methylpentyl)-5,8-dihydroxy-1,4-naphthoquinone(III)—isolated along with alkannin,5,8-dihydroxy-2-(1'-β,βdimethylacryloxy-4'-methylpent-1'-enyl)-1,4-naphthoquinone and 5,8-dihydroxy-2-(1'-acetoxy-4'-methylpent3'enyl)-1,4-naphthoquinone, hexacosanol,heptacosanoic acid and sitosterol. Naphthoquinones A-1(arnebin-1, alkannin β,β-dimethylacrylate), A-3(arnebin-3, alkannin monoacetate) and A-4 (arnebin-4, alkannin) isolated from roots.[57]

PHARMACOLOGICAL ACTIVITIES

Ventilago madraspatana

ANTIDIABETIC ACTIVITY

Methanolic extract of *V. madraspatana* leaf powder at the doses of 100, 200 and 400 mg/kg possesses significant anti-hyperglycemic and anti-hyperlipedemic activity on long term [45 d] treatment in STZ induced diabetic rats. Methanolic extract of *V. madraspatana* showed maximum activity at 400 mg/kg. It reduced cholesterol, TG, LDL, VLDL, and improved HDL in diabetic rats.[58] The root extracts of *V. madraspatana* had also possessed anti-diabetic activity.[59] Methanolic extract of root bark of *V. madraspatana* had 56.25% of inhibitory activity against the enzyme alpha–glucosidase.[60]

ANTIOXIDANT ACTIVITY

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Volume 9, Issue 3 May-June 2024, pp: 590-605 www.ijprajournal.com ISSN: 2456-4494

Ethanolic and hydroethanolic root extracts of *V. madraspatana* exhibited a significant antioxidant effect eliciting and increased catalase level and decreased levels of LPO and glutathione. Alcoholic extract at the dose of 500 mg/kg elicited slightly greater antioxidant activity than the hydroalcoholic extract at the dose of 500 mg\kg.[59] Methanolic extract of root bark has potential to inhibit the DPPA activity and has IC_{50}at the dose of 60.15 kg/ml.[38]Ethnolic extract of whole plant of *V. madraspatana* possesses the anti-oxidant and anti-denaturation activity.[61] Root extracted with hexane of *V. madraspatana* possessed free radical scavenging activity and also ABTS scavenging activity.[62]

