REVIEW ARTICLE

Wound healing activity of certain root drugs - A review from classical and ethnomedicinal claims

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Abstract

Drugs of herbal origin consist a major part in all traditional systems of medicine. Recently, focus on plant research is increased, due to the great potential of medicinal plants used in various traditional systems. Wounds are one of the major causes of physical disabilities. Traditional medicinal plants are remarkable for their significant potential to treat wounds in different tribal areas, all over the world. Many ethnomedicinal survey reports, research articles, and books have been published highlighting the use of medicinal plant for the management of wound. Recent research reveals that some of these plants are renowed either clinically or experimentally for their wound healing activities. Many plants are yet to be studied for their traditional claims. Single hand information regarding these plants with their specific parts used is still lacking. Present study reports the wound healing activity of 221 root drugs, being reported in 14 books and 70 research articles, related to ethnobotany and ethnomedicine. It is noticed that roots of ethnomedicinal plants belonging to 72 families (*Fabaceae* - 13, *Rubiaceae* - 12, *Vitaceae* - 11, *Euphorbiaceae* - 11, *Asteraceae* - 9, etc.) are reported for their wound healing activity. Among them, 122 plants reported for topical application, 6 for oral administration, and 6 for both oral and topical. Maximum drugs are used in paste form followed by juice, decoction, and ash form.

Key words: Ethnobotany, folklore, root drugs, traditional medicine, wound

INTRODUCTION

Wounds are physical injuries that result in an opening or break of the skin that causes disturbance in the normal skin anatomy and function. They result in the loss of continuity of epithelium with or without the loss of underlying connective tissue.[1] The prevalence of wounds in the population studied is 15.03/1000. The prevalence of chronic wounds in the community is reported as 4.5/1000 population, whereas that of acute wounds is nearly doubled at 10.5/1000 population.[2]

Healing of wounds starts from the moment and can continue for varying periods of time depending on the extent of wounding. The process can be broadly categorized into three stages: Inflammatory phase, proliferative phase, and finally, the remodeling phase which ultimately determines the strength and appearance of the healed tissue.[3] Wound healing agents are agents that can stimulate fibroblast proliferation, induce keratinocytes proliferation and differentiation. They can also increase collagen formation, exhibit antimicrobial, antioxidant, and anti-inflammatory properties. In most cases, for an agent from medicinal plants or natural product to be classified as a good wound healing agent, it should possess two or more of the above properties.[4,5]

Medicinal plants have been reported to be very beneficial in wound care, promoting the rate of wound healing with minimal scarring to the patient.[6] In traditional medicine, all over the world, a wide range of plant preparations are employed as wound healing agents. Natural product research is often based on ethnobotanical information and many of

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the drugs used today were developed from medicinal plants employed in indigenous societies.[7]

Various plants in different dosage forms are used by tribals and folklore traditions for treatment of wounds, cuts, and burns. Many ethnomedicinal survey reports, research findings, and books have been published highlighting the use of plant drug for the management of wound healing.[8] Single hand information regarding the plant with their specific parts used except leaves[9] for wound healing activity is still lacking.

Hence, the present research work has been planned with an aim to compile the root drugs reported for their wound healing activity in published ethnobotanical and ethnomedicinal books and research articles. For this purpose, the ethnomedicinal plants which have been reported for their use in cuts, wounds, burns, etc., wherein root as the part used, were noted down in a specially designed format in regard to their botanical names with family, local name, dosage form, route of drug administration, and tribal areas followed by references. The review was carried out during January 2017–June 2018. Available 14 books and 70 research articles related to ethnomedicine, ethnobotany, and ethnopharmacology were reviewed. Each book and research article referred, for easy recording purpose, were assigned with a serial referencing number. The details of the referencing number assigned for books are as follows: Ethnobotany and Medicinal Plants of Indian Subcontinent,[10] Ethnobotany in South Asia,[11] Medicinal Plants: Ethnobotany Approach,[12] A Lexicon of Medicinal Plants in India, vol.-I,[13] The Medicinal and Poisonous Plants of India,[14] Medicinal Plants in India, vol.-I,[15] Medicinal Plants in India, vol.-II,[16] Ethnobotany of Santhal Pargana,[17] Medicinal Plants of Uttaranchal State,[18] An appraisal of Tribal-Folk Medicines,[19] Glimpses of Medico-Botany of Bastar district (Madhya Pradesh),[20] Medico-Botanical Exploration of Phulbani and Koraput district of Orissa,[21] Medicinal Plants of Nagpur and Wardha Forest Division, Maharashtra,[22] and Notable plants in Ethnomedicine of India.[23] The numbers in bracket in reference column of Table 1 are denoting the page numbers of books.

The details of the reference number for research articles, presented according to the first author, assigned are as follows: Prusti and Behera 2007,[24] Nallella Sreeramulu *et al.*, 2013,[25] Thomas *et al.*, 2004,[26] Patel 2014,[27] Amri and Kisangau 2012,[28] Inngjerdingen *et al.*, 2004,[29] Dash *et al.*, 2011,[30] Jyoti *et al.*, 2012,[31] Das *et al.*, 2003,[32] Latheef *et al.* 2014,[33] Dey *et al.*, 2012,[34] Sahu *et al.,* 2014,[35] Ayyanar *et al.*, 2009,[36] Bhardwaj *et al.*, 2005,[37] Suthari *et al.*, 2014,[38] Wadankar *et al.*, 2011,[39] Manikandan 2005,[40] Kota *et al.*,[41] Muthu *et al.,* 2006,[42] and Mallik *et al.* 2012.[43]

Major classical texts of Ayurveda, i.e., *Bhrihatrayee* were refered for *Sandhaniya* (healers of wound), *Vrana shodhana* (cleanses wound), *Dushta vrana vishodhana* (cleanses septic wound), *Vranya* (beneficial in wound), and *Vrana ropana* (wound healing) activities of various plant drugs being described in various vargas/ganas (group of drugs) in these texts.

Abbreviations were made for the local name of plants. Details of abbreviation used are as follows: Andm - Andamanese, Asm - Assamaese, Bn - Bengali, E - English, Guj - Gujarati, H - Hindi, Hp - Himachal, Kd - Kadar, Kmn - Kumaon, Kn - Kannada, Ldk - Ladakhi, Lut - Local Uttaranchal, Mizo - Mizorami, Ml - Malayalam, Mnd - Mundari, Mr - Marathi, Ncb - Nicobarese, O - Oriya, Pun - Punjabi, Raj - Rajasthani, S - Sanskrit, Sik - Sikkimese, Snt - Santali, Tel - Telugu, and Tm - Tamil. In route of administration, "T" is denoting topical application and "O" is for oral administration.

WOUND HEALING PLANTS

Present study reports 221 plants (root as useful part), compiled from 14 books and 70 research articles related to ethnobotany and ethnomedicine, being reported for their wound healing activity [Table 1].

TRIBAL AREAS

The use of root drugs by different tribal population in different tribal parts of the world is reported in Table 1. Among these plants, many plants were reported for the same activity from different tribal areas of the world indicating their ample uses. *Curcuma longa* (Zingiberaceae) was reported from maximum six tribal areas (Assam, Bihar, Chhattisgarh, Maharashtra, Tamil Nadu, and Uttarakhand), while *Achyranthes aspera* (Amaranthaceae), *Boenninghausenia albiflora* (Rutaceae), *Eclipta prostrata* (Asteraceae), and *Sida cordifolia* (Malvaceae) were from four tribal areas: *A. aspera* from Andhra Pradesh, Odisha, Uttar Pradesh, and Uttarakhand; *B. albiflora* from Andhra Pradesh, Arunachal Pradesh, Meghalaya, and Uttarakhand; *E. prostrata* from Assam, Odisha, Tamil Nadu, and Uttarakhand; *S. cordifolia* from Chhattisgarh, Maharashtra, Odisha, and Uttarakhand. Reporting of a single drug from many tribal areas indicates the wider use of this drug.

