



Ethnomedicinal practices in different communities of Uttara Kannada district of Karnataka for treatment of wounds

Pradeep Bhat*, Gurumurthi Hegde, Ganesh R. Hegde

P.G. Department of Studies in Botany, Karnatak University, Dharwad 580003, Karnataka, India

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ABSTRACT

Ethnopharmacological relevance: Uttara Kannada district is located in the heart of the Western Ghats, one of the biodiversity hotspots, in Karnataka state of India. The thick evergreen forests are home to several ethnic communities. The study was under taken for documentation and analysis of ethnomedicinal plants in the treatment of wounds.

Materials and methods: Field trips were made in Uttara Kannada district to identify the key informants. The collection of information was through semi-structured open ended interviews with a questionnaire. The questionnaire was designed to obtain the information about their experience in the field of treatment, number of patients treated per week, knowledge about the medicinal plants, vernacular names, parts of the plants used and other ingredients added during the drug formulations. Plants mentioned for treatment were photographed in the field, cuttings of the samples were taken and voucher specimens are deposited in the herbarium of P.G. Department of Botany, Karnatak University, Dharwad. The information such as botanical name, status, family, vernacular name habit and habitat, statistical analysis like percentage of parts used, Use value (UV) and Informants Consensus Factor (ICF) are provided.

Results: Present study resulted in recording 106 medicinal plant species of 55 families and 86 formulations to treat different types of wounds by 44 key informants. Among the 106 plants recorded four species are endemic to India and 22 species have the nativity outside India. Rest of the species have nativity both in India and elsewhere. The highest number of species belonged to Apocynaceae and Rubiaceae (6 species each). Trees are used more often (35.84%), followed by herbs (28.30%), shrubs (23.58%), climbers (11.32) and parasites (0.80%). Leaves are the major part of the plants used in the formulations (28.57%). The highest Use value is for *Calycopteris floribunda* (1.80), followed by *Rauvolfia serpentina* and *Achyranthes aspera* (1.67). The different types of wounds treated by traditional healers are classified into 15 categories and the highest ICF scored is for the burns (0.66).

Conclusions: Ethnomedicinal survey in Uttara Kannada district of Karnataka revealed uses of 106 plants in traditional practices for curing various types of wounds. The statistical analysis confirmed high degree of sharing the knowledge amongst 44 key informants. Information about the largest number of remedies was obtained from the Havyaka Brahmin ethnic community which has strong Sanskrit background.

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1. Introduction

Since time immemorial man has used various parts of plants in either prevention or treatment of many ailments (Chah et al., 2006). The World Health Organization (WHO) estimates that nearly 80% of the population still depends on herbal medicines due to their easy availability, low cost and possible less side effects as compared to allopathic system of medicine (Sandhya et al., 2011). One of the very common problems in day to day

activities of human is the wound. It may be due to physical, chemical, thermal, microbial or immunological insult to the tissue. According to the Wound Healing Society, wounds are 'physical injuries that result in an opening or break of the skin causing disturbance in the normal skin anatomy and function' (Strodtbeck, 2001). The process of wound healing consists of integrated cellular and biochemical events leading to re-establishment of structural and functional integrity with regain of strength of injured tissue (Raina et al., 2008). Research on wound healing agents is one of the developing areas in modern biomedical sciences and many traditional practitioners across the world particularly in countries like India and China have valuable information of either less-known or hitherto unknown wild

* Corresponding author. Tel.: +9964796943, +9164633062.

E-mail address: bhat.pradeep08@gmail.com (P. Bhat).

plants for treating wounds and burns (Kumar et al., 2007). However, ethnobotanical information on plants in India for treatment of cuts, wounds and burns is widely scattered (Bharadwaj and Gakhar, 2005; Kumar et al., 2007; Ayyanar and Ignacimuthu, 2009; Patil et al., 2009; Kuvar and Bapat, 2010; Subramanian et al., 2011).

Karnataka is one of the plant diversity rich states in Southern India. Ethnomedicinal survey started in Karnataka as early as 1993 by Hosagoudar and Henry. Studies on this aspect in Uttara Kannada district in Karnataka have been made by Bhandary et al. (1995, 1996, 2001, 2002, 2003), Harsha et al. (2002, 2003, 2005), Hegde et al. (2007) and Achar et al. (2010). Present study is to document and analyze the plants used in traditional therapies for various wounds and related injuries in humans and cattle by different communities in Uttara Kannada district of Karnataka State.

2. Materials and methods

2.1. Study area

Uttara Kannada is one of the 30 districts of Karnataka State. It is located between 74°09' to 75°10'E longitude and 13°55' to 15°31'N latitude with an area approximately 10,327 km². Nearly 81% of the total geographical area of the district (10,291 km²) is under forest cover (Satyanarayana and Rajashekara, 1985). The soil type is alluvial throughout coastal region and mostly lateritic in most part of the district. However, on the interior regions the soil varies from red to sandy red and black towards eastern margin. The average rainfall of the district is 2835 mm per annum. The temperature remains moderate throughout the year. It fluctuates between 37 °C in mid-summer to 15 °C in winter. The vegetation of the Uttara Kannada District shows much diversification similar to its geographical and physiological patterns. It is classified as (a) Littoral vegetation, (b) Evergreen vegetation, (c) Moist deciduous forests and (d) Scrub and thorny forests (Kamath, 1985).

2.2. People communities of Uttara Kannada

The thick evergreen forests are home to several tribal communities such as Siddis, Gowlis, Kunbis, Halakki Okkaligas and Kare Okkaligas. According to the history of the District the Halakki Okkaligas are the original tribe and others are the migrants. In addition to these tribes Havyaka Brahmins, Saraswatas, Nayaks, Harijanas, Idigas and Nadavas are the other ethnic communities. Amongst these, the Havyaka Brahmin community is basically advanced and scholarly community. This community is depending on farming, mainly areca for their livelihood. Siddis were the slaves from Africa, brought to Goa during Portuguese period. Some of them escaped and settled in the deep forests of Uttara Kannada. Similarly the Gowlis and Kunabis are the migrants from Maharashtra, settled deep in the Western Ghats part of Uttara Kannada. All these communities have developed the practical knowledge about medicinal plants (Bhandary et al., 1995, 1996; Hegde et al., 2007) (Fig. 1).

2.3. Ethnomedicinal survey

Keeping the objective in mind several field trips were made in Uttara Kannada District in different seasons between 2010 and 2012. The collection of information was through semi-structured open ended interviews as suggested by Martin (1995) with a questionnaire. The traditional healers were not pressurized to reveal their knowledge and were convinced that the information

would be exclusively for academic purpose. The questionnaire was designed to obtain the information about their experience in the field of treatment, number of patients treated per week, knowledge about the medicinal plants, vernacular names, parts of the plants used and other ingredients added during the drug formulations. The questionnaire also involved authentic consent of the informants for sharing their valuable knowledge in a signed proforma. The purpose of taking the sign in the last is for more authentication of their information. To get the consistent information on formulation each informer was interviewed more than twice and only those formulations having consistency are considered. This study focused on the use of plants for treating different types of wounds.

2.4. Plant identification and herbaria

Plants were collected with the help of herbal healers and were identified authentically by using published floras, such as Flora of Presidency of Bombay (Cooke, 1967), Flora of British India (Hooker, 1978), Flora of Presidency of Madras (Gamble, 1984), Flora of Karnataka (Saldahna, 1984). The recent names of the plants have been given based on the Flora of Kolhapur District (Yadav and Sardesai, 2002), Flora of Kerala (Nayar et al., 2006) and IPNI (www.ipni.org). Plants mentioned for treatment were photographed in the field, cuttings of the samples were taken and voucher specimens (Voucher specimen from PB/GRH 1 to PB/GRH 106) are deposited in the herbarium of P.G. Department of Botany, Karnatak University, Dharwad.

2.5. Tabulation and data analysis

The information such as botanical name, family, vernacular name, part used, habit, habitat, status, Use value and voucher specimen number are provided for each species (Table 1). Informants Consensus Factor and formulations of the taxa for the treatment of wounds are tabulated separately (Tables 2 and 3).

2.5.1. Use-value (UV)

The Use value (UV), a quantitative method that demonstrates the relative importance of species known locally, was calculated according to the following modified (Phillips and Gentry, 1993a, 1993b) formula:

$UV = \sum U_i/n$ (Albuquerque et al., 2006). Where UV is the Use value of a species; U_i the number of uses mentioned by each informant for a given species; n the total number of informants.