ANTIMICROBIAL AND ANTIBACTERIAL

The antibacterial activity of the extracts of *V. madraspatana* stem-bark, *Rubia cordifolia* root and *Lantana camara* root-bark, prepared with solvents of different polarity, was evaluated by the agar-well diffusion method. Twelve bacteria, six each of gram-positive and gram-negative strains, were used in this study. Chloroform and ethanol extracts of *V.madraspatana* showed broad-spectrum activity against most of the bacteria except *S. aureus, E. coli* and *V. cholerae.* On the other hand, the activity of the chloroform and methanol extracts of *R. cordifolia* and *L. camara* was found to be more specific towards the gram-positive strains, although gram-negative *P. aeruginosa* was also inhibited by the methanol extracts of both these plants in a dose dependent manner. The water extracts of *V. madraspatana* and *L. camara* were found to be inactive, while that of *R. cordifolia* was significantly active against *B. subtilis* and *S. aureus* compared with streptomycin and penicillin G used as standards. In the course of bio-assay guided fractionation, emodin and physcion were isolated for the first time from the stem-bark of *V. madraspatana.* It was noteworthy to find the MICs of emodin in the range 0.5-2.0 microg/mL against three Bacillus sp. both the anthraquinonoid compounds inhibited *P. aeruginosa,* emodin being more effective, showing an MIC of 70 microg/mL.[40] Different extracts of *V. madraspatana* such as petroleum ether, benzene, ethyl acetate, methanol and ethanol extract were used to test against *Bacillus thuringiensis, Streptococcus faecalis, Staphylococcus aureus, Salmonella paratyphi, Proteus vulgaris* and *Serratia marcescens* by agar disc diffusion method. Methanolic extract showed the maximum activity against *Serratia marcescens*. Petrolium ether extract showed maximum activity against *Proteus vulgaris.* Among the different solvents studied petroleum ether extract exhibited maximum activity against the entire tested microorganism.[38] the stem bark of *V. madraspatana* is rich in phytochemicals which has free radicals scavenging activity and strong antimicrobial activity against various microorganisms. 100 mg/ml concentration of methanolic extract showed significant rate of inhibition in *P. vulgaris,* showing 13.98 mm inhibition zone by disk diffusion method. Further, *Psendomonas aeruginosa, Bacillus subtilis, Bacillus magatherium Klebsiella pneumonia, Salmonella typhi* also showed significant susceptibility to methanolic extract of stem bark.[58] *Cyperus rotundus, Caesalpinia bonducella, Tinospora cordifolia, Gardenia gummifera, Ailanthus excelsa, Acacia arabica, Embelia ribes* and *V. madraspatana* from Melghat forest were screened for their antibacterial potential against *Escherichia coli, Staphylococcus aureus, Klebsiella pneumoniae, Proteus vulgaris, Salmonella typhi, Shigella flexneri, Salmonella paratyphi, Salmonella typhimurium, Pseudomonas aeruginosa, Enterobacter aerogenes* by disc diffusion method. Out of these medicinal plants *Caesalpinia bonducella, Gardenia gummifera* and *Acacia arabica* showed remarkable antibacterial potential. The phytochemical analysis had showed the presence of Cardiac glycosides in all extracts (aqueous, acetone, ethanol and methanol) of *Acacia arabica, Gardenia gummifera* and ethanol, methanol extracts of *Caesalpinia bonducella*. Flavonoids were present in *Gardenia gummifera, Ailanthus excelsa* and acetone, methanol extracts of *Acacia Arabica*. Tannins and phenolic were present in *Cyperus rotundus, Embelia ribes*, and organic extracts of *Ventilago maderspatana*[63]The anti-inflammatory and anticancer compounds from three medicinal plants, viz. *Ventilago madraspatana* Gaertn., *Rubia cordifolia* Linn. and *Lantana camara* Linn. was studied. The study shows that the NO• scavenging potential of selected plant extracts was determined on LPS/IFN-g activated murine peritoneal macrophage cultures, and iNOS and COX-2 expression was evaluated by Western blot analysis. Bio-assay guided fractionation yielded four compounds: physcion and emodin from *V. madraspatana*, 1-hydroxytectoquinone from *R. cordifolia,* and oleanonic acid from *L. camara.* The anti-inflammatory activity of these compounds was tested through the carrageenan-induced rat-paw oedema model. They were then tested against a murine tumour (Ehrlich ascites carcinoma), and

International Journal of Pharmaceutical Research and Applications
Volume 9, Issue 3 May-June 2024, pp: 590-605 www.ijprajournal.com ISSN: 2456-4494

three human cancer cell lines, namely A375 (malignant skin melanoma), Hep2 (epidermoid laryngeal carcinoma) and U937 (lymphoma). All four compounds dose dependently inhibited NO• through suppression of iNOS protein without affecting macrophage viability. Physcion and emodin caused 65–68% reduction of oedema volume at 40 mg/kg, which validated their in-vivo anti-inflammatory effect. 1-hydroxytectoquinone and oleanonic acid exhibited promising cytotoxicity against A375 cells.[64]

CARDIOPROTECTIVE EFFECT

Methanolic extract of whole plant was found to possess cardioprotective effect against Isoproterenol induced myocardial infarction.[65] A study was conducted to evaluate the anti-diabetic, anti-hyperlipidemic and antioxidant activity of *Ventilago madraspata*. Antidiabetic activity was evaluated by oral glucose tolerance test and streptozotocin-induced model. Anti-hyperlipidemic activity was evaluated by estimating lipid levels. In addition, *Ventilago madraspatana* was also evaluated for antioxidant activity employing catalase, lipid peroxidase and glutathione reductase methods. By soxhlet extraction process alcoholic, hydroalcoholic, chloroform and petroleum ether extracts were obtained. All these extracts except petroleum ether were evaluated for toxicity unto 3000 $mg.kg^{-1}$. In oral glucose tolerance test, chloroform extract did not produce significant glucose lowering effect. Alcoholic and hydroalcoholic extracts of *Ventilago madraspatana* elicited significant glucose tolerance effect. Hence, VMAE and VMHAE were screened further by streptozocin induced diabetic model. VMAE and VMHAE significantly lowered blood glucose, triglycerides, total cholesterol, LDL cholesterol, VLDL cholesterol, creatinine, urea and increased HDL cholesterol, serum insulin and liver glycogen levels when compared to standard drug glibenclamide (10 $mg.kg^{-1}$).*V.maderaspatana* also increased catalase levels and decreased lipid peroxidase and glutathione reductase. VMAE and VMHAE elicited significant dose-dependent anti-diabetic, anti-hyperlipidemic and antioxidant activity. VMHAE at 500 mg.kg-1 induced more significant anti-diabetic activity than VMAE (500 $mg.kg^{-1}$). VMAE at 500 $mg.kg^{-1}$ elicited more anti-hyperlipidemic and antioxidant activity compared to VMHAE (500 $mg.kg^{-1}$).[66]