ROUTE OF ADMINISTRATION

Among these ethnomedicinal plants, 122 plants reported for topical application, 6 for oral administration, and 6 for both oral and topical [Table 2]. Remaining 87 plants were not mentioned for any particular route of administration in the referred sources. Non-reporting of the route of drug administration indicates its external application from its dosage form.

Table 1: Ethnomedicinal root drugs highlighted for their wound healing activity

S. No.	Botanical name (Family)	Local names	Mode of administration	Route of administration	Tribal area	References
1.	*Abelmoschus moschatus* Moench. (Malvaceae)	Banbhindi, Janglibhindi, Muska-dana	Paste	-	-	11 (138)
2.	*Abrus precatorius* L. (Fabaceae)	Ghumchi, Ratti (H); Kawet kara lattha (Snt)	Paste with mustard oil	T	Santhal Pargana, Bihar	11 (138), 15 (7), 17 (19)
3.	*Abutilon indicum* (L.) Sweet (Malvaceae)	Bonabhendi	Fresh root is eaten raw	O	Malkangiri, Orissa	24
4.	*Acacia pennata* (L.) Willd. (Fabaceae)	Ari (S), Kuchaya; Biswal	Roots are crushed with black pepper seeds	-	Haryana	11 (112), 12 (147), 15 (17)
5.	*Achyranthes aspera* L. (Amaranthaceae)	Uttareni	-	-	Nalgonda and Warangal, A. P.	25
		Apamarga (S); Aspmarango	Paste	T	Bhadrak, Odisha; North Eastern U.P.; Uttarakhand	10 (499), 11 (192), 12 (262), 18 (386), 19 (314)
6.	*Acorus calamus* L. (Araceae)	Vacha (S)	Powder	-	Kullu, H.P.	10 (185), 11 (350), 13 (42)
7.	*Acorus gramineus* Soland ex Ait. (Araceae)	-	-	-	Meghalaya	13 (44), 19 (303)
8.	*Acronychia pedunculata* (L.) Miq. (Rutaceae)	Loajan (Asm); Bhutali (Kn)	-	T	Meghalaya, Assam, Karnataka	13 (45), 15 (27)
9.	*Acrostichum aureum* L. (Pteridaceae)	Paku laut	Pounded to paste	-	-	11 (375)
10.	*Adhatoda vasica* Linn. (Acanthaceae)	Vasa (S); Basanga (O)	Powder	T	-	10 (467), 18 (356)
11.	*Adiantum venustum* D. Don (Polypodiaceae)	Hansraj (H)	Paste	-	-	11 (414)
12.	*Agave cantula* Roxb. (Agavaceae)	Kattahaalla	-	T	Wayanad, Kerala	26
13.	*Ainsliaea aptera* DC. (Asteraceae)		Powder	-	Kullu, H.P.	10 (185)
14.	*Albizia procera* (Roxb.) Benth. (Fabaceae)	Safed shiris, Gurar, Karra, Karro (H)	Powder of root bark	T	Uttarakhand	11 (439)
15.	*Aleurites moluccana* (L.) Willd. (Euphorbiaceae)	Jangli akhrot (H); Asphotaka, Phalasneha (S)	Paste of root bark	-	Assam	15 (35)
16.	*Aleuritopteris farinasa* (Forsk.) Fee. (Pteridaceae)	Dubani sinka, rani sinka	Juice	-		11 (414)
17.	*Alisma plantago-acquatica* L. (Alismataceae)	Water-plantain	-	-	Haryana	12 (147)

(Contd...)

Table 1: *(Continued)*

S. No.	Botanical name (Family)	Local names	Mode of administration	Route of administration	Tribal area	References
18.	*Allium cepa* L. (Liliaceae)	Palandu, Sukandaka (S); Onion (E)	Paste	-	Madhya Pradesh; Bilaspur, Chhattisgarh	13 (90), 27
19.	*Allium sativum* L. (Liliaceae)	Rasona (S)	Juice of garlic fried in mustard oil	T	Madhubani and Sitamarhi, Bihar; Uttarakhand	10 (651), 18 (450)
20.	*Alocacia indica* (Roxb.) Schott. (Araceae)	Manakanda (H)	Ash	-	Assam; South India	13 (97)
21.	*Alpinia malaccensis* Rosc. (Zingiberaceae)	Saliyeridumpa (Tm)	-	-	Eastern and Western Ghats	13 (104)
22.	*Amorphophallus paeoniifolius* (Dennestedt.) Nicolson (Araceae)	Surum kanda	Paste	T	Koraput, Odisha	21 (111)
23.	*Ampelocissus latifolia* (Roxb.) Panch (Vitaceae)	Panibel (H)	-	T	-	15 (51), 19 (320)
24.	*Ampelocissus tomentosa* (Heyne ex Roth) Planch. (Vitaceae)	Devunimal	Paste	T	Koraput, Odisha	21 (112)
25.	*Annona senegalensis* Pers. (Annonaceae)	-	Paste	T	-	28
		Jankoonno	Decoction	O	Dogonland, West Africa	29
26.	*Anogeissus latifolia* (Roxb. ex DC.) Wall. Ex Guill. and Perr. (Combretaceae)	Bhuyi dhavidi	Pounded and tied	T	Bastar, Madhya Pradesh	20 (99)
27.	*Argemone maxicana* L. (Papaveraceae)	Dhamoi (Snt) Siyal Kata	Paste	T	Tezpur, Assam	30, 31
28.	*Arisaema atrorubens* Blume (Araceae)	Mitthi-vaimin	Roasted	-	-	11 (439)
29.	*Arisaema curvatum* Kunth. (Araceae)	Koa-ghoch (H)	Paste	-	-	19 (307)
30.	*Arisaema speciosum* (Wall.)Mart. (Araceae)	Sanpbuti (H); Gurba (Sik)	-	-	Sikkim	13 (181)
31.	*Aristolochia bracteolate* L. (Aristolochiaceae)	Gadida garapa	-	-	Nalgonda and Warangal, Andhra Pradesh	25
32.	*Arnebia benthamii* Wallich ex Don (Boraginaceae)	-	Juice, paste alternate day	T	Almora, Uttarakhand	10 (247)
33.	*Asclepias curassavica* L. (Asclepiadaceae)	Bharadwaji (S); Kakatundi, Kaura dodi (H)	Powder with Acorus root	T	Uttarakhand	15 (75), 18 (310)

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Table 1: *(Continued)*

S. No.	Botanical name (Family)	Local names	Mode of administration	Route of administration	Tribal area	References
34.	*Asparagus racemosus* Willd. (Liliaceae)	Insungi	Root powder mixed with water	T	Koraput, Odisha	32
		Satavar	-	-	Haryana, Uttarkhand	12 (147), 13 (205), 15 (77), 18 (454)
35.	*Atalantica monophylla* (Roxb.) DC. (Rutaceae)	-	-	-	Konkan	13 (212)
36.	*Baliospermum montanum* Mull-Arg. (Euphorbiaceae)	Danti (S)	-	-	Uttarakhand	14 (190), 18 (402)
37.	*Barleria prionitis* L. (Acanthaceae)	Sahachara (S); Katseraya, Jhinti	Crushed	T	Haryana	12(147), 13 (241), 18 (355)
		Koranta	Paste	T	Nagpur, Maharashtra	22 (21)
38.	*Barringtonia asiatica* (L.) Kurz. (Lecythidaceae)	Cingola, Dod-da (Andm)	-	-	Andaman and Nicobar	13 (244)
39.	*Bauhinia purpurea* L. (Fabaceae)	Kaliar, Khairwal (H); Rakta kanchan	-	O	Mahabubnagar, Andhra Pradesh	10 (341), 12 (147), 13 (249)
40.	*Bauhinia reticulata* DC. (Fabaceae)	Koibo	Juice	T	Dogonland, West Africa	29
41.	*Berberis aristata* DC. (Berberidaceae)	Daruharidra	Paste of root bark	T	Kullu, Himachal Pradesh; Uttarakhand	13 (260), 18 (73)
42.	*Bergenia ciliata* (Haw.) Sternb. (Saxifragaceae)	Pashaanabheda (S)	-	-	Uttarakhand	15 (95), 18 (207)
		Pakharabheda (H)	-	-	Uttar Pradesh	13 (267)
43.	*Berginia stracheyi* (Hk. and Th.) Engler. (Saxifragaceae)	Gheepati (Kmn)	-	-	Kumaon, Uttarakhand	13 (269)
44.	*Boenninghausenia albiflora* (Hk.) Reichb. Ex Meissn. (Rutaceae)	Pishumar, Upniyaghas (Lut)	Paste	T	Arunachal; Meghalaya; Uttarakhand	13 (293), 18 (128)
		Nukmman	Paste	T	Kameng, Andhra Pradesh	23 (47)
45.	*Boerhavia diffusa* L. (Nyctaginaceae)	Serende	Paste	T	Attappady, Kerala	33
46.	*Botrychium virginianum* Sw. (Ophioglossaceae)	Moonwort (E)	-	T	Uttarakhand	14 (45)
47.	*Butea monosperma* (Lamk.) Taub. (Fabaceae)	Palasha (S); Dhak(H)	Powder of root bark	T	Uttarakhand	18 (167)
48.	*Byttneria herbacea* Roxb. (Sterculiaceae)	Kamraj, Idel sanga	Paste	T	Purulia, West Bengal	34
49.	*Cadaba fruticosa* (L.) Druce (Capparaceae)	Kodhab (H); Dabi	-	-	Haryana	12 (147)