2.5.2. Informants Consensus Factor (ICF)

For the data analysis, Informant Consensus Factor (ICF) was employed to indicate how homogenous the information is. All the citations were placed into ailment categories for which the plant was claimed to be used. ICF values will be low (near 0) if plants are chosen randomly or if informants do not exchange information about their use. Values will be high (near or more than 1) if there is a well defined selection criterion in the community and/or if information is exchanged between informants.

The ICF is calculated as in the following formula (Gazzaneo et al., 2005):

$$ICF = \text{Nur} - \text{Nt} / \text{Nur} - 1$$

where 'Nur' is the number of use citations in each category and 'Nt' is the number of species used.

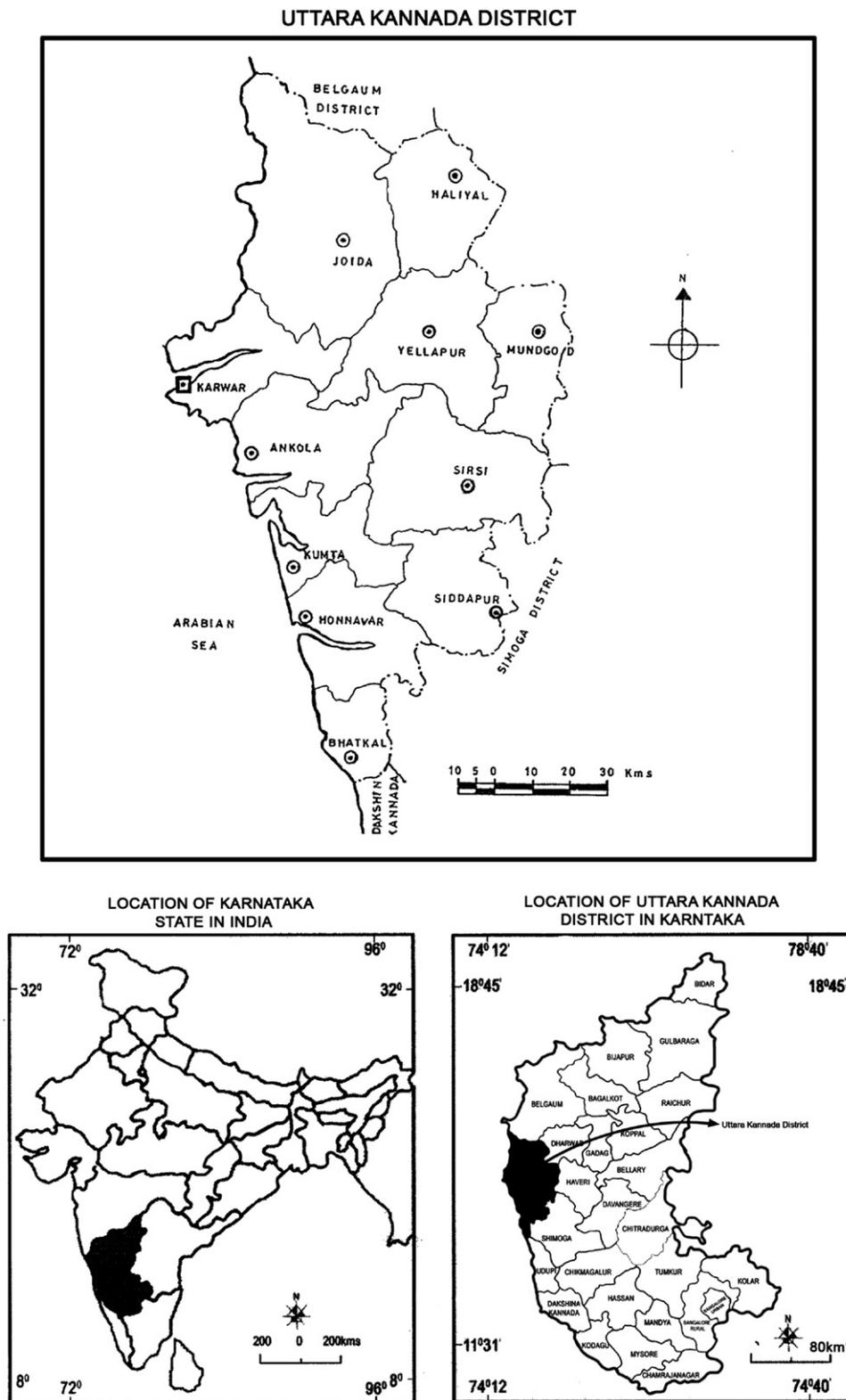


Fig. 1. Map of Uttara Kannada District.

3. Results and discussion

Present study resulted in recording 106 medicinal plant species of 55 families to treat different types of wounds by 44 key informants. Average age of the informants is 59 years with maximum age of 93 years and minimum of 31. Among the informants only two were women. Out of 44 informants 38 had

inherited knowledge descended from their forefathers and other informants acquired knowledge from others and practicing out of first hand notes gathered from the local practitioners by repeated visits to the same persons. The traditional healers are either farmers or laborers working on wages. Some are practicing it as a profession.

Table 1
Plants used for treating wounds.

Sl. no.	Species/voucher specimen number	Family	Vernacular name	Part used	Habit/habitat	$\sum U$	n	UV	Recommended uses	Literature reports for wounds or related symptoms from Karnataka State, India, and other tropical countries
1	<i>Acacia catechu</i> (L.f.) Willd. PB/GRH. 48	Mimosaceae	Khaira	R	T/Wi	1	3	0.33	Wounds due to prickly heat	Bark in wounds (Patil et al., 2009; Wadankar et al., 2011)
2	<i>Achyranthus aspera</i> L. PB/GRH. 78	Amaranthaceae	Uttarane	W, L	H/Wi	10	6	1.67	Cuts, gingival wounds	Leaves in ulcers and foot cracks (Seetharam et al., 1999), root in venomous snake bite and scorpion sting (Bhandary et al., 1996), leaves in cuts and wounds (Bhandary and Chandrashekar, 2002; Patil et al., 2009; Wadankar et al., 2011), root in wounds (Shiddamallayya et al., 2010a), whole plant in cuts and wounds (Subramanian et al., 2011; Nandagopalan et al., 2011; Khan, 2009; Venkataswamy et al., 2010), tooth problems (Mahmood et al., 2011)
3	<i>Adhathoda zeylanica</i> Medikus PB/GRH. 49	Acanthaceae	Aadusoge	L, S	Sh/Wi	1	3	0.33	Cuts	Leaf in cuts and wounds (Bharadwaj and Gakhar, 2005)
4	<i>Allium cepa</i> L. ^a PB/GRH. 25	Liliaceae	Eerulli	Bu	H /Cu	1	8	0.13	Cuts	Wounds (Abbasi et al., 2010)
5	<i>Allium sativum</i> L. ^a PB/GRH. 21	Liliaceae	Bellulli	Bu	H/Cu	1	9	0.11	Cuts	
6	<i>Alstonia scholaris</i> (L.) R. Br. PB/GRH. 60	Apocynaceae	Maddaale	B	T/Wi	1	2	0.50	Cuts	Latex in ulcers (Shiddamallayya et al., 2010a), latex in wounds, boils and earache (Bharadwaj and Gakhar, 2005), leaf and stem in cuts and wounds (Subramanian et al., 2011)
7	<i>Alternanthera sessilis</i> (L.) R. Br. ex DC. PB/GRH. 33	Amaranthaceae	Agrada kudi	W	H/Wi	1	6	0.17	Aphthae	
8	<i>Anacardium occidentale</i> L. ^a PB/GRH. 42	Anacardiaceae	Geru	Sd	T/Cu,	1	4	0.25	Corn	Root, stem bark, fruit and seeds in ulcers (Shiddamallayya et al., 2010b), fruit in wounds (Ayyanar and Ignacimuthu, 2009), root, stem, fruit in cuts and wounds
9	<i>Annona squamosa</i> L. ^a PB/GRH. 39	Annonaceae	Seetaphala	L	T/Cu	1	5	0.20	Cuts	Leaf and seeds in cuts, wounds and in animal wounds (Dash and Misra, 1999; Nayak et al., 2004), root, leaf, fruit, seed in cuts and wounds (Subramanian et al., 2011), leaf in wounds (Jaiswal et al., 2004; Raja et al., 2009), bark in wounds (Wadankar et al., 2011)
10	<i>Artocarpus heterophyllus</i> Lam. PB/GRH. 29	Moraceae	Halasu	L	T/Wi	1	7	0.14	Gingival wounds	Gums in Burns (Hosagoudar and Henry, 1996), wounds (Rana et al., 2010)
11	<i>Azadirachta indica</i> A. Juss. PB/GRH. 34	Meliaceae	Bevu	L	T/Wi	1	6	0.17	Cuts	Dog bite (Parinitha et al., 2005), whole plant in wounds (Joshi et al., 2011), eye diseases and as antiseptic (Shiddamallayya et al., 2010b), leaves in ulcers (Hiremath et al., 2010), whole plant in cuts and wounds (Subramanian et al., 2011), leaf, bark and fruits in wound healing (Jaiswal et al., 2004)
12	<i>Barleria prionitis</i> L. PB/GRH. 61	Acanthaceae	Arisina Gentige	L	Sh/Wi	1	2	0.50	Gingival wounds	Wounds (Patil et al., 2009), foot and mouth disease in animals (Khan, 2009)
13	<i>Barringtonia racemosa</i> (L.) Sprengel PB/GRH. 50	Barringtoniaceae	Samudraphala, Nanjina mara	Fr	T/Wi	1	3	0.33	Dog bite	
14	<i>Brassica juncea</i> (L.) Czern & Coss. PB/GRH. 11	Brassicaceae	Saasive	Sd	H/Cu	1	13	0.08	Gingival wounds	
15	<i>Calamus rotang</i> L. PB/GRH. 43	Arecaceae	Bettha	R	Cl/Wi	1	4	0.25	Scorpion bite	
16	<i>Calotropis gigantea</i> (L.) R. Br. PB/GRH. 79	Asclepiadaceae	Ekke	R	Sh/Wi	4	3	1.33	Gingival wounds, Otorrhoea, Scorpion bite, Snake bite	Latex in corns (Harsha et al., 2003), wounds created by thorns (Ayyanar and Ignacimuthu, 2009), cuts and wounds (Reddy et al., 2003; Begum and Nath, 2000; Kuvar and Bapat, 2010), leaf in cuts and wounds (Subramanian et al., 2011; Chettri et al., 1992)
17	<i>Calycopteris floribunda</i> (Roxb.) Poir et PB/GRH. 62	Combretaceae	Kumsulu	L, Br	Cl/Wi	9	5	1.80	Gangrene, snake bite	Cuts and wounds (Bhandary and Chandrashekar, 2002; Kshirasagar et al., 2003)
18	<i>Capsicum annum</i> var. <i>glabrusculum</i> (Dunal) Heiser f. & Pickers. PB/GRH. 57	Solanaceae	Sanna menasu	L, Fr	H/Cu	2	5	0.40	Otorrhoea, throat infection in cattle	Hemorrhagic septicemia in cattles (Harsha et al., 2005)