OTHER PHARMACOLOGICAL ACTIVITIES

Ethanolic extract of *V. madraspatana* exhibit neuroproductive effect in cerebral ischemia by potentiating the antioxidant defence system of the brain.[67]Bark of this plant has hepato protective effect against CCl_4included liver damage.[68] Emodin as a phyto compound isolated from *V. madraspatana* possesses strong hepato protective abilities by reversal CYP activity and ultrastructure changes.[69] The root bark also has the hepato protective properties and as a natured antioxidants.[70, 71] The stem bark of this plant was found to possess anti-inflammatory and anticancer activities[48] and also used to cure gout.[72]

Arnebia euchroma

ANTICANCER EFFECTS

The phytocompound deoxyshikonin isolated from *Arnebia euchroma* significantly down regulated the proteins of PI3K and the p-Pl3K/Akt/mTOR pathway in HT29 and DLD-1 cells. Acetylshikonin isolated from *Arnebia euchroma* is a potential inhibitor of tumor growth in human lung adenocarcinoma cell A549.[73]
Preliminary clinical studies revealed that shikonin exerts additive and synergetic interactions in combination with potential pharmacological drugs used in cancer therapy.[74]

ANTI INFLAMMATORY EFFECTS

The polysaccharides available in *Arnebia euchroma* modulate body temperature, reduce the number of leukocytes, and improve the complement system and lung permeability, and lower oxidative stress.[75]In vivo studies of 10 mg/kg per day shikonin, a derivative of Lithospermum (the dry root of borage perennial, the herbaceous Plant), inhibits inflammation and chondrocyte apoptosis thorough the PI3K/Akt pathway.[76]The petroleum ether, chloroform, alcoholic and aqueous extracts of root in a dosage of 500 mg/kg orally, each were found to exhibit anti-inflammatory activity (61.2, 45, 27.5 and 60 percent, respectively) against carrageenin-induced rat paw oedema. The activity shown by petroleum ether and aqueous extracts was comparable to that shown by the standard drug ibuprofen (50mg/kg p.o.) against carrageenin-oedema.[77]

ANTI OBESITY EFFECTS

The prevalence of obesity is a global health issue linked to many metabolic complications. One comorbidity is metabolic syndrome, which is correlated with body waist circumference and abdominal fat thickness. Methods are widely available to reduce fat

International Journal of Pharmaceutical Research and Applications
Volume 9, Issue 3 May-June 2024, pp: 590-605 www.ijprajournal.com ISSN: 2456-4494

thickness around the abdomen, such as liposuction, to remove fat in specific parts External application of an ointment made with extracts of *Arnebia euchroma* were reported to have potential efficacy in obese women, and to reduce body weight (2.96 kg), abdominal fat thickness (2.3 cm), and abdominal circumference (11.3 cm).[78]

ANTIDIABETIC AND DIABETIC WOUND-HEALING ACTIVITY

A stereological study on rats orally administered *Arnebia euchroma* extract at a dose of 100 or 300 mg kg/body weight resulted in improved pancreatic islet volume, beta cell population and regulated blood glucose levels.[79]*Arnebia euchroma* also has potential applications for diabetic foot ulcers; significant effects were found for epithelial thickness and complete healing time.[80]The root phytochemical extracted by hexane and further formulated as an ointment had significant wound-healing activity.[81]Healing of wounds is a complex process leading to the regeneration of damaged skin tissue. Through its fibroblast-regulating activity, a gel made from *Arnebia euchroma* showed excision wound-healing properties.[82]

CYTOTOXIC ACTIVITY

Cytotoxic studies are one of the most important parameters for assessing the dose concentration that is safe for respective species. The meroterpenoids isolated from *Arnebia euchroma* gave potent IC50 activity against MMC-7721 (6.40 μM), HepG2 (3.86 μM), QGY-7703 (3.43 μM), and HepG2/ADM (11.31 μM) human liver cancer Cell lines.[83] Novel phytochemical compounds isolated from the roots were tested against cytotoxicity in different cancer cells (human leukemia cell CCRF-CEM, breast cancer cell MDA-MB-231, human glioblastoma cell U251, and colon cancer cell HCT 116); the propionyl alkannin had potent cytotoxic activity with low IC50 values.[84]Use of the extract of *Arnebia euchroma* against human gastric adenocarcinoma cells resulted in significant cytotoxic activity in a dose-dependent manner.[85]A study was conducted to determine the healing effect of *Arnebia euchroma* on second degree burn wounds in comparison to silver sulfadiazine ointment using pathological and unbiased stereological methods revealed that silver sulfadiazine and *Arnebia euchroma* had similar stimulatory impact on wound contracture.[86]