(Contd...)

Table 1: *(Continued)*

S. No.	Botanical name (Family)	Local names	Mode of administration	Route of administration	Tribal area	References
50.	*Calophyllum inophyllum* Linn. (Clusiaceae)	Sultanchampa (H); Punnaga (Bng); Nagachampa(S)	Decoction	T	Medagascar	14 (428)
51.	*Calotropis gigantea* (L.)R.Br. (Asclepiadaceae)	Rui (M); Madar (H); Parkha (Snt)	Powder	-	Santhal Pargana, Bihar	13 (346), 19 (315)
52.	*Calotropis procera* (Aiton) W.T. Aiton (Asclepiadaceae)	Aak/Shishudurw	Paste	O and T	Dantewada, Chhattisgarh	35
		Poobu	Powder of dried internal root bark	T	Dogonland, West Africa	29
53.	*Capparis decidua* (Forsk.) Edgew. (Capparaceae)	Karirah (S); Karil (H)	-	-	-	15 (119), 19 (321)
54.	*Capparis sepiaria* L. (Capparaceae)	Hains	Paste	T	-	11 (138)
55.	*Capparis spinosa* Linn. (Capparaceae)	Caper plant (E)	Macerated roots	T	Kangra, Himachal Pradesh	14 (269)
56.	*Capsicum frutescens* L. (Solanaceae)	Pilipililukwale	Crushed or pounded	T	Kimboza Forest, Tanzania	28
57.	*Carissa carandas* L. (Apocynaceae)	Karandakoli	-	-	Mayurbhanj, Odisha	32
		Karaunda	Paste	T	North Eastern Uttar Pradesh	12 (259), 19 (318)
58.	*Carissa congesta* Wight.(Apocynaceae)	Karamarda (S)	Paste	T	Uttarakhand	18 (303)
59.	*Catharanthus roseus* (L.) G. Don (Apocynaceae)	Sada sawagaon (H)	Paste	-	Lodha tribes	13 (398)
60.	*Cayratia trifolia* (L.) Domin. (Vitaceae)	Gandira (S)	Poultice	T	-	15 (146)
61.	*Ceiba pentandra* (L) Gaertn. (Bombacaceae)	Panjimaram	Paste of root bark	T	Wayanad, Kerala	26
62.	*Celastrus paniculatus Willd.* (Celastraceae)	Jyotishmati (S); Malkangni (H)	Paste of root bark	-	Lodha tribes	13 (406)
63.	*Chasalia chartacea* Craib. (Rubiaceae)	Vellakurinji (Tm)	-	T	Sikkim, Assam	13 (422)
64.	*Chasalia curviflora* Wall. ex Kurz. (Rubiaceae)	Mundanchedi (Tm)	Root is ground into a paste with water	T	Tirunelveli Hills, Southern India	36
65.	*Cheilanthus farinosa* Kaulf. (Pteridaceae)	-	-	-	-	11 (24)
66.	*Chrozophora rottleri* A.Juss. ex Spreng. (Euphorbiaceae)	Suryavarta (S); Shadevi, Subali (H)	-	-	Santhal pargana, Bihar	13 (429)

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Table 1: *(Continued)*

S. No.	Botanical name (Family)	Local names	Mode of administration	Route of administration	Tribal area	References
67.	*Cirsium sinense* C.B. Clarke (Asteraceae)	Len-hling (Mizo)	Root is crushed and tied on the wounds	T	Saiha, Mizoram	11 (439), 37
68.	*Cissampelos pareira* L. (Menispermaceae)	Ponmutootai	-	T	Wayanad, Kerala	26
		Patha (S); Tubuki lot (Asm)	Root ash	T	North Eastern Uttar Pradesh	11 (338), 12 (259), 19 (324)
69.	*Cissus pallida* Planch. (Vitaceae)	Nalla teega	-	-	Northern Telangana	38
70.	*Cissus populnea* Guill. and Perr. (Vitaceae)	Jumbo	Powder	T	Dogonland, West Africa	29
71.	*Cissus quadrangularis* L. (Vitaceae)	Nalleru (Tel); Perandai (Tm)	Powder, paste	O and T	Dharmapuri, Tamil Nadu; Bihar	10 (395), 13 (443)
72.	*Cissus repanda* Vahl. (Vitaceae)	Bod-lar-nari (Snt)	Powder heated and applied	T	Santhal Pargana, Bihar	17 (28)
73.	*Clematis graveolens* Lindl. (Ranunculaceae)	-	Paste	T	-	11 (82)
74.	*Clitoria ternatea* L. (Fabaceae)	Aparajita	Paste	T	Tezpur, Assam	31
75.	*Cnisus sinensis* Gard. (Poaceae)	K'u Ao (Chinese)	-	T	Khasia hills, India; China	14 (336)
76.	*Colocasia esculenta* (L.) Schott. (Araceae)	Gowsingo	Paste mixed with castor oil	T	Bolangir, Odisha	32
77.	*Combretum albidum* (Combretaceae)	Bontha teega	Root bark	-	Northern Telangana	38
78.	*Combretum glutinosum* Perr. ex DC. (Combretaceae)	Bannakile	Powder	T	Dogonland, West Africa	29
79.	*Combretum micranthum* G. Don (Combretaceae)	K´ek´e	Powder of root bark	T	Dogonland, West Africa	29
80.	*Combretum molle* R.Br. ex G. Don. (Combretaceae)	Mlamweusi	Decoction	O	Kimboza Forest, Tanzania	28
81.	*Commelina suffruticosa* Bl. (Commelinaceae)	Dare orsa (Snt)	-	T	Santali	14 (127)
82.	*Coscinium fenestratum* (Gaertn.) Colebr. (Menispermaceae)	Jhar-ki-haldi (H); Daruharidra (S)	-	T	South India	14 (171)
83.	*Costus speciosus* (Koem.)Sm. (Costaceae)	Keu (H); Keu kand	Paste	-	Bilaspur, Chhattisgarh	11 (268), 27
		Penva, Pushkarmula	-	-	Washim, Maharashtra	39