19	<i>Careya arborea</i> Roxb. PB/GRH. 35	Lecythidaceae	Koulu	B	T/Wi	2	6	0.33	Aphthae, ulcer in intestine	Scorpion sting (Parinitha et al., 2005)
20	<i>Cassia fistula</i> L. PB/GRH. 63	Caesalpinaceae	Kakke	L	T/Wi	1	2	0.50	Gangrene	Stem bark in burns (Mamatha et al., 2006), whole plant in wounds (Shiddamallayya et al., 2010a), leaves in wounds (Shivanna and Rajakumar, 2010; Rajakumar and Shivanna, 2009), snake bite (Mamatha et al., 2006)
21	<i>Chromolaena odorata</i> (L.) R. King & H. Robinson ^a PB/GRH.51	Asteraceae	Congress gida	L	Sh/Wi	2	6	0.33	Gangrene, cuts	Wounds (Achar et al., 2010; Upadhya et al., 2009; Rajakumar and Shivanna, 2009; Gangwar et al., 2010; Dangol, 2008; Rahman, 2010)
22	<i>Citrus aurantifolia</i> (Christm. & Panzer) Swingle ^a PB/GRH. 59	Rutaceae	Nimbu	Fr	T/Cu	5	9	0.55	Cuts, snake bite, aphthae, dog bite, scorpion bite	
23	<i>Citrus limon</i> (L.) Burm. f. ^a PB/GRH. 47	Rutaceae	Hulikanchi	Fr	Sh/Cu	2	7	0.29	Whitlow	
24	<i>Citrus medica</i> L. PB/GRH. 26	Rutaceae	Maadl kanchi	R	T/Cu	1	8	0.13	Snake bite	Fruit in cuts and wounds (Subramanian et al., 2011)
25	<i>Clerodendrum indicum</i> (L.) Kuntze PB/GRH. 44	Verbenaceae	Indravaaruni	R	Sh/Wi	1	4	0.25	Snake bite	
26	<i>Clerodendrum infortunatum</i> L. PB/GRH. 52	Verbenaceae	Teggi	L	Sh/Wi	1	3	0.33	Gangrene	
27	<i>Clitoria ternatea</i> L. ^a PB/GRH. 30	Fabaceae	Bili Shankhapushpa	R	Cl/Wi	1	7	0.14	Otorrhoea	Snake bite (Shiddamallayya et al., 2010a), cleaning of wounds (Mamatha et al., 2006), root, leaf, seed in cuts and wounds (Subramanian et al., 2011)
28	<i>Cocos nucifera</i> L. PB/GRH. 80	Arecaceae	Tengu	L, Fr, Tf	T/Cu	3	4	0.75	Aphthae, burn, cuts	Endocarp of the fruit in burns (Hosagoudar and Henry, 1996; Bhandary and Chandrashekhar, 2002), tender leaves in wounds (Achar et al., 2010; Harsha et al., 2002), internal ulcer (Odukoya et al., 2012)
29	<i>Costus speciosus</i> (Koenig) J. E. Smith PB/GRH. 64	Zingiberaceae	Aarthi kundge	S	H/Wi	1	2	0.50	Otorrhoea	Dog bite (Bhandary and Chandrashekhar, 2002), leaf in wounds (Ayyanar and Ignacimuthu, 2009)
30	<i>Croton roxburghii</i> Balakr. PB/GRH. 6	Euphorbiaceae	Somaari	R	T/Wi	1	14	0.07	Snake bite	
31	<i>Cryptolepis buchananii</i> R. Br. ex Roemer & Schultes PB/GRH. 12	Asclepiadaceae	Karibanta	R	H/Wi	1	13	0.08	Snake bite	Leaves used against snake bite in cattles (Harsha et al., 2005), in cuts and wounds (Subramanian et al., 2011)
32	<i>Cuminum cyminum</i> L. PB/GRH. 91	Apiaceae	Jeerige	Sd	H/Cu	3	4	0.75	Aphthae, ulcer in intestine, gangrene, gingival wounds.	
33	<i>Curcuma longa</i> L. PB/GRH. 104	Zingiberaceae	Arisina	Rh	H/Cu	2	3	0.67	Crack foot, cuts, gangrene, inter trigo, Otorrhoea.	Incision of wasp bite (Hosagoudar and Henry, 1996); foot and mouth disease in cattle (Harsha et al., 2005), wounds (Patil et al., 2009; Subramanian et al., 2011; Nandagopalan et al., 2011), rhizome and seeds in wounds (Wadankar et al., 2011), wounds in livestock (Chowdhury et al., 2009)
34	<i>Cynodon dactylon</i> (L.) Pers. PB/GRH. 65	Poaceae	Doorbhe	W	H/Wi	1	2	0.50	Sore nose	Burns (Bhandary and Chandrashekhar, 2002), wounds (Shiddamallayya et al., 2010a), centipede bite (Nagabhushan and Kotresha, 2010), whole plant in cuts and wounds (Subramanian et al., 2011; Abbasi et al., 2010), nasal bleeding (Gangwar et al., 2010), bleeding from wounds (Khan et al., 2007; Nawaz et al., 2009), tender leaves in wounds (Chowdhury et al., 2009; Rahman, 2010), nose bleeding (Barkatullah et al., 2009)
35	<i>Dendranthema indicum</i> (L.) Des Moul. ^a PB/GRH. 53	Asteraceae	Sevantige	L	H/Cu	1	3	0.33	Cuts	
36	<i>Diploclisia glaucescens</i> (Blume) Diels PB/GRH. 81	Menispermaceae	Thimri	R	Cl/Wi	2	3	0.67	Snake bite, Inter trigo	
37	<i>Elaegnis conferta</i> Roxb. PB/GRH. 82	Elaegnaceae	Halage	B, Fr	Cl/Wi	2	3	0.67	Whitlow, Aphthae, ulcer in intestine	
38	<i>Elettaria cardamomum</i> (L.) Maton PB/GRH. 7	Zingiberaceae	Yaalakki	Fr	H/Cu	1	15	0.07	Cuts	
39	<i>Ficus racemosa</i> L. PB/GRH. 67	Moraceae	Atthi	B, TI	T/Wi	2	4	0.50	Aphthae, cuts	Latex in wounds (Shiddamallayya et al., 2010a), stem bark in wounds (Ayyanar and Ignacimuthu, 2009). Bark and fruits in cuts, wounds and ulcers (Punjani, 2002; Sen and Behara, 2003)
40	<i>Foeniculum vulgare</i> Miller. ^a PB/GRH.8	Apiaceae	Badesoppu	Fr	H/Cu	1	14	0.07	Gingival wounds	
41	<i>Garcinia gummi-gutta</i> (L.) Robs. ^b PB/GRH. 40	Clusiaceae	Uppage	Sd	T/Wi	1	5	0.20	Crack foot	
42	<i>Girardinia diversifolia</i> (Link.) Friis PB/GRH. 45	Urticaceae	Thorke gida	R	H/Wi	1	4	0.25	Snake bite	