ANTIOXIDANT ACTIVITY

A study provides evidence that the antioxidant activities of *Arnebia euchroma (*AE) are greater than those of Lithospermum erythrorhizon(LE). Furthermore, the antioxidant activities of AE and LE are closely related to the total content of polyphenols, flavonoids and flavonols. Total polyphenols play a vital role in anti-oxidization. Hence, Zicao (Zicao include the roots of AE and LE) could be used as an easily accessible source of natural antioxidants in pharmaceutical and medicalIndustries.[87]

GENERAL PHARMACOLOGY

In a preliminary biological screening, the ethanolic extract of the plant revealed abortifacient activity in rat. The extract was devoid of antibacterial, antifungal, anthelmintic, antiviral and diuretic activities and effects on isolated guinea pig ileum, rat uterus, respiration, preganglionically stimulated nictitating membrane, CVS and CNS in experimental animals. The LD_{50} was found to be 825 mg/kg i.p. in mice.[88]

Arnebia nobilis

ANTIOXIDANT ACTIVITY

A study was conducted for the evaluation of In-vitro antioxidant potency of *A. nobilis* root extract and they were concluded that the plant is responsible for antioxidant properties and also the root extract has shown maximum antioxidant potency with IC50 value of 4.2μg/ml when compared with standard ascorbic acid with IC 50 value of 4.6 μg/ml.[89]

ANTIMICROBIAL ACTIVITY

The antimicrobial activity of the extracted dye and separated components of *A. nobilis* have studied. The extracted dye and its major component, alkannin β, β-dimethyl acrylate has also been evaluated as an antibacterial finish on various textile substrates viz. nylon, polyester, silk, wool, cotton and acrylic. The dye and its components showed excellent antimicrobial activity against both *S. aureus and E.coli.* Amongst the fabrics dyed with 5% dye, wool, silk and acrylic showed 100% activity against both the microbes. Polyester showed 100% activity against S. Aureus and ~ 80% activity against E. coli. Nylon and cotton showed no antimicrobial activity.[90]

ANTI-SKIN AGEING ACTIVITY

Anti-skin ageing activity of napthoquinones from *Arnebia nobilis* have studied. Among the four napthoquinones tested, the compound having larger lipophilic side chain, b-

International Journal of Pharmaceutical Research and Applications
Volume 9, Issue 3 May-June 2024, pp: 590-605 www.ijprajournal.com ISSN: 2456-4494

Acetoxyisovaleryl alkannin (AAN-II) possessed the strong antioxidant activity and inhibited H_2O_2 induced cellular senescence in dermal fibroblasts. The effect of AAN-II on collagen, elastin and involucre in suggests that they can help restore skin elasticity and thereby slow the ageing process. These red coloured alkannins possessing anti-ageing properties could be utilised in the development of natural colours for cosmetic products.[91]

ANTICANCER ACTIVITY

In view of the toxicity of arnebin-1, several metal complexes of arnebin-1 were prepared and evaluated for anticancer activity and antipassive cutaneous anaphylaxis. Zinc (II) and manganese (II) complexes were found to possess pronounced anticancer activity against Leukaemia P_{388}. Arnebin inhibited the antipassivecutaneousanaphylactic reaction in mice up to 90% whereas its metal complexes showed inhibition in the range of 30-60 per cent.[92]The effect of 50% of ethanolic extract of the root and its naphthaquinones, arnebin 1, 2, 3 and 4 were studied in rat Walker carcinoma 256. Arnebin-1and arnebin-3 was reported to be effective in anticancer fractions and In vitro studies against rat Walker tumour cells. Both significantly reduced the tumour weights in rats with inhibition index ranging between 68-79. Combination of arnebin-1 with both mitomycin-C and sulphone isothiocyanate was found to be more active in rat Walker tumour than either drug alone in comparable dosage. Arnebin-2 and arnebin-4 were not found active.[93]