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Table 1: *(Continued)*

S. No.	Botanical name (Family)	Local names	Mode of administration	Route of administration	Tribal area	References
84.	*Cotoneaster microphyllus* Wall. (Rosaceae)	-	Paste	T	Uttarakhand	18 (206)
85.	*Crinum asiaticum* L. (Amaryllidaceae)	Penjari gadda	-	-	Nalgonda and Warangal, Andhra Pradesh	25
		Nagdamani (S)	-	-	-	15 (187)
86.	*Curculigo capitulata* (Lour.) O.Kuntze (Hypoxidaceae)	Phai-phek	Juice	T	-	11 (439)
87.	*Curculigo orchioides* Gaertn. (Hypoxidaceae)	Khansaba; Kali moosli (H)	Paste, powder	T	Santhal Pargana, Bihar	12 (259), 15 (195), 17 (30), 19 (316)
		Kovaa Kaanda	Paste	T	Koraput, Odisha	21 (121)
88.	*Curcuma angustifolia* Roxb. (Zingiberaceae)	Jangli haldi	Paste	-	-	11 (192)
89.	*Curcuma aromatica* Salisb. (Zingiberaceae)	Vanaharidra(S)	Paste	-		19 (318)
90.	*Curcuma domestica* Valeton (Zingiberaceae)	Aieng (Mizo)	Tuber is mashed and warmed	T	Lunglei, Mizoram	37
91.	*Curcuma longa* L. (Zingiberaceae)	Manjal	Paste	T	Nilgiri, Tamil Nadu	40
		Haldi	-	-	Bilaspur, Chhattisgarh	27
		Haladhi	Rhizome is grond into paste and mixed with mustard oil	T	Tezpur, Assam	31
		Haldi (H); Haridra (S)	Paste	T	Hazaribagh, Bihar; Uttarakhand	10(545), 11 (318), 13 (512), 18(441)
		Halad, Haladee	Hot paste of powder	T	Washim, Nagpur and Wardha, Maharashtra	22 (37), 39
92.	*Curcuma pseudomontana* J. Graham (Zingiberaceae)	Adavi pasupu	-	-	Nalgonda and Warangal, Andhra Pradesh	25
93.	*Cyanoglossum glochidiatum* Wall. (Boraginaceae)	Latenga	Paste	T	Purulia, West Bengal	34
94.	*Cyathula prostrata* (L.)Bl. (Amaranthaceae)	Raktapamargah (S); Devil's grass (E)	-	-	-	15 (200)
95.	*Cyclea peltata* (Lam.) Hook.f. and Thomas (Menispermaceae)	Path, Pathi, Parvel (H); Durva, Patha(S)	-	-	-	15 (201)
96.	*Cynodon dactylon* L. (Pers.) (Poaceae)	Durva (S); Dub (H)	-	T	Santal, Bihar	13 (522)

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Table 1: *(Continued)*

S. No.	Botanical name (Family)	Local names	Mode of administration	Route of administration	Tribal area	References
97.	*Cynoglossum zeylanicum* Thunb. ex Lehm. (Boraginaceae)	Huringjikipota (Mnd)	-	-	Bihar	13 (524)
98.	*Cyperus rotundus* L. (Cyperaceae)	Mustaka (S)	Paste	T	Uttarakhand	13 (525), 14 (29), 18 (463)
99.	*Dactylorhiza hatagirea* D.Don (Orchidaceae)	-	Paste	T	Kullu, Himachal Pradesh	10 (185)
100.	*Datura metel* Linn. (Solanaceae)	Dhattura (S)	-	-	Uttarakhand	18 (331)
101.	*Daucas carota* L. (Apiaceae)	-	Juice of the root is mixed with honey	T	Khargone, Madhya Pradesh	41
		Gajar	-	-	Washim, Maharashtra; Bilaspur, Chhattisgarh	27, 39
102.	*Delphinium denudatum* Wall. ex Hook.f. and Thomas (Ranunculaceae)	Nirvisha (S)	-	-	-	15 (213)
103.	*Dioscorea bulbifera* L. (Dioscoreaceae)	Varahikanda (S); Mataru	Dried powder	T	Uttarakhand; Nagpur and Wardha, Maharashtra	18 (440), 22 (40)
104.	*Dissotisrotundifolia* (Sm.) Triana. (Melastomataceae)	Kinzasu	Crushed or pounded; Decoction	O and T	Kimboza Forest, Tanzania	28
105.	*Drynaria quercifolia* (L.) J. Smith (Polypodiaceae)	Asvakatri (H,S)	-	-	-	15 (227)
106.	*Dryopteris chrysocoma* (Christ) C. Chr. (Dryopteridaceae)	Chyamle (Npl)	Paste	-	Nepal	11 (414)
107.	*Dryopteris schimperiana* (Hochst.) C. Chr. (Dryopteridaceae)	Seth (Npl)	Grounded with water	T	Nepal	19 (307)
108.	*Dryopteris sparsa* (D. Don) Kuntze (Dryopteridaceae)	Jire nyuro, Kuthurke (Npl)	Paste	-	Nepal	11 (414)
109.	*Echinops echinatus* Roxb. (Asteraceae)	Utakanja; Brahmadandi	Paste	T	Mahabubnagar, Andhra Pradesh	10 (341), 11 (175)
110.	*Eclipta prostrata* L. (Asteraceae)	Bhringaraja (S); Karisalankanni (Tm)	Paste	T	Phulbani, Odisha; Dharmapuri, Tamil Nadu; Uttarakhand	10 (395), 10 (515), 18 (265)

(Contd...)

Table 1: *(Continued)*

S. No.	Botanical name (Family)	Local names	Mode of administration	Route of administration	Tribal area	References
		Keheraj	Roots are ground into paste and mixed with coconut oil	T	Tezpur, Assam	31
111.	*Elephantopus scaber* Linn. (Asteraceae)	Moyuro chandrika		T	Koraput, Odisha	21 (125)
112.	*Eriolaena quinquelocularis* Wight. (Sterculiaceae)	-	-	-	-	14 (486)
113.	*Euphorbia balsamifera* Ait. (Euphorbiaceae)	Gommuju	Decoction of root bark	T	Dogonland, West Africa	29
114.	*Euphorbia nerifolia* L. (Euphorbiaceae)	Snuhi (S); Sehund (H)	-	T	Haryana	12 (147), 19 (304)
115.	*Euphorbia nivulia* Buch.-Ham. (Euphorbiaceae)	Thura	-	-	Haryana	12 (147)
116.	*Euphorbia sudanica* A. Chev (Euphorbiaceae)	Teegnu	Decoction	T	Dogonland, West Africa	29
117.	*Feretia apodanthera* Delile (Rubiaceae)	Gigiree	Powder of root bark	T	Dogonland, West Africa	29
118.	*Ficus asperifolia* Hook. ex Steud. (Moraceae)	Mkoya	Crushed or pounded	T	Kimboza Forest, Tanzania	28
119.	*Ficus cunia* Ham.ex Roxb. (Moraceae)	Khar patra	-	-	-	11 (359)
120.	*Flemingia bracteata* (Roxb.) Wight (Fabaceae)	Salpan	-	-	Nagpur and Wardha, Maharashtra	22 (46)
121.	*Gelcimium elegans* Benth. (Loganiaceae)	Hnam-tur	Crushed to juice	-	-	11 (439)
122.	*Gloriosa superba* L. (Liliaceae)	Kalihar (H); Chenganthal (Tm)	Paste, powder	T	Dharmapuri, Tamil Nadu	15 (269), 10 (395), 19 (301)
		Kalihari	-	-	Bilaspur, Chhattisgarh	27
123.	*Gmelina arborea* Roxb. (Verbenaceae)	Gambhari (S), Kumhar	-	T	Haryana	12 (147)
124.	*Gossipium arboreum* Linn. (Malvaceae)	Deokapas (H)	Paste	T	Konkan, Maharashtra	14 (450)
125.	*Grewia bicolor* Juss. (Tiliaceae)	Yooro	Decoction of root bark	T	Dogonland, Mali, West Africa	29
126.	*Grewia flavescens* Juss. (Tiliaceae)	Chaperandhavi	Paste	-	Jaipur, Rajasthan	12 (387)

(Contd...)