Table 1 (continued)

Sl. no.	Species/voucher specimen number	Family	Vernacular name	Part used	Habit/habitat	ΣU	n	UV	Recommended uses	Literature reports for wounds or related symptoms from Karnataka State, India, and other tropical countries
43	<i>Gladiolus dalenii</i> Van Geel PB/GRH. 2	Iridaceae	Naagadaali	R	H/Cu	1	16	0.06	Snake bite	
44	<i>Glycyrrhiza glabra</i> L. PB/GRH. 68	Fabaceae	Jyesthamaddu	R	T/Wi	1	2	0.50	Cuts	
45	<i>Grewia tiliifolia</i> Vahl PB/GRH. 83	Tiliaceae	Dadasala	B	T/Wi	2	3	0.67	Wounds due to prickly heat	
46	<i>Hibiscus rosa-sinensis</i> L. ^a PB/GRH. 13	Malvaceae	Daasavaala	Fl	Sh/Cu	1	13	0.08	Burn	
47	<i>Holarrhena pubescence</i> (Buch. Ham.) Wallich ex G. Don PB/GRH. 36	Apocynaceae	Kodasa	B	T/Wi	1	6	0.17	Aphthae, ulcer in intestine	Wounds with worms in cattle (Parinitha et al., 2004). Bark and latex in deep cuts (Girach et al., 1999)
48	<i>Ixora coccinea</i> L. PB/GRH. 69	Rubiaceae	Bili kusumaale	R	Sh/Wi	2	4	0.50	Snake bite, aphthae	Flowers in wounds (Ayyanar and Ignacimuthu, 2009), sores and ulcers (Nandagopalan et al., 2011)
49	<i>Jasminum malabaricum</i> Wight ^b PB/GRH. 14	Oleaceae	Mallige	R	Cl/Wi	1	12	0.08	Aphthae	Leaves in cuts and wounds (Rajakumar and Shivanna, 2010)
50	<i>Jatropha curcas</i> L. ^a PB/GRH. 103	Euphorbiaceae	Beligida	W, La, L	Sh/Wi	3	2	1.50	Whitlow, cuts	Latex in cuts and wounds (Bhandary and Chandrashekar, 2002), leaf in cuts and wounds (Subramanian et al., 2011), internal ulcer (Odukoya et al., 2012), stem bark in wounds (Kasarla et al., 2012), oral ulcer (Venkataswamy et al., 2010)
51	<i>Kalanchoe pinnata</i> (Lam.) Pers. ^a PB/GRH. 19	Crassulaceae	Pata pate gida	L	H/Wi	1	11	0.09	Cuts	Cuts (Bhandary et al., 1995, 1996; Bhandary and Chandrashekar, 2002), wounds (Upadhyaya et al., 2009; Shiddamallayya et al., 2010b; Subramanian et al., 2011; Abbasi et al., 2010)
52	<i>Lantana camara</i> L. ^a PB/GRH. 41	Verbenaceae	Bendele	L	Sh/Wi	1	5	0.20	Cuts	Cuts and wounds (Prashantkumar and Vidyasagar, 2008; Mamatha et al., 2006; Wadankar et al., 2011), whole plant in cuts and wounds (Subramanian et al., 2011), leaf in wounds (Rajakumar and Shivanna, 2009)
53	<i>Leea asiatica</i> (L.) Ridsd PB/GRH. 70	Leeaceae	Bili Nedtige	R	Sh/Wi	1	2	0.50	Burn	
54	<i>Leea indica</i> (Burm.f.) Merr. PB/GRH. 84	Leeaceae	Nedtige	R	Sh/Wi	2	3	0.67	Snake bite	
55	<i>Loranthus species</i> PB/GRH. 27	Loranthaceae	Bandarike	W	P/Wi	1	8	0.13	Whitlow	
56	<i>Madhuca indica</i> J. Gmelin PB/GRH. 71	Sapotaceae	Ippi	B, L	T/Wi	1	2	0.50	Aphthae and ulcer in intestine	Whole plant in cuts and wounds (Subramanian et al., 2011)
57	<i>Mammea suriga</i> (Buch.-Ham. ex Roxb.) Kosterm. ^b PB/GRH. 46	Clusiaceae	Surgi	B	T/Wi	1	4	0.25	Wounds on cattle skin due to tick bite	
58	<i>Mangifera indica</i> L. PB/GRH. 37	Anacardiaceae	Maavu	L	T/Wi	1	6	0.17	Cuts	Stem bark in wounds (Kuvar and Bapat, 2010), ulcer (Malla and Chhetri, 2009; Manandhar, 1993)
59	<i>Mimosa pudica</i> L. PB/GRH. 31 ^a	Mimosaceae	Naachike mullu	W	H/Wi	1	7	0.14	Gingival wounds	Leaves in cuts and wounds (Bhandary and Chandrashekar, 2002; Bhandary et al., 1995; Patil et al., 2009; Wadankar et al., 2011), roots in accidental wounds (Shiddamallayya et al., 2010a), whole plant in cuts and wounds (Subramanian et al., 2011)
60	<i>Mirabilis jalapa</i> L. PB/GRH. 22 ^a	Nyctaginaceae	Bili Madyahna mallige	R	H/Cu	1	9	0.11	Otorrhoea	Leaves in wounds and burns (Hiremath et al., 2010)
61	<i>Momordica charantia</i> L. PB/GRH. 3	Cucurbitaceae	Haagala	L	Cl/Cu	1	17	0.06	Cuts	
62	<i>Moringa oleifera</i> Lam. PB/GRH. 54 ^b	Moringaceae	Nugge	L, R, B, Fl and Sd	T/Cu	1	3	0.33	Cuts	Bark in dog bite (Parinitha et al., 2004), leaves in cuts, wounds (Patil et al., 2009; Wadankar et al., 2011-), snakebite and dogbite wounds (Das, 1997; Begum and Nath, 2000), whole plant in cuts and wounds (Subramanian et al., 2011), root bark in wound healing (Jaiswal et al., 2004), bark in wounds (Mondal and Chauhan, 2000)
63	<i>Musa paradisiaca</i> L. PB/GRH. 72	Musaceae	Karibaale	Su	H/Cu	1	2	0.50	Gingival wounds	Whole plant in cuts and wounds (Subramanian et al., 2011)
64	<i>Mussaenda frondosa</i> L. PB/GRH. 73	Rubiaceae	Bellatte	L	Cl/Wi	1	2	0.50	Gangrene	