WOUND HEALING

The wound healing activity of arnebin-1 was studied in cutaneous punch wound model. When applied topically daily on wounds of hydrocortisone-treated or untreated animals; arnebin-1 significantly accelerated healing of wounds as revealed by reduction in the wound width and gap as compared to controls. Arnebin-1 treatment promoted the cell proliferation, migration and vessel formation to form a thick granulation tissue and reepithelialisation of the wounds. An increase in the synthesis of collagen, fibronectin and transforming growth factor (TGF)-β1 was seen in arnebin-1 treated wounds compared with the untreated control. The enhanced expression of TGF- β1at both translational and transcriptional level by arnebin-1 might be responsible for the enhancement of wound healing during normal and impaired wound repair.[94]

Arnebia benthamii

PHARMACOLOGICAL STUDIES

FREE RADICAL SCAVENGING ACTIVITY

Study investigation of the radical scavenging potential of folklore medicinal herb – *Arnebia benthamii* and its competence in protection against DNA damage. The presence of shikonin (5,8-dihydroxy-2-(1-hydroxy-4-methyl-3-pentenyl)-1,4-naphthoquinone) in the plant was confirmed by HPLC quantification from its roots. The ethyl acetate extract of 50 µg/ml yields the 5.19µg/g shikonin. This ethyl acetate extract exhibited complete protection of DNA by quenching of hydroxyl radicals. The activity of plant extract was also compared with the synthetic shikonin which also validates the presence of dye like substance for the augmenting antioxidant defence system.[95] DPPH radical scavenging and hydroxyl radical scavenging potential of the plant revealed that the extract to be active radical scavenger. Reducing (Fe (3+)- Fe(2+)) power and lipid peroxidation inhibition efficiency (TBARS assay) of the extract was also evaluated and the extract showed promising activity in preventing lipid peroxidation and might prevent oxidative damages to biomolecules. The extract offered a significant protection against plasmid and calf thymus DNA damage induced by hydroxyl radicals. The extract was also evaluated on different bacterial strains and the maximum antibacterial activity was exhibited against Escherichia coli (E. coli) when compared with standard drug.[96]

Alkanna tinctoria

PHARMACOLOGICAL STUDIES

Anticancer Activity

Akanna species have different promising potential to treat diverse types of human cancer. Root bark of A. tinctoria (L.) contains alkannin and angelylalkannin compounds which have the capability to inhibit the proliferation of the human colon cancer cells by arresting the cancer cell cycle at the G1 phase resulted in apoptotic induction activity.[97]

Wound Healing Activity

The effect of *A. tinctoria* (L.) on burn wound healing in rabbits were studied and concluded that 16 % solution of *A. tinctoria* accelerates partial thickness burn wound and olive oil burn wound healing.[98]

Anti-Bacterial Activity

International Journal of Pharmaceutical Research and Applications
Volume 9, Issue 3 May-June 2024, pp: 590-605 www.ijprajournal.com ISSN: 2456-4494

A study was carried out to evaluate the biological potential of *Alkanna tinctoria* leaves extract against multidrug resistant human pathogenic bacteria. Anti-multi-drug resistant bacterial activity of aqueous, chloroform, ethanol and hexane extracts of *Alkanna tinctoria* leaves were evaluated by well diffusion method. Minimum inhibitory concentrations (MICs) and minimum bactericidal concentrations (MBCs) of different extracts were determined. All four selected bacteria including *A. baumannii, E. coli, P. aeruginosa* and *S. aureus* were categorized as multi-drug resistant (MDR) as they were found to be resistant to 13, 10, 19 and 22 antibiotics belonging to different groups respectively. All the four-extract showed potential activity against *S. aureus* as compare to positive control antibiotic (Imipenem). Similarly, among the four extracts of *Alkanna tinctoria* leaves, aqueous extract showed best activity against *A. baumannii* (10 ± 03 mm), *P. aeruginosa* (12 ± 0.5 mm), and *S. aureus* (14 ± 0.5 mm) as compare to Imipenem. The MICs and MBCs results also showed quantitative concentration of plant extracts to inhibit or kill MDR bacteria. When phytochemicals analysis was performed it was observed that aqueous and ethanol extracts showed phytochemicals with large number as well as volume, especially Alkaloides, Flavonoides and Charbohydrates.[99]

Cardiovascular Health

Alkanna root contributes considerably to maintain the health of heart. This can be done by soaking alkanet root into the water and extract the essence to be drunk. Frequent use of the alkanet root can help to release the poison out of the body and optimize the function of heart to circulate the blood. Alkanna roots also have hypo-tense impact to control stress on cardiovascular system and are very effective to reduce higher blood pressure. This also may help to prevent and prohibit heart attack to be occurred and reduce the risk of stroke disease. This may be related to antioxidant activity that plays an important role for scavenging the free radical which normally is by-products of metabolism, and they are introduced into the body from external sources of harmful chemicals in the environment or during day life. Alkanna roots able to neutralize the free radicals and protect the body from cell damage.[100]