Table 1: *(Continued)*

S. No.	Botanical name (Family)	Local names	Mode of administration	Route of administration	Tribal area	References
127.	*Grewia hirsuta* Vahl. (Tiliaceae)	Nagabala (S)	Powder in water	T	Bihar; Odisha	14 (479), 19 (309)
128.	*Grewia rothii* DC (Tiliaceae)		Paste	T	Bastar, Madhya Pradesh	20 (110)
129.	*Gynandropsis gynandra* Merrill. (Capparidaceae)	Ajagandha (S)	-	T	-	14 (275)
130.	*Habenaria intermedia* D. Don. (Orchidaceae)	Jarkabutta (Tm)	Poultice	T	Tamil Nadu	19 (310)
131.	*Helicteres isora* L. (Sterculiaceae)	Kurkurai	Decoction	T	Gajnam, Odisha	32
132.	*Hemidesmus indicus* (Linn.) R. Br. ex. Schult. (Asclepiadaceae)	Nannari	Paste	T	Wayanad, Kerela	56
		Sugandhi	Pounded and poultice	T	Phulbani, Odisha	21 (128)
133.	*Hibiscus pandulaeformis* Burm. (Malvaceae)	Kochli	Paste as poultice	T	Nagpur and Wardha, Maharashtra	22 (52)
134.	*Hygrophila auriculata* Heine (Acanthaceae)	Bisahi, Dhela kanta	Paste	T	Purulia, West Bengal	34
135.	*Ichnocarpus frutescence* (L.) R.Br. (Apocynaceae)	Sariva (S)	-	-	-	16 (303)
136.	*Indigofera pes-tigridis* L. (Fabaceae)	Languliata	-	T	Nagpur and Wardha, Maharashtra	22 (54)
137.	*Ixora acuminate* Roxb. (Rubiaceae)	Tudana	Paste	T	Assam	23 (134)
138.	*Ixora arborea* (Rubiaceae)	Korivi	-	-	Nalgonda and Warangal, Andhra Pradesh	25
139.	*Ixora coccinea* L. (Rubiaceae)	Paranti (S)	-	-	-	16 (312)
140.	*Kaempferia rotunda* L. (Zingiberaceae)	Bhumichampaka (S)	-	T	-	16 (321)
141.	*Leea acuta* Linn. (Vitaceae)	Chota Hansia (H)	Paste	-		19 (321)
142.	*Leea aspera* Edgew. (Vitaceae)	Hansiakanda	Paste, poultice	T	Bihar	19 (309)
143.	*Leea macrophylla* Roxb. (Vitaceae)	Bado hanshia	Roasted and powdered	-	-	19 (308)
144.	*Leptadenia reticulate* (Retz.) Wt. and Arn. (Asclepiadaceae)	Dudhkadi		T	Nagpur and Wardha, Maharashtra	22 (57)
145.	*Leptodermis lanceolata* Wall. (Rubiaceae)	Baramujara	Paste	T	Jhabua,Madhya Pradesh	23 (141)

(Contd...)

Table 1: *(Continued)*

S. No.	Botanical name (Family)	Local names	Mode of administration	Route of administration	Tribal area	References
146.	*Loxogramme involuta* (D.Don) Presl. (Polypodiaceae)	Parpare (Npl)	Paste	-	Nepal	11 (414)
147.	*Lygodium circinatum* (Burm. f.) Sw. (Lygodiaceae)	-	-	-	-	11 (24)
148.	*Lygodium flexuosum* (L.) Sw. (Lygodiaceae)	Dawn-zem	Fresh root boiled with mustard oil	T	Tirhut	11 (375), 11 (439), 14 (50)
		Anda tonada	Paste	T	Bastar, Madhya Pradesh	20 (110)
149.	*Madhuca longifolia* (Koen.) Macbride (Sapotaceae)	Madhooka (S)	-	T	Uttarakhand	18 (297)
150.	*Mahonia borealis* Takeda (Berberidaceae)	Haldia (H)	Paste	T	Uttarakhand	18 (74)
151.	*Manihot esculenta* Crantz. (Euphorbiaceae)	Kappa Kizhangu	Paste	T	Wayanad, Kerala	26
		Darukandah, Kalpakandah(S)	-	-	-	16 (347)
152.	*Manihot utilissima* Pohl. (Euphorbiaceae)	Sakarakanda (H)	Pounded and applied	T	Cambodia	14 (218)
153.	*Melastoma malabathricum* L. (Melastomataceae)	Nakkukaruppan	Paste	T	Wayanad, Kerala	26
		Palore (Mr); Tinrok (Ncb)	Paste	-	Andaman and Nicobar	11 (375), 16 (350)
		Builukham (Mizo)	-	-	Lungsen, Mizoram	37
154.	*Milicia excelsa* (Welw.) C.C Berg. (Moraceae)	Mvule	Crushed or pounded	T	Kimboza Forest, Tanzania	28
155.	*Mimosa pudica* L. (Fabaceae)	Lajamani; Chuimui; Lajjalu (S)	Paste	-	Haryana	11 (166), 11 (253), 12 (147)
156.	*Momordica dioica* Roxb. ex Willd. (Cucurbitaceae)	Karkotaki (S)	Juice	-	-	16 (363)
157.	*Monochoria vaginalis* (Burm. f.) Presl. (Pontederiaceae)	Idivarah (S)	-	-	-	16 (364)
158.	*Morina longifolia* Wall. ex DC. (Dipsacaceae)	Biskandru	Paste	T	-	18 (257), 19 (308)
159.	*Morinda pubescence* J.E. Smith (Rubiaceae)	Paphanah (S); Achh, Al (H)	-	-	-	16 (366)
160.	*Moringa pterygosperma* Gaertn. (Moringaceae)	Sigruh (S); Drumstick tree	-	T	-	16 (368)
161.	*Mucuna pruriens* (L.) DC. (Fabaceae)	Dulagunda	-	-	Nalgonda and Warangal, Andhra Pradesh	25

(Contd...)

Table 1: *(Continued)*

S. No.	Botanical name (Family)	Local names	Mode of administration	Route of administration	Tribal area	References
162.	*Murraya koenigii* (L.) Sprengel (Rutaceae)	Meethi Neem	-	O and T	Dantewada, Chhattisgarh	35
163.	*Murraya paniculata* (L.) Jack. (Rutaceae)	Kamini	Powder	-	Haryana	12 (147)
164.	*Nelsonia canescens* (Lamk.) Spreng. (Acanthaceae)	Mujari	Paste	T	Jhabua, Madhya Pradesh	23 (157)
165.	*Nerium indicum* Mill. (Apocynaceae)	Karavira (S)	Paste	T	Uttarakhand	18 (306), 19 (319)
		Kanher	Crushed and bandaged	T	Nagpur and Wardha, Maharashtra	22 (64)
166.	*Ocimum gratissimum* L. (Lamiaceae)	Ram tulsi, Ban-tulsi (H); Vriddhutulasi (S)	Paste	-	Uttarakhand	11 (138), 18 (374)
167.	*Ophioglossum nudicaule* L.f. (Ophioglossaceae)	Jibre sag (Npl)	Paste	-	Nepal	11 (414)
168.	*Ophioglossum thermale* Komarov (Ophioglossaceae)	-	-	-	-	11 (24)
169.	*Ophiorrhiza mungos* L. (Rubiaceae)	Sarpakshi (S)	-	-	-	16 (389)
170.	*Orchis latifolia* Linn. (Orchidaceae)	Panch aunlay (Npl)	Paste	T	Assam	10 (599)
171.	*Osmunda claytoniana* L. (Osmundaceae)	-	-	T	-	11 (62)
172.	*Paeonia emodi* Wall. (Paeoniaceae)	Udsalib, Udsalap (H)	Paste	-	-	19 (305)
173.	*Pavetta hispidula* Wight and Arn. (Rubiaceae)	Kaattu kitchili (Tm)	Powder of root bark	O	Tirunelveli Hills, Southern India	36
174.	*Pentanema indicum* (L.) King. (Asteraceae)	Banjhouri, Seema (Snt)	Paste	-	Santhal Pargana, Bihar	17 (43)
175.	*Phyllanthhus virgatus* Forst. f. (Euphorbiaceae)	-	-	-	Haryana	12 (147)
176.	*Picrorrhiza kurroa* Royle ex Benth. (Scrophulariaceae)	Katurohini (S)	-	-	-	16 (409)
177.	*Plumbago rosea* Linn. (Plumbaginaceae)	Raktachita	Paste	T	Phulbani, Odisha	21 (134)
178.	*Plumbago zeylanica* L. (Plumbaginaceae)	Otte Kotuveli	Paste	T	Attappady, Kerala	33

(Contd...)