65	<i>Myristica fragrans</i> Hault. ^a PB/GRH. 4	Myristicaceae	Jaayikaayi	Fr	T/Cu	1	16	0.06	Aphthae and ulcer in intestine	
66	<i>Naravelia zeylanica</i> (L.) DC. PB/GRH. 85	Ranunculaceae	Talevadetada Balli	S, L, R	Cl/Wi	2	3	0.67	Sores in buccal cavity, wounds with maggots in cattle	Whole plant in wounds with worms (Rajakumar and Shivanna, 2010)
67	<i>Naringi crenulata</i> (Roxb.) Nicolson PB/GRH. 86	Rutaceae	Saavira Kannina Gida	L	T/Wi	2	3	0.67	Aphthae, gangrene	
68	<i>Neolamarckia cadamba</i> (Roxb.) Bossler PB/GRH. 15	Rubiaceae	Aapatthi	B	T/Wi	1	12	0.08	Snake bite	
69	<i>Ocimum tenuiflorum</i> L. PB/ GRH. 94	Lamiaceae	Tulasi	L	H/Cu	2	2	1.00	Cuts, gingival wounds	Ulcers (Shiddamallayya et al., 2010a), wounds (Kasarla et al., 2012; Wadankar et al., 2011)
70	<i>Opuntia stricta</i> var. <i>dillenii</i> (Ker-Gawler) L. Benson ^a PB/GRH. 38	Cactaceae	Mullu kalli	SuSt	Sh/Cu	1	6	0.17	Whitlow	Fleshy part of stem in wounds (Ayyanar and Ignacimuthu, 2009)
71	<i>Phyllanthus emblica</i> L. PB/ GRH. 74	Euphorbiaceae	Nelli	Br	T/Wi	2	3	0.66	Wounds with maggots in cattle, snake bite	Bark paste in incision of insect bite (Hosagoudar and Henry, 1996), bark in scorpion bite (Mamatha et al., 2006)
72	<i>Piper betle</i> L. ^a PB/GRH. 75	Piperaceae	Veelyadele	L	Cl/Cu	1	2	0.50	Cuts	Petiole and leaves in cuts and burns (Sarma et al., 2002; Thomus and John De Britto, 2003; Chowdhury et al., 2009)
73	<i>Piper longum</i> L. PB/GRH. 32	Piperaceae	Hippali	Fr	Cl/Wi	1	7	0.14	Otorrhoea	
74	<i>Piper nigrum</i> L. PB/GRH. 106	Piperaceae	Bolkaalu, Menasina kaalu	Fr	Cl/Wi	2	4	0.50	Aphthae, ulcer in intestine, crack foot, cuts, gangrene, gingival wounds, Otorrhoea, snake bite	
75	<i>Plectranthes amboinicus</i> (Lour.) Sprengel ^a PB/GRH. 1	Lamiaceae	Sambaar soppu	L	H/Cu	1	20	0.05	Cuts	
76	<i>Plumbago zeylanica</i> L. PB/GRH. 5	Plumbaginaceae	Bilichitramoola	R	H/Wi	1	18	0.06	Snake bite	Wounds (Shivanna and Rajakumar, 2010; Kasarla et al., 2012; Rajakumar and Shivanna, 2009), bark juice in sore-wounds (Parinitha et al., 2005), ulcer (Nandagopalan et al., 2011; Odukoya et al., 2012), bleeding (Cheikhoussef et al., 2011)
77	<i>Plumeria rubra</i> L. PB/GRH. 87	Apocynaceae	Govesampige	B	T/Cu	2	3	0.67	Gingival wounds, snake bite	Wound (Rajakumar and Shivanna, 2010), ulcer (Nandagopalan et al., 2011), latex used to take out any worms from wounds (Manandhar, 1993)
78	<i>Polygonum chinense</i> L. PB/ GRH. 95	Polygonaceae	Kannekudi	S, L	Sh/Wi	2	2	1.00	Aphthae	
79	<i>Pongamia pinnata</i> (L.) Pierre PB/GRH. 9	Fabaceae	Thore honagalu	R	T/Wi	1	15	0.07	Snake bite	Leaves in wounds (Shiddamallayya et al., 2010a), oil from seeds in wounds (Ayyanar and Ignacimuthu, 2009), leaves in wound (Patil et al., 2009), roots in ulcer (Qureshi and Khan, 2001)
80	<i>Psidium guajava</i> L. ^a PB/ GRH. 10	Myrtaceae	Perale	R	T/Cu	1	14	0.07	Snake bite	Leaves and tender fruits in mouth ulcer (Upadhya et al., 2009) and cuts, wounds (Subramanian et al., 2011; Kasarla et al., 2012; Malla and Chhetri, 2009)
81	<i>Psychotria dalzellii</i> Hook.f. ^b PB/GRH. 96	Rubiaceae	Kadoon kivi beru.	R	Sh/Wi	1	1	1.00	Scorpion bite	
82	<i>Randia dumetorum</i> (Retz.) Poiret PB/GRH. 88	Rubiaceae	Kaare	R	Sh/Wi	2	3	0.67	Snake bite	
83	<i>Rauvolfia serpentina</i> (L.) Benth. ex Kurz PB/GRH. 105	Apocynaceae	Sarpagandha	R	Sh/Wi	5	3	1.67	Snake bite, Otorrhoea, scorpion bite	Snake bite (Parinitha et al., 2005; Bhandary and Chandrashekar, 2002; Parinitha et al. 2004; Prakasha et al., 2010), root and leaf in cuts and wounds
84	<i>Remusatia vivipara</i> (Roxb.) Schott PB/GRH. 16	Araceae	Marakesu	Tu	H/Wi	1	13	0.08	Otorrhoea	
85	<i>Rhinacanthus nasuta</i> (L.) Kurz PB/GRH. 66	Acanthaceae	Pakshiraja	L	Sh/Wi	1	2	0.50	Burn	
86	<i>Salacia chinensis</i> L. PB/GRH. 76	Celastraceae	Ekanayaka	R	Sh/Wi	1	2	0.50	Snake bite	
87	<i>Sapindus trifoliata</i> L. PB/ GRH. 55	Sapindaceae	Antuvaala	R	T/Wi	1	3	0.33	Snake bite	Fruits in wounds (Mamatha et al., 2006)
88	<i>Semecarpus anacardium</i> L.f. PB/GRH. 28	Anacardiaceae	Guddegeru	Sd, B	T/Wi	1	8	0.13	Corn, crack foot	Fruits in wounds (Wadankar et al., 2011)
89	<i>Sesamum orientale</i> var. <i>malabaricum</i> Nan. PB/GRH. 20	Pedaliaceae	Yellu	Fr	H/Cu	1	10	0.10	Cuts	
90	<i>Solanum melongena</i> L. PB/ GRH. 23	Solanaceae	Badane	L	H/Cu	1	9	0.11	Cuts	

Table 1 (continued)

Sl. no.	Species/voucher specimen number	Family	Vernacular name	Part used	Habit/habitat	$\sum U$	n	UV	Recommended uses	Literature reports for wounds or related symptoms from Karnataka State, India, and other tropical countries
91	<i>Strychnos nux-vomica</i> L. PB/GRH. 101	Loganiaceae	Kaasarka	R, B, L	T/Wi	4	3	1.33	Snake bite, cuts, gangrene	Ulcers (Shiddamallayya et al., 2010a), root bark in venomous snake bite (Bhandary et al., 1995), stem bark in cuts and wounds of cattle (Bhandary et al., 1995)
92	<i>Syzygium aromaticum</i> (L.) Merr. & Perry ^a PB/GRH. 100	Myrtaceae	Lavanga	Fb	T/Cu	5	4	1.25	Aphthae, ulcer in intestine, crack foot, gangrene, gingival wounds	
93	<i>Syzygium cumini</i> (L.) Skeels PB/GRH. 97	Myrtaceae	Nerale	B	T/Wi	2	2	1.00	Aphthae and ulcer in intestine	Bark in wounds (Shiddamallayya et al., 2010a), bark and leaf in burns (Hosagoudar and Henry, 1996; Mishra et al., 1996), stem and seeds in cuts, wounds (Subramanian et al., 2011), stem bark in wounds (Sudarsanam et al., 1995)
94	<i>Tabernaemontana divaricata</i> (L.) R.Br. Ex Roemer & Schultes PB/GRH. 17	Apocynaceae	Nanjatte	R	Sh/Cu	1	13	0.08	Cuts	Snake bite (Prakasha et al., 2010)
95	<i>Tabernaemontana heyneana</i> Wallich ^b PB/GRH. 102	Apocynaceae	Maddarasa	B, R	Sh/Wi	4	3	1.33	Cuts, scorpion bite, snake bite	Bark juice and latex on wounds or cuts (Prakasha and Krishnappa, 2006), bark in snake bite (Achar et al., 2010), stem bark decoction in wounds (Bhandary et al., 1995; Prakasha and Krishnappa, 2006), root in snake bite (Bhandary and Chandrashekar, 2002)
96	<i>Tagetes erecta</i> L. PB/GRH. 24	Asteraceae	Gonder gida	L	Sh/Cu	1	9	0.11	Wounds with maggots in cattle	Wounds (Kasarla et al., 2012), wound and worms in cattle (Rajakumar and Shivanna, 2009), cuts (Chowdhury et al., 2009)
97	<i>Tamarindus indica</i> L. ^a PB/GRH. 18	Caesalpiniaceae	Hunase	L	T/Cu	1	12	0.08	Cuts	Fruit pulp in injuries caused by bear (Hosagoudar and Henry, 1996), fruit pulp in burns (Bhandary and Chandrashekar, 2002), wounds (Venkataswamy et al., 2010)
98	<i>Tectona grandis</i> L.f. PB/GRH. 77	Verbenaceae	Saagavani	L	T/Wi	1	2	0.50	Burn	Burns (Harsha et al., 2002; Bhandary et al., 1995; Bhandary and Chandrashekar, 2002; Maruthi et al., 2000; Parinitha et al. 2004), cuts and wounds (Bhandary et al., 1995)
99	<i>Terminalia bellirica</i> (Gaertner) Roxb. PB/GRH. 56	Combretaceae	Taare	B	T/Wi	1	3	0.33	Wounds with maggots in cattle	Infected wounds, foot and mouth diseases in cattle (Harsha et al., 2002, 2005; Rajakumar and Shivanna, 2010), fruit in wounds (Ayyanar and Ignacimuthu, 2009)
100	<i>Terminalia chebula</i> Retz. PB/GRH. 98	Combretaceae	Anale	Fr	T/Wi	2	2	1.00	Inter trigo, Otorrhoea	Burns (Upadhyaya et al., 2009), leaves in wounds (Patil et al., 2009), fruit in cuts and wounds (Subramanian et al., 2011)
101	<i>Trachyspermum ammi</i> (L.) Sprague ^a PB/GRH. 89	Apiaceae	Omu	Sd	H/Cu	2	3	0.67	Aphthae and ulcer in intestine	
102	<i>Vernonia anthelmintica</i> (L.) Willd. PB/GRH. 93	Asteraceae	Kaalu jeerige	Sd	H/Wi	4	5	0.80	Crack foot, cuts, gangrene	
103	<i>Vitex negundo</i> L. PB/GRH. 92	Verbenaceae	Nukki	L	Sh/Wi	3	4	0.75	Whitlow, wounds due to prickly heat, wounds with maggots	Burns and wounds (Prakasha and Krishnappa, 2006), poisonous bites in cattle (Harsha et al., 2005), sore nose (Rajakumar and Shivanna, 2010), cracks and wounds in domestic animals (Prakasha and Krishnappa, 2006), cuts and wounds (Subramanian et al., 2011), snake bite (Barkatullah et al., 2009)
104	<i>Wattakaka volubilis</i> (L.f.) Stapf PB/GRH. 90	Asclepiadaceae	Hegleballi	R, S, Fr	Sh/Wi	2	3	0.67	Throat infection in cattle, inter trigo	
105	<i>Wendlandia thyrsoides</i> (Roemer & Schultes) Steudel PB/GRH. 99	Rubiaceae	Chilge	Tl	Sh/Wi	1	1	1.00	Conjunctivitis	
106	<i>Zingiber officinale</i> Roscoe PB/GRH. 58	Zingiberaceae	Shunthi	Rh	H/Cu	2	5	0.40	Aphthae, ulcer in intestine	Wounds (Abbasi et al., 2010; Wadankar et al., 2011), whole plant in wounds (Odukoya et al., 2012)