Antifungal and Skin Healing

Alkanna root has anti-fungi activity and able to heal any diseases related to skin fungi such as phlegm, ringworm, and eczema on your skin disorder.[101]

Herpes Treatment

Anti-viral property of Alkanna roots gives this plant the ability to cure viral diseases like herpes. Herpes is such immunity and skin disorder which lead to a very serious illness of skin scare or skin bleeding. Herpes is caused by virus which can be improved by using Alkanna root due to its antiviral activity.[102]

International Journal of Pharmaceutical Research and Applications
Volume 9, Issue 3 May-June 2024, pp: 590-605 www.ijprajournal.com ISSN: 2456-4494

Table 4: Summary of the Activities reported from the source plants and adulterants.

PLANT	ACTIVITIES
Ventilago madraspatana	Antidiabetic Activity, Antimicrobial and Antibacterial, Antioxidant Activity, Cardioprotective Effect.
Arnebia euchroma	Anticancer Effects, Anti Inflammatory Effects, Anti-Obesity Effects, Antidiabetic and Diabetic Wound-healing Activity, Cytotoxic Activity, Antioxidant Activity.
Arnebia nobilis	Antioxidant Activity, Antimicrobial Activity, Anti-skin Ageing Activity, Anticancer Activity, Wound Healing,
Arnebia benthamii	Free Radical Scavenging Activity
Alkanna tinctoria	Anticancer Activity, Wound Healing Activity, Anti-bacterial Activity, Supports and Promotes High Performance Cardiovascular Health. Antifungal and Skin healing activity.

III.

IV. DISCUSSION

From the previous studies it is confirmed that *dineśavallī* of south India is equated with *'Ratanjot'*- a herbal dye of North India. From the literature review, roots of Arnebia and Alkanna which is sold as 'Ratanjot' - a herbal dye, in some markets. As per Khatoon et. al., 2003, Ratanjot is attributed to eight species of Boraginacae species belonging to genera Alkanna, Arnebia, Maharanga and Onosma and regarded as one of the important herbal drugs of indigenous systems of medicine.[1] The root and root stock, which form the actual drug, are considered to be an anthelmintic, antipyretic and antiseptic. They are also claimed to be useful in burn, eczema, wounds and eruptions, and used for treating the diseases of eyes, bronchitis, abdominal pains, itch, etc.

V. CONCLUSION

Dineśavallī locally known as *Vēṁpāta* is a very popular South Indian drug used in many Āyurvēdic medications for skin-related ailments. There are no direct references to *dineśavallī* in any *bṛhatrayī* or *laghutrayī.* On detailed analysis, the first reference of *Vēṁpāṭa* was obtained from *kairalivyākhyāna* on the *Aṣṭāṅgahṛdaya.*

Various synonyms of *Vēṁpāṭa* were mentioned in traditional books of Kerala. It is found that *dineśavallī* got synonyms like *arkavallī, raktavallī* in which have the synonyms of 'sun', and mainly used for pacifying skin ailments and also in conditions of *vāta-kapha* origin. It has *kaṣāya, tikta rasa* in which, *kaṣāya rasa* of the drug helps in *asṛaviśōdhana,* pacifies the vitiated *rakta* and *pitta.* The drug acts as *tvakprasādana* since *tiḳta rasa* is having *tvacya* property. So, we can say that the plant known by the names *dineśavallī, niśāta, sūryavallī, arkavallī,* and *suryāvartaka* in some traditional books of Kerala is *Vēṁpāṭa* itself.

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ABBREVIAITONS
C.S: Carakasaṃhitā.
S.S: Suśrutasaṃhitā.
AH:Aṣtāngahṛdaya.
V.M: Vaidyamanōrama
A.M:Âlatturmanipravālaṃ
C.M: Cikitsamañjari
S.Y: Sahasṛayōgaṃ
Y.S:Yōgasāraṃ
Y.M: Yōgāmṛtaṃ
P.S: Prayōgasamucayaṃ
V.J:Viṣavaidyajyotsnika

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International Journal of Pharmaceutical Research and Applications
Volume 9, Issue 3 May-June 2024, pp: 590-605 www.ijprajournal.com ISSN: 2456-4494

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