Table 1: *(Continued)*

S. No.	Botanical name (Family)	Local names	Mode of administration	Route of administration	Tribal area	References
		Chitrak (S); Chitramoolam (Tm)	Powder with coconut oil	T	Dharmapuri, Tamil Nadu; Uttarakhand	10 (395), 12 (387), 16 (418), 18 (283)
179.	*Podophyllum hexandrum* Royle (Berberidaceae)	Vanatrapusi (S)	Paste	T	-	19 (304)
180.	*Pogostemon benghalensis* (Burm. f.) O. Kunze. (Lamiaceae)	Kal-basingu (H); Phangla	-	-	Haryana	12 (147)
181.	*Polygonatum verticillatum* (Linn.) Allioni (Liliaceae)	Mahameda (S)	Paste	T	Uttarakhand	18 (459)
182.	*Polygonum cirrhifolium* (Wall.) Royle (Liliaceae)	Meda (S)	-	-	-	16 (422)
183.	*Polystichum stenophyllum* Christ (Dryopteridaceae)	Simal	Paste	-	-	11 (414)
184.	*Pongamia pinnata* (L.) Pierre (Fabaceae)	Karanja (S); Pungan (Tm)	Juice	T	Dharmapuri, Tamil Nadu; Maharashtra	10 (265), 10 (273), 10 (395), 16 (425)
		Punga maram (Tm)	Juice of root is mixed with equal amount of coconut milk and boiled	T	Kancheepuram, Tamil Nadu	42
185.	*Psychotria flavida* Talbot. (Rubiaceae)	Periya avalpori (Tm)	Root is dried, powdered and mixed with coconut oil	T	Tirunelveli Hills, southern India	36
186.	*Pteris aquilina* Linn. (Pteridaceae)	Bracken brakes (E)	Bruised and boiled or powder	T	Khasia hills	14 (53)
187.	*Rauwolfia serpentina* (L.) Benth.ex Kurz. (Apocynaceae)	Sarpagandha (S)	-	-	Haryana	12 (147)
188.	*Rheum austral* D. Don (Polygonaceae)	Revandchini (H)	Paste	T	Garwal, Uttarakhand	18 (392)
189.	*Rheum moorcroftianum* Royle (Polygonaceae)	Dholu	Paste	T	Almora, Uttarakhand	10 (247), 18 (393)
190.	*Rheum webbianum* Royle (Polygonaceae)	Revandchini (H); Pombhaak	Paste	T	Uttarakhand	11 (50), 18 (393)
191.	*Rubia cordifolia* L. (Rubiaceae)	Manjishtha (S)	Paste with honey	T	Uttarakhand	16 (448), 18 (250)
192.	*Rumex nepalensis* Spreng. (Polygonaceae)	Ghandruk (Npl)	Paste placed on the gums	-	Nepal	11 (408)

(Contd...)

Table 1: *(Continued)*

S. No.	Botanical name (Family)	Local names	Mode of administration	Route of administration	Tribal area	References
193.	*Saussurea lappa* (Decne) Sch.-Bip. (Asteraceae)	Kushtha (S)	Powder of dried root	T	Punjab; Uttarakhand	14 (359), 16 (459), 18 (268)
194.	*Saussurea obvallata* (DC.) Edgew. (Asteraceae)	Bergandutongur	-	T	Kashmir; Sikkim	14 (360)
195.	*Sida acuta* (Burm. f.) (Malvaceae)	Bala; Vattatiruppi (Tm)	Paste, fresh juice	T	Tirunelveli and Dharmapuri, Tamil Nadu	10 (363), 10 (395)
196.	*Sida cordata* (Burm. f.) Barssum (Malvaceae)	Bhumibala, Rajabala (S); Daravan talai (Kd)	Paste	-	-	11 (260), 19 (312)
197.	*Sida cordifolia* Linn. (Malvaceae)	Jhanti	Paste	O	Dantewada, Chhattisgarh	35
		Bisiripi (O); Bala (S)	Powder, Juice	T	Phulbani, Odisha; Konkan; Uttarakhand	10 (515), 14 (467), 18 (109)
198.	*Smilax zeylanica* L. (Smilacaceae)	Kuruvilanchi (Tm)	Powder	O	Tirunelveli Hills, Southern India	36
199.	*Solanum anguivi* Lam. (Solanaceae)	Vrishati (S)	Pounded	-	-	16 (468)
200.	*Solanum ferox* Linn. (Solanaceae)	Ringani (Raj)	Paste	-	Rajasthan	19 (311)
201.	*Sterculia urens* Roxb. (Sterculiaceae)	Kadhayo (Guj)	Root bark pounded and made into poultice	T	Philippines	14 (491)
202.	*Stereospermum kunthianum* Cham. (Bignoniaceae)	Popolo	A decoction is used as a wash and powder is applied	T	Dogonland, West Africa	29
203.	*Streblus asper* Lour. (Moraceae)	-	-	-	Haryana	12 (147)
204.	*Suregada zanzibariensis* Roxb. ex Rottler. (Euphorbiaceae)	Mndimu pori	Decoction	O	Kimboza Forest, Tanzania	28
205.	*Tacca leontopetaloides* (Linn.) O.Ktze. (Dioscoreaceae)	-	Paste	T	-	19 (301)
206.	*Tamarindus indica* L. (Fabaceae)	Chincha(S); Imli (H)	Root bark	-	Haryana	12 (147), 16 (493)
207.	*Thevetia peruviana* (Pers.) Kschum (Apocynaceae)	Kaner	Juice	T	Dantewada, Chhattisgarh	35
208.	*Tylophora indica* (Burm.f.) Merr. (Asclepiadaceae)	Arkapatri (S)	-	-	-	19 (303)
209.	*Valeriana hardwickii* Wall (Valerianaceae)	Taggara (H)	-	T	Uttarakhand	18 (255)

(Contd...)

Table 1: *(Continued)*

S. No.	Botanical name (Family)	Local names	Mode of administration	Route of administration	Tribal area	References
210.	*Valeriana wallichii* DC. (Valerianaceae)	Tagara (S)	-	-	Uttarakhand	18 (256)
211.	*Vetiveria zizanoides* Stapf. (Poaceae)	Ushira (S)	-	-	Bengal, India; Burma	14 (97)
212.	*Vitis auriculata* Arn. (Vitaceae)	Dumalaha	Dried rhizome powder is sprinkled	T	Kalahandi, Odisha	43
213.	*Waltheria americana* L. (Sterculiaceae)	Yang anwan	A decoction of root bark is used as a wash and powder is applied	T	Dogonland, West Africa	29
214.	*Withania somnifera* (L.) Dunal (Solanaceae)	Ashvagandha (S); Asgandha	-	-	Washim, Maharashtra; Haryana	12 (147), 39
		domma dolu gadda	-	-	Nalgonda and Warangal, Andhra Pradesh	25
215.	*Woodfordia fruticosa* (L.) Kurz. (Lythraceae)	Dhataki (S)	Pounded	-	Phulbani, Odisha	10 (515)
216.	*Xanthium strumarium* L. (Asteraceae)	Kothu	Paste	T	Malkangiri, Odisha; China	14 (375), 19 (318), 24
217.	*Ximenia americana* L. (Olacaceae)	Onombani	Powder of root bark	T	Dogonland, West Africa	29
218.	*Zingiber officinale* Rosc. (Zingiberaceae)	Ardraka(S)	Juice	-	Washim, Maharashtra	19 (318), 39
219.	*Ziziphus mauritiana* Lamk. (Rhamnaceae)	Kola (S); Ilandai (Tm); Jom-Janum (Snt); Ber (H)	Powder, Paste	T	Haryana; Tirunelveli, Tamil Nadu; Uttarakhand	10 (363), 16 (548), 18 (145)
220.	*Ziziphus numularis* W. and A. (Rhamnaceae)	Bhubadari (S)	Decoction	T		19 (306)
221.	*Ziziphus oenoplia* (L.) Mill (Rhamnaceae)	Yernil	Root bark	-	Nagpur and Wardha, Maharashtra	22 (88)