$\sum U$ —total number of uses mentioned by the informants for a given species, n —total number of informants for a given species, W—whole plant, R—root, L—leaves, Tl—tender leaves, S—stem, Br—branch of the leaves, Tf—tender fruit, B—bark, Fl—flower, Fr—fruit, Fb—flower bud, Sd—seed, Rh—rhizome, E—endosperm, Bu—bulb, Su—sucker, Tu—tuber, SuSt—succulent stem, La—latex, T—tree, Sh—shrub, H—herb, P—parasite, Wi—wild, Cu—cultivated.

^a Exotic.

^b Endemic.

Table 2
Informant consensus factor categorized by medicinal use.

Sl. no.	Category	Use citation	No. of plant taxa used	ICF
1	Gangrene	1	12	–
2	Conjunctivitis	1	1	–
3	Otorrhoea	11	9	0.20
4	Crack foot	8	6	0.28
5	Wounds due to cuts	43	30	0.31
6	Animal bites	41	27	0.35
7	Inter trigo	9	6	0.37
8	Gingival wounds	21	13	0.40
9	Corn	3	2	0.50
10	Wounds due to prickly heat	5	3	0.50
11	Whitlow	9	5	0.50
12	Sores	3	2	0.50
13	Apthae	39	18	0.55
14	Wounds in cattle	18	7	0.64
15	Burn	13	5	0.66

Wound types ranged from simple cuts to highly intricate gangrene in humans. It includes both external and internal damages of the tissues like apthae, burn, conjunctivitis, corn, crack foot, animal bites, gingival wounds, otorrhoea, sores, whitlow etc in humans and in cattle it was a result of tick bite, throat infection and wounds with maggots.

3.1. Preparation and mode of application

Traditional medicines for treatment of wounds are either used externally or internally or sometimes as both depending on the type of wound. The drug formulation are normally five types viz. paste with water or limejuice, juice extract from fresh juicy parts, aqueous decoction, oil extracts and powder from either fresh or dry materials. The external application is used exclusively for skin aberrations like burn, corn, crack foot, gangrene, inter trigo, whitlow and wounds due to prickly heat. Almost all the external remedies are in the form of

Table 3
Formulations of the taxa for the treatment of wounds.

Ailments	Plants and parts used	Preparation	Administration route
Apthae	<i>Alternanthera sessilis</i> (whole plant)	Crushed and juice is extracted	Oral
	<i>Ixora coccinea</i> (root)	Chewing	Oral
	<i>Naringi crenulata</i> (leaves)		
	<i>Ficus racemosa</i> (tender leaves)		
Apthae and ulcer in intestine	<i>Jasminum malabaricum</i> (root)	Ground in lime juice	Oral
	<i>Polygonum chinense</i> (shoot and leaves)+ <i>Cocos nucifera</i> (tender fruit)+ <i>Ficus racemosa</i> (bark)	Ground in milk	Oral
	<i>Syzygium cumini</i> (bark)+ <i>Holarrhena pubescence</i> (bark)+ <i>Madhuca indica</i> (leaves and bark)+ <i>Careya arborea</i> (bark)+ <i>Elaegmus conferta</i> (bark)+ <i>Myristica fragrans</i> (fruit)+ <i>Syzygium aromaticum</i> (flower bud)+ <i>Piper nigrum</i> (fruit)+ <i>Trachyspermum ammi</i> (fruit)+ <i>Zingiber officinale</i> (rhizome)+ <i>Cuminum cyminum</i> (fruit)	Decoction in water with jaggery	Oral
	<i>Cocos nucifera</i> (tender fruit)	Chewed by removing outer coverings	Oral
Burn	<i>Cocos nucifera</i> (endosperm)	Burnt and made into paste in water	External
	<i>Rhinacanthus nasuta</i> (leaves)+ <i>Tectona grandis</i> (leaves)	Crushed and boiled in coconut oil	External
	<i>Hibiscus rosa-sinensis</i> (flower)	Ground in coconut oil	External
	<i>Leea asiatica</i> (root)	Ground in rice washed water	External
Conjunctivitis	<i>Wendlandia thyrsoides</i> (tender leaves)	Ground and packed in a fresh cotton cloth, dipped in cow's milk and dropped into the affected eye	Internal
Corn	<i>Anacardium occidentale</i> (seed)+ <i>Semecarpus anacardium</i> (seed)	Burnt and squeezed the oil	External
Crack foot	<i>Garcinia gummi-gutta</i> (seed)	Oil extracted	External
	<i>Semecarpus anacardium</i> (seed and bark)+ <i>Piper nigrum</i> (fruit)+ <i>Vernonia anthelmintica</i> (fruit)+ <i>Syzygium aromaticum</i> (flower bud)+ <i>Curcuma longa</i> (rhizome)	Ground with Copper sulphate, camphor tablets and boiled in cow's ghee, grease and paraffin	External
Cuts	<i>Achyranthes aspera</i> (leaves)	Crushed and juice is extracted	External
	<i>Adhathoda zeylanica</i> (leaves and stem)	Ground and juice is extracted	External
	<i>Allium cepa</i> (bulb)	Chopped into small pieces, boiled in coconut oil	External
	<i>Allium sativum</i> (bulb)	Squeezed in water	External
	<i>Alstonia scholaris</i> (bark)+ <i>Tabernaemontana heyneana</i> (bark)+ <i>Jatropha curcas</i> (leaf)	Ground, boiled in coconut oil, allowed to cool	External
	<i>Annona squamosa</i> (leaves)	Dried, fried, ground into fine powder	External
	<i>Azadirachta indica</i> (leaves)+ <i>Sesamum orientale</i> var. <i>malabaricum</i> (seeds)	Ground, boiled in coconut oil, allowed to cool	External
	<i>Chromolaena odorata</i> (leaves)	Crushed and juice is applied	External
	<i>Cocos nucifera</i> (leaves)	Burnt and powdered	External
	<i>Cocos nucifera</i> (fruit)	Tender coconut water is boiled and oily mass is applied	External
	<i>Curcuma longa</i> (rhizome)	Powdered and applied	External
	<i>Dendranthema indicum</i> (leaves)+ <i>Curcuma longa</i> (rhizome)	Ground and bandaged	External
	<i>Glycyrrhiza glabra</i> (root)	Ground with ghee and made into paste	External
	<i>Jatropha curcas</i> (whole plant)	Crushed and juice is applied	External
	<i>Jatropha curcas</i> (leaves)	Crushed with limestone	External
	<i>Lantana camara</i> (leaves)	Crushed and juice is applied	External
	<i>Momordica charantia</i> (leaves)		
	<i>Kalanchoe pinnata</i> (leaves)		
	<i>Mangifera indica</i> (leaves)	Dried in shade, roasted and powdered	External