T - Topical application, O - Oral administration

FAMILY-WISE CLASSIFICATIONS

Family-wise classifications of plants are noted in Table 3. It was found that plants belonging to Fabaceae - 13 were maximum followed by Rubiaceae - 12, Vitaceae - 11, Euphorbiaceae - 11, and Asteraceae - 9. Recent review study[44] shows that Asteraceae is an important plant family for being a valuable and potential source for the natural products possessing wound healing activity. The plants of Fabaceae, Rubiaceae, and Euphorbiaceae families are mostly of sweet taste (*Madhura rasa*), astringent taste (*Kashaya rasa*), and bitter taste (*Tiktarasa*). In Ayurved classics, *Madhura ras*a and *Kashaya ras*a have been highlighted for their *Vrana-sandhan*a (healers of wound) and *Vrana-ropan*a (wound healing) properties[45] and, hence, may be used as wound healing agents in many disease conditions.

AYURVEDA ON WOUND HEALING

In Ayurvedic classics, many drugs have been described for their *Sandhaniya* (healers of wound), *Vranya* (benefical in wound healing), *Vrana-sodhana* (cleanses wound), *Dusta vrana shodhana* (cleanses septic wound), and *Vrana-ropana* (wound healing) actions [Table 4]. Plants having these properties are classified under *Sandhaniya mahakashaya*[46] in *Charaka Samhita* and *Aaragvadhadi gana,*[47] *Arkadi gana,*[48] *Patoladi gana,*[49] *Priyangvadi gana*,[50] *Ambashthadi gana,*[51] *Nygrodhadi gana,*[52] *Lakshadi gana*[53] *in Sushruta Samhita* and *Aaragvadhadi gana,*[54] *Arkadi gana,*[55] *Priyangvadi gana,*[56] *Ambashthadi gana,*[57] and *Nygrodhadi gana*[58] in *Ashtanga Hridaya Samhita*. *Patha* (*Cissampelos pareira* L.), *Lajjalu* (*Mimosa pudica* Linn.), and *Dhataki* (*Woodfordia fruticosa* (L.) Kurz.) have been mentioned in *Sandhaniya Mahakashaya* in *Charaka Samhita*.

Patha (*C. pareira*), *Saireyaka* (*Barleria prionitis* Linn.), *Chitraka* (*Plumbago zeylanica* L.), and *Karanja* (*Pongamia pinnata* (L.) Pierre) have been mentioned in *Aaragvadhadi gana*; *Arka* (*Calotropis procera* (Ait.) R. Br.), *Alarka* (*Calotropis gigantea* (Linn.) R. Br. ex Ait.), *Karanja* (*P. pinnata*), *Apamarga* (*A. aspera* L.), *Langali* (*Gloriosa superba* L.), *Shweta Shirish* (*Albizia procera* Roxb.), and *Jyotishmati* (*Celastrus paniculatus* Willd.) in *Arkadigana*; *Patha* (*C. pareira*) in *Patoladigana*; *Lajjalu* (*M. pudica*), *Dhataki* (*W. fruticosa*), *Punnaga* (*Calophyllum inophyllum* Linn.), *Daruharidra* (*Berberis aristata* DC.), and *Manjistha* (*Rubia cordifolia* L.) in *Priyangvadigana*; *Patha* (*C. pareira*), *Dhataki* (*W. fruticosa*) *Lajjalu* (*M. pudica*), and *Palasha* (*Butea monosperma* (Lamk.) Taub.) in *Ambashthadigana*; *Palasha* (*B. monosperma*) and *Badari* (*Ziziphus numularis* W. and A.) in *Nygrodhadigana*; and *Karvira* (*Nerium indicum* Mill.), *Haridra* (*Zingiber officinale* Rosc.), and *Daruharidra* (*B. aristata*) in *Lakshadigana,* in *Sushruta Samhita*.

Patha (*C. pareira*), *Saireyaka* (*B. prionitis*), *Karanja* (*P. pinnata*), *Chitraka* (*P. zeylanica*), and *Badari* (*Z. numularis*) have been mentioned in *Aaragvadhadi gana*; *Arka* (*C. procera*), *Alarka* (*C. gigantia)*, *Langali* (*G. superba*), *Apamarga* (*A. aspera*), *Jyotishmati* (*C. paniculatus*), *Karanja* (*P. pinnata*), and *Shweta Shirish* (*A. procera*) in *Arkadigana*; *Daruharidra* (*B. aristata*), *Manjistha* (*R. cordifolia*), *Lajjalu* (*M. pudica*), *Punnaga* (*C. inophyllum*), and *Dhataki* (*W. fruticosa*) in *Priyangvadigana*; *Patha* (*C. pareira*), *Lajjalu* (*M. pudica*), *Palasha* (*B. monosperma*), *Kapikacchu* (*Mucuna pruriens* (L.) DC.), and *Dhataki* (*W. fruticosa*) in *Ambashthadigana*; and *Palasha* (*B. monosperma*) and *Badari* (*Z. numularis*) in *Nygrodhadigana*, in *Ashtanga Hridaya Samhita*.

Table 2: Classification of wound healing root drugs reported according to route of administration

S. No.	Route of administration	Number of plants
1.	Topical	122
2.	Oral	6
3.	Both (topical and oral)	6

Table 3: Family-wise classification of wound healing root drugs

S. No.	Name of families	Total number of enlisted families	Plants found in each
1.	Fabaceae	1	13
2.	Rubiaceae	1	12
3.	Euphorbiaceae and Vitaceae	2	11
4.	Asteraceae	1	9
5.	Araceae and Zingiberaceae	2	8
6.	Apocynaceae and Malvaceae	2	7
7.	Asclepiadaceae and Liliaceae	2	6
8.	Combretaceae, Rutaceae, Solanaceae, and Sterculiaceae	4	5
9.	Acanthaceae, Capparaceae, Dryopteridaceae, Moraceae, Polygonaceae, Pteridaceae, and Tiliaceae	7	4
10.	Berberidaceae, Boraginaceae, Menispermaceae, Ophioglossaceae, Orchidaceae, Poaceae, Polypodiaceae, and Rhamnaceae	8	3
11.	Amaranthaceae, Hypoxidaceae, Lamiaceae, Lygodiaceae, Melastomataceae, Plumbaginaceae, Ranunculaceae, Valerianaceae, and Saxifragaceae	9	2
12.	Agavaceae, Alismataceae, Amaryllidaceae, Annonaceae, Apiaceae, Aristolochiaceae, Bignoniaceae, Bombacaceae, Capparidaceae, Celastraceae, Clusiaceae, Commelinaceae, Costaceae, Cucurbitaceae, Cyperaceae, Dipsacaceae, Dioscoreaceae, Lecythidaceae, Loganiaceae, Lythraceae, Moringaceae, Nyctaginaceae, Olacaceae, Osmundaceae, Paeoniaceae, Papaveraceae, Pontederiaceae, Rosaceae, Sapotaceae, Scrophulariaceae, Smilacaceae, Taccaceae, and Verbenaceae	33	1

Table 4: Categorization of wound healing root drugs in Ayurvedic classical texts

S. No.	Name of *Samhita*	*Gana* name	Classical name of drugs mentioned	Total number of drugs	*Karma*
1.	*Charaka Samhita*	*Sandhaniya Mahakashaya*[46]	*Ambasthaki (Patha)*, *Samanga (Lajjalu),* and *Dhatki*	3	*Sandhana karma*
2.	*Sushruta Samhita*	*Aragvadhadi gana*[47]	*Patha, Kurantaka (Saireyaka), Chitraka,* and *Karanja*	4	*Vrana shodhana*
		Arkadi gana[48]	*Arka, Alarka, Karanja, Mayuraka (Apamarga), Indrapushpi (Langali), Kshudra Shweta* (*Shirisha*), and *Alavana (Jyotishmati)*	7	*Visheshad vrana shodhana*
		Patoladi gana[49]	*Patha*	1	*Vranya*
		Priyangvadi gana[50]	*Samanga (Lajjalu), Dhataki, Punnag, Rasanjana* (*Daruharidra*), and *Yojanvalli* (*Manjistha*)	5	*Vrana ropana*
		Ambashthadi gana[51]	*Ambashtha (Patha), Dhataki, Samanga (Lajjalu),* and *Palasha*	4	*Vrana ropana*
		Nygrodhadi gana[52]	*Palasha* and *Badari*	2	*Vranya*
		Lakshadi gana[53]	*Ashwamaar (Karvira), Haridra* and *Daruharidra*	3	*Dushta vrana vishodhana*
3.	*Ashtanga Hridaya Samhita*	*Aaragvadhadi gana*[54]	*Patha, Saireyaka, Karanja, Agni* (*Chitraka*) and *Ghonta* (*Badari*)	5	*Dushta vrana vishodhana*
		Arkadi gana[55]	*Arka, Alarka,Vishalya (Langali), Pratyakpushpi (Apamarga), Peet tailaa (Jyotishmati), Udkriya* (*Karanja*), and *Kshudra Shweta* (*Shirisha*)	7	*Visheshad vrana shodhana*
		Priyangvadi gana[56]	*Rasanjana* (*Daruharidra*), *Yojanvalli* (*Manjistha*), *Samanga (Lajjalu), Punnaga* and *Madaniyhetu* (*Dhataki*)	5	*Vrana ropana*
		Ambashthadi gana[57]	*Ambashtha (Patha), Namaskari (Lajjalu), Palasha, Kacchura (Kapikacchu),* and *Dhataki*	5	*Vrana ropana*
		Nygrodhadi gana[58]	*Palasha* and *koli* (*Badari*)	2	*Vranya*

RECENT RESEARCHES

The wound healing activity of different extracts (petroleum ether, solvent ether, chloroform, alcohol, and chloroform water) of tubers of *Allium cepa* L. was evaluated in excision, incision, and dead space wound models in albino rats at a dose of 300 mg/k.g. B.W. by oral route. Alcoholic extract of tubers of *A. cepa* has shown better wound healing activity in excision, incision, and dead space wound models as compared to chloroform and chloroform water extracts.[59]

The isolates of the bulbs of *Allium sativum* L. (Liliaceae) were evaluated for wound healing activity on the Swiss albino rats in excision wound model and incision wound model, by topical application. The studies on excision wound model reveal significant wound healing activity of the extract, which is comparable with the reference control framycetin.[60]

The aqueous extract of the roots of *Asparagus racemosus* Willd.was screnned for wound healing activity in albino rats using a dead space wound model at a dose of 200 mg/kg or 400 mg/kg for 10 days by oral route. The extract showed a significant increase in granulation tissue breaking strength and a significant increase in hydroxyproline, hexosamine, and hexuronic acid in granulation tissue.[61]

Aqueous and methanol extracts of the root of *Berberis lycium* Royle, evaluated using incision, excision and dead wound space models in rats, results increased epithelialization, wound contraction, skin breaking strength, tissue granulation, dry weight and hydroxyproline content. Histopathological studies of the granulation tissue also indicated that there was an increase in collagen formation in those rats treated with the methanol extract, compared with the control group. The methanol extract was more effective than the aqueous extract, but both showed significant results compared with the control.[62]

Anti-inflammatory and wound healing activities of the major calophyllolide (CP) compound isolated from *Calophyllum inophyllum* Linn. have been proved. These study findings may enable the utilization of CP as a potent therapeutic for cutaneous wound healing.[63]

Wound healing activity of *Calotropis gigantea* (L.) R. Br. root bark was evaluated by excision, incision, and dead space wound healing models in Wistar albino rats. Topical application of *C. gigantea* in excision wound model increased the percentage of wound contraction. Scar area and epithelization time were decreased. In incision wound and dead space wound, breaking strength of wounds and hydroxyproline was increased.[64]

Healing activity of *Capparis spinosa* L. against surgical wounds, in rats infected by *Escherichia col*i, excisions were created surgically on the animals' skin and then infected with *E. coli*. Ethanol extract of *C. spinosa* includes properties that promote intense granulation tissue formation and accelerate wound healing activities.[65]

The methanolic extract of *C. orchioides* tuberous root with the concentration of 200 mg/kg and 400 mg/kg significantly increased the level of superoxide dismutase and nitric oxide and decreased lipid peroxidation in granuloma tissue of diabetic mice.[66]

Ethanolic extract of *C. longa* ointment (EtOHCl) containing 10% curcumin displayed a remarkable healing process against wound retardation by aspirin. Topical application of ointment showed significant ($P < 0.01$) difference as compared to the control group. Histopathological studies also showed healing of the epidermis, increased collagen, fibroblasts, and blood vessels.[67]

Roots of *M. pudica* L. were studied for wound healing activity by incorporating the methanolic and the total aqueous extract in simple ointment base B.P. in a concentration of 0.5% (w/w), 1% (w/w) and 2% (w/w). Wound healing activity was studied in three types of model in rats, namely excision, incision, and estimation of biochemical parameter. Treatment of wound with ointment containing 2% (w/w) methanolic and 2% (w/w) total aqueous extract exhibited significant ($P < 0.001$) wound healing activity. The methanolic extract exhibited good wound healing activity probably due to phenol constituents which were 11% (w/w) and 17% (w/w) in methanolic and total aqueous extract, respectively.[68]

The wound healing activities of the ointment of aqueous and methanol extracts of the root of *Hemidesmus indicus (*Linn.) R. Br. ex. Schult. were evaluated using excision wound model in rats. The ointment made from the methanolic extract displayed significant wound healing activity.[69]

The ethanolic extracts of roots of *Morinda pubescens* J.E. Smith at different concentrations (10% w/w and 20% w/w) showed a faster rate of wound healing activity. The extract-treated mice exhibit a reduction in wound area when compared to controls. The extract-treated wounds are found to epithelize faster as compared to controls.[70]

The methanol root extract of *P. zeylanica* L. exhibited a significant wound healing activity as compared to control in excision wound model in Wistar albino rats. The epithelization of wound with 10% (w/w) extract ointment-treated group was found to be earlier as compared to control.[71]

Hydroalcoholic extract of root of *Withania somnifera* (L.) Dunal has been evaluated for its wound healing activity in the male rats. The reduction of incisional wound area in the all groups treated with root extract of *W. somnifera* ointment was significantly higher on the 8th day. Moreover, dose of 60% and 90% revealed better effects.[72]

The alcoholic extract of roots of *Saussurea lappa* (Decne) Sch.-Bip. at the dose of 500 mg/kg, p.o., showed a significant increase in wound closure rate, tensile strength, granuloma breaking strength, and hydroxyproline content and decrease in epithelization period in extract-treated group when compared to control group.[73]

CONCLUSION

The present review reports the use of 221 root drugs for their reported wound healing activity. Among them, 122 plants are reported for topical application, 6 for oral administration, and 6 for both oral and topical. Maximum drugs are used in paste form followed by juice, decoction, and ash form. Root drugs of Fabaceae and Rubiaceae family have great potency for healing the wounds. Recent researches show that some of these root drugs have been proved their efficacy as a wound healing agent in pharmacology studies. Finding of the present review may give leads for new drug development for wound healing. There is a need for scientific validation, standardization, and safety evaluation of ethnomedicinal root drugs before these could be recommended for healing of the wounds.

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