Table 3 (continued)

Ailments	Plants and parts used	Preparation	Administration route
	<i>Moringa oleifera</i> (leaves, root, bark, flower, stem)	Ground and paste dressing	External
	<i>Ocimum tenuiflorum</i> (leaves)	Crushed and paste dressing	External
	<i>Piper betle</i> (leaves)	Crushed with lime juice and paste dressing	External
	<i>Plectranthes amboinicus</i> (leaves)	Paste baked on flame	External
	<i>Solanum melongena</i> (leaves)+ <i>Vernonia anthelmintica</i> (fruit)+ <i>Curcuma longa</i> (rhizome)+ <i>Piper nigrum</i> (fruit)+ <i>Elettaria cardamomum</i> (fruit)	Paste with camphor tablets, boiled in coconut oil	External
	<i>Tabernaemontana divaricata</i> (root)	Infusion with lime juice	Oral
	<i>Tabernaemontana heyneana</i> (bark)+ <i>Strychnos nux-vomica</i> (bark)+ <i>Curcuma longa</i> (rhizome)+ <i>Vernonia anthelmintica</i> (seeds)	Ground in coconut oil	External
	<i>Tamarindus indica</i> (leaves)	Paste with salt	External
	<i>Ficus racemosa</i> (bark)	Paste with ghee	External
Dog bite	<i>Barringtonia racemosa</i> (fruit)	Paste with lime juice, applied externally and mixed with buttermilk, taken orally	External and oral
Gangrene	<i>Mussaenda frondosa</i> L. (leaves)+ <i>Cassia fistula</i> (leaves)+ <i>Naringi crenulata</i> (leaves)+ <i>Strychnos nux-vomica</i> (leaves)+ <i>Calycopteris floribunda</i> (leaves)+ <i>Chromolaena odorata</i> (leaves)+ <i>Clerodendrum infortunatum</i> (leaves)+ <i>Curcuma longa</i> (rhizome)+ <i>Cuminum cyminum</i> (seeds)+ <i>Vernonia anthelmintica</i> (fruit)+ <i>Piper nigrum</i> (fruits)+ <i>Syzygium aromaticum</i> (flower buds)	Paste with coconut oil and boiled, allowed to cool	External
Gingival wounds	<i>Achyranthes aspera</i> (whole plant)+ <i>Ocimum tenuiflorum</i> (leaves)+ <i>Mimosa pudica</i> (whole plant)+ <i>Calotropis gigantea</i> (root)+ <i>Cuminum cyminum</i> (seeds)+ <i>Foeniculum vulgare</i> (fruits)+ <i>Piper nigrum</i> (fruits)+ <i>Syzygium aromaticum</i> (flower buds)	Ground and boiled in water, lukewarm infusion is used to gargle	Oral
	<i>Barleria prionitis</i> (leaf)	Crushed with weaver ants (<i>Oecophylla smaragdina</i>) and juice is dropped into the ear opposite to the side of gingival wound through a small funnel made by a leaf of <i>Artocarpus heterophyllus</i>	Internal
	<i>Musa paradisiaca</i> (sucker)+ <i>Brassica juncea</i> (seeds)	Paste	External
	<i>Plumeria rubra</i> (bark)	Ground and boiled in water, lukewarm infusion is used for gargling	Oral
Inter trigo	<i>Terminalia chebula</i> (fruit)	Baked, squeezed and made into paste	External
	<i>Diploclisia glaucescens</i> (root)+ <i>Wattakaka volubilis</i> (root and stem or fruit)+ <i>Curcuma longa</i> (rhizome)	Paste with lime juice	External
Otorrhoea	<i>Calotropis gigantea</i> (leaves)	Leaf is externally applied with coconut oil, baked on flame, crushed, lukewarm juice is extracted and poured into the ear	Internal
	<i>Capsicum annum</i> var. <i>glabriusculum</i> (leaves and fruits)	Ground and juice is extracted, dropped into the ear	Internal
	<i>Clitoria ternatea</i> (root)+ <i>Mirabilis jalapa</i> (root)+ <i>Rauvolfia serpentina</i> (root)+ <i>Curcuma longa</i> (rhizome)	Ground with lime water to get extract, warm extract is poured into the affected ear, allowed for some minutes and poured off from the ear. The paste prepared in the lime juice from the plants is applied externally around the ear	Internal and external
	<i>Costus speciosus</i> (stem)	Baked and crushed. Lukewarm juice is poured into the ear	Internal
	<i>Remusatia vivipara</i> (tuber)+ <i>Curcuma longa</i> (fruits)	Crushed and boiled in coconut oil, allowed to cool and poured into the ear	Internal
	<i>Terminalia chebula</i> (fruit)+ <i>Piper longum</i> (fruit)	Ground, boiled in coconut oil, lukewarm oil is dropped into the ear	Internal
Scorpion bite	<i>Psychotria dalzellii</i> (root)+ <i>Rauvolfia serpentina</i> (root)+ <i>Calotropis gigantea</i> (root)+ <i>Tabernaemontana heyneana</i> (bark)+ <i>Calamus rotang</i> (root)	Ground with lime juice, paste is applied externally and a spoon of paste is taken orally	External and oral
Snake bite	<i>Calotropis gigantea</i> (root)+ <i>Neolamarckia cadamba</i> (bark)	Paste with water, applied externally and a spoonful of paste is swallowed	External and oral
	<i>Calycopteris floribunda</i> (branch of leaves)+ <i>Phyllanthus emblica</i> (branch of leaves)	Burnt and powdered	External
	<i>Clerodendrum indicum</i> (root)	Paste with water	External
	<i>Croton roxburghii</i> (root)	Paste with water, applied externally and swallowed	External and oral
	<i>Diploclisia glaucescens</i> (root)+ <i>Rauvolfia serpentina</i> (root)+ <i>Calotropis gigantea</i> (root)+ <i>Cryptolepis buchananii</i> (root)+ <i>Tabernaemontana heyneana</i> (root)+ <i>Randia dumetorum</i> (root)+ <i>Strychnos nux-vomica</i> (bark)+ <i>Plumbago zeylanica</i> (root)+ <i>Plumeria rubra</i> (bark)	Paste with lime juice and applied	External
	<i>Diploclisia glaucescens</i> (root)+ <i>Pongamia pinnata</i> (root)+ <i>Girardinia diversifolia</i> (root)+ <i>Rauvolfia serpentina</i> (root)	Paste with lime juice and swallowed	Oral
	<i>Gladiolus dalenii</i> (root)+ <i>Leea indica</i> (root)+ <i>Rauvolfia serpentina</i> (root)	Paste with water and swallowed	Oral
	<i>Ixora coccinea</i> (root)	Paste with lime juice and swallowed	Oral
	<i>Leea indica</i> (root)+ <i>Citrus medica</i> (root)+ <i>Piper nigrum</i> (fruit)	Paste with lime juice applied externally and swallowed	External and oral
	<i>Psidium guajava</i> (root)+ <i>Calotropis gigantea</i> (root)	Paste with rice washed water	External
	<i>Randia dumetorum</i> (root)	Paste with water	External
	<i>Salacia chinensis</i> (root)	Paste with lime juice applied externally and swallowed	External and oral

Table 3 (continued)

Ailments	Plants and parts used	Preparation	Administration route
	<i>Sapindus trifoliata</i> (root)	Paste with honey	Oral
	<i>Strychnos nux-vomica</i> (root)	Paste with water and swallowed, oily foods are avoided for one week.	Oral
Sore nose	<i>Cynodon dactylon</i> (whole plant)	Crushed and juice is obtained	Internal
Sore in buccal cavity	<i>Naravelia zeylanica</i> (root)	Ground and juice is boiled in coconut oil, allowed to cool for some time, dropped into the ear	Internal
Throat infection in cattle	<i>Wattakaka volubilis</i> (stem)+ <i>Capsicum annum</i> var. <i>glabriusculum</i> (fruit)	Rubbed with salt	Internal
Whitlow	<i>Loranthus</i> species (whole plant) (grown on <i>Citrus limon</i> plant)	Paste with lime juice	External
	<i>Elaeagnus conferta</i> fruit	Juice	External
	<i>Jatropha curcas</i> (latex)	Latex	External
	<i>Loranthus</i> species (whole plant) (grown on <i>Vitex negundo</i> plant)	Paste with lime juice	External
Wounds due to prickly heat	<i>Opuntia stricta</i> var. <i>dillenii</i> (succulent stem)	Paste and made into a poultice	External
	<i>Acacia catechu</i> (root)	Paste with water	External
	<i>Grewia tiliifolia</i> (bark)	Paste with water	Internal
Wounds on cattle skin due to tick bite	<i>Vitex negundo</i> (leaf)	Paste with coconut oil	External
	<i>Mammea suriga</i> (bark)	Paste with water	External
Wounds with maggots in cattle	<i>Naravelia zeylanica</i> (whole plant)	Tied around the neck of the cattle. Care should be taken that person should not talk while tying the stem	External
	<i>Tagetes erecta</i> (leaves)+ <i>Vitex negundo</i> (leaves)	Paste with wood ash and kerosene oil	External
	<i>Terminalia bellirica</i> (bark)	Peeled by stone and juice is extracted	Internal

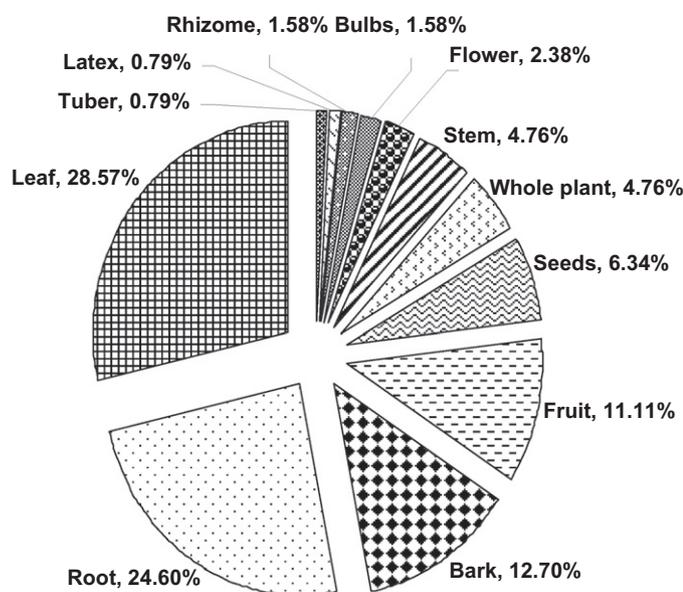


Fig. 2. Relative use of plant parts as remedies.

paste of the drug part ground in water, lime juice or in the form of oil prepared by boiling pounded plant parts in coconut oil. The internal use of plant medicines is in the form of juice from the fresh parts of the plant, infusion with water or lime juice and in the form of paste with honey, buttermilk or water. It is practiced to get relief of aphthae, animal bites (snake bite, dog bite and scorpion bite), sore nose, sore in buccal cavity, conjunctivitis etc. Treatments are done with either single plant formulation, combinations of several plants or even with many parts of the same plant (Table 3). Of the 86 formulations, 26 involved multiple drugs obtained from two to fourteen different plant species. According to the practitioners, the combinations of different plant species increases the activity of medicine and 'ill effect' of any one plant, if exists, will be 'neutralized' by the other.

An interesting practice of curing the gingival wounds using insect along with the plant parts is observed (Table 3). They believe that the body sap of this insect plays a major role in the healing. Usage of camphor tablets, lime stone along with the plant mixtures to treat cuts is another interesting fact as they act as antiseptic agents. While preparing the external application for burns, the materials are ground in rice washed water (before cooking the rice (*Oryza sativa* L.), it is first washed in water and this water is discarded. The rice is once again soaked in water for ten minutes and the decanted water is used for grinding the plant drug parts). According to them this rice washed water acts as a coolant and as a media to repair the burnt tissues.

3.2. Analysis of the data

In all 106 plants belonging to 55 plant families have been documented in the present study (Table 1). The highest number of species belonged to Apocynaceae and Rubiaceae (six species each) followed by Verbenaceae (five species), Asteraceae, Rutaceae, Zingiberaceae (four species each). Trees are used more often (35.84%), followed by herbs (28.30%), shrubs (23.58%), climbers (11.32) and parasites (0.80%). From Fig. 2 it is clear that leaves are the most frequently used, followed by the roots. Most of the ethnobotanical studies confirm that leaves are the major portion of the plant used for the treatment of diseases (Ayyanar and Ignacimuthu, 2009) as they are active sites of photosynthesis and production of metabolites (Ghorbani, 2005).

As indicated in Table 1, the highest Use-Value is for *Calycopteris floribunda*, *Rauvolfia serpentina*, *Achyranthes aspera*, *Jatropha curcas*, *Tabernaemontana heyneana*, *Strychnos nux-vomica* and *Calotropis gigantea*. *Calycopteris floribunda* scored the highest UV (1.80), followed by *Rauvolfia serpentina* and *Achyranthes aspera* (UV=1.67). The lowest UV is scored by *Plectranthes amboinicus* (UV=0.05).

The different types of wounds treated by traditional healers are classified into 15 categories and the ICF values for each category are given (Table 2). ICF values obtained for the reported categories indicate the degree of shared knowledge for the treatment of each category of ailment. The highest ICF scored is

for the burns. Five plants are used to treat the burns (ICF=0.66) and were cited by the 13 practitioners. Most of the practitioners quoted about the *Hibiscus rosa-sinensis* and *Cocos nucifera* to treat the burns. The second level of ICF was reported for cattle wounds (ICF=0.64), which include the ailments such as throat infection, wounds with maggots and wounds on skin due to tick bite. Aphthae recorded the third highest value (ICF=0.55), 18 plants with 39 citations are recorded to treat the ailment. *Alternanthera sessilis*, *Jasminum malabaricum* and *Ixora coccinea* are cited by the maximum number of healers. Sores, whitlow, wounds due to prickly heat and corn in humans were ranked with the same ICF (0.50). Table 2 indicates that more number of traditional healers are experts in treating wounds such as wounds due to cuts, animal bites, aphthae, gingival wounds, wounds in cattle, burn etc. However the ICF value indicates that highest sharing of knowledge is for burns followed by Aphthae. Similarly, information collected from various parts of Karnataka indicates that *Tectona grandis* is most widely used plant to cure burn wounds (Bhandary et al., 1995; Maruthi et al., 2000; Harsha et al., 2002; Bhandary and Chandrashekar, 2002; Parinitha et al., 2004). Uses of different parts of *Tabernaemontana heyneana*, an endemic tree species, in the folklore medicine to cure wound is reported by Bhandary et al. (1995, 2002), Prakasha and Krishnappa (2006) and Achar et al. (2010). *Rauvolfia serpentina* root used against wounds due to snake bite is reported by Parinitha et al. (2005), Bhandary et al. (2002) and Prakasha et al. (2010).

Among the 106 plants recorded four species are endemic to India and 22 species have the nativity outside India (Table 1). Rest of the species have nativity both in India and elsewhere. Also from the review of literature it is found that information about wound healing properties of 39 species already exists in Ayurveda (Sharma et al., 2000, 2001 and 2002; Billore et al. (2003, 2005); Kailash et al., 2007; Yoganarasimhan, 1996). Interestingly, eight species out of these 39 have the nativity outside India.

4. Conclusion

Uttara Kannada district has diverse vegetation with various medicinal plants and is equally rich in indigenous ethnomedicinal knowledge. Present study evaluates 106 plants used in herbal medicines to cure 15 categories of wounds by 44 key informants belonging to different ethnic communities in the district. Analysis of the data in terms of Use value and Informants Consensus Factor, confirmed that the relative importance of species and sharing knowledge of herbal treatment between different communities is high. Information about the wound healing properties of some of the plant species used especially by the Havyaka Brahmin community has been mentioned in Ayurveda. Their sound knowledge is possibly due to their strong Sanskrit background along with the trial and error based medicinal practices. Similar practices have also been developed by other communities, simultaneously, as a result of inter-community interactions. Claims are recorded from simple wounds like aphthae to severe gangrene, indicating their strong knowledge in curing a range of diseases using different parts of the plants. Present study quantifies the indigenous knowledge of different communities in the district and plants can be considered in effective treatment of different types of wounds.

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Appendix A. Supplementary material

Supplementary data associated with this article can be found in the online version at <http://dx.doi.org/10.1016/j.jep.2012.07.003>.

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