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Traditional phytoremedies for wounds healing used by local community of Tehsil Kahuta, District Rawalpindi, Pakistan

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Abstract

The present study was aimed to unveil the medicinal plants (MPs) being used traditionally as phytoremedies for wounds healing by local community of Tehsil Kahuta, District Rawalpindi (Pakistan). For the purpose, 117 informants (64 female and 53 male) of various age groups were investigated through well planned questionnaires and interviews. As a result total 75 medicinal plants (36 herbs, 24 trees, 14 shrubs & 1 climber) belonging to 48 families, alongwith traditional phytoremedies were documented. Data analysis showed that leaves were most frequently used (44.71%) followed by whole plant and bark (12.94% each), fruits (7.06%), roots and seeds (4.71% each), flowers (3.53), rhizome and latex (2.35% each), and stem, resin, tuber and bulb (1.18% each). Most species were used against bites (anti-venom) and external wounds (10 species each) followed by mouth ulcer and burns (9 species each) and wounds inflammations (7 species). The data was also quantitatively analyzed by using different statistical tools like Frequency citation (FC), Relative Frequency citation (RFC), Use value (UV) and Fidelity level (FL). From the study it was concluded that medicinal plants have potential for wounds healing and play significance role in primary health care in study area. This research paper will provide baseline data for advance pharmacological screening of medicinal plants of study area in future.

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Introduction

Pakistan is a fairly large country endowed with a variety of climates, ecological zones and topographical regions. The flora is likewise extremely varied and diverse and highly fascinating. Nearly six thousand species of flowering plants are reported from Pakistan and Kashmir (Shinwari, 1996). The history of discovery and use of different medicinal plants is as old as the history of discovery and use of plants for food (Ibrar, 2002). Wound infections and related diseases are very common in developing and some developed countries due to unhygienic conditions (Menke *et al.,* 2007). Wounds can be referred as physical disabilities (Strodtbeck, 2001). Wounds are marked as injury in normal skin structural, anatomical physiological and functional variation (Chitra *et al.,* 2009).For the proper functioning of skin it is very important to recover skin from these wounds by proper methods. According to an estimate, 6 million peoples of world are suffering from different wound problems that cost more than $3 billion annually (Mathieu *et al*., 2006). Currently the global research is focusing on the developing of more effective wound healing medicines. Wounds and especially chronic wounds are the major concern and center of research. Many researchers like Pawar *et al*., 2012; Rawat *et al*., 2012; Pirbalouti *et al*., 2010; Sabale *et al*., 2012; Sandeep *et al*., 2015; Agyare *et al*., 2015 and Aruna *et al*., 2015 have been explored traditional phytoremedies for wound healings from different regions of world. The people often use phytoremedies for treatment of various ailments as modern medicines are unviable or they prefer it because of its fewer or no side effects. So the main objective of this research was to unveil the medicinal plants being used traditionally as phytoremedies for wounds healing by local community of Tehsil Kahuta, District Rawalpindi (Pakistan). This research paper will provide baseline data for advance pharmacological screening of medicinal plants of the study area in future.

Materials and methods

Study area

District Rawalpindi is situated on the Northern most part of Punjab province with an area of 5,286 km² (2,041 sq. miles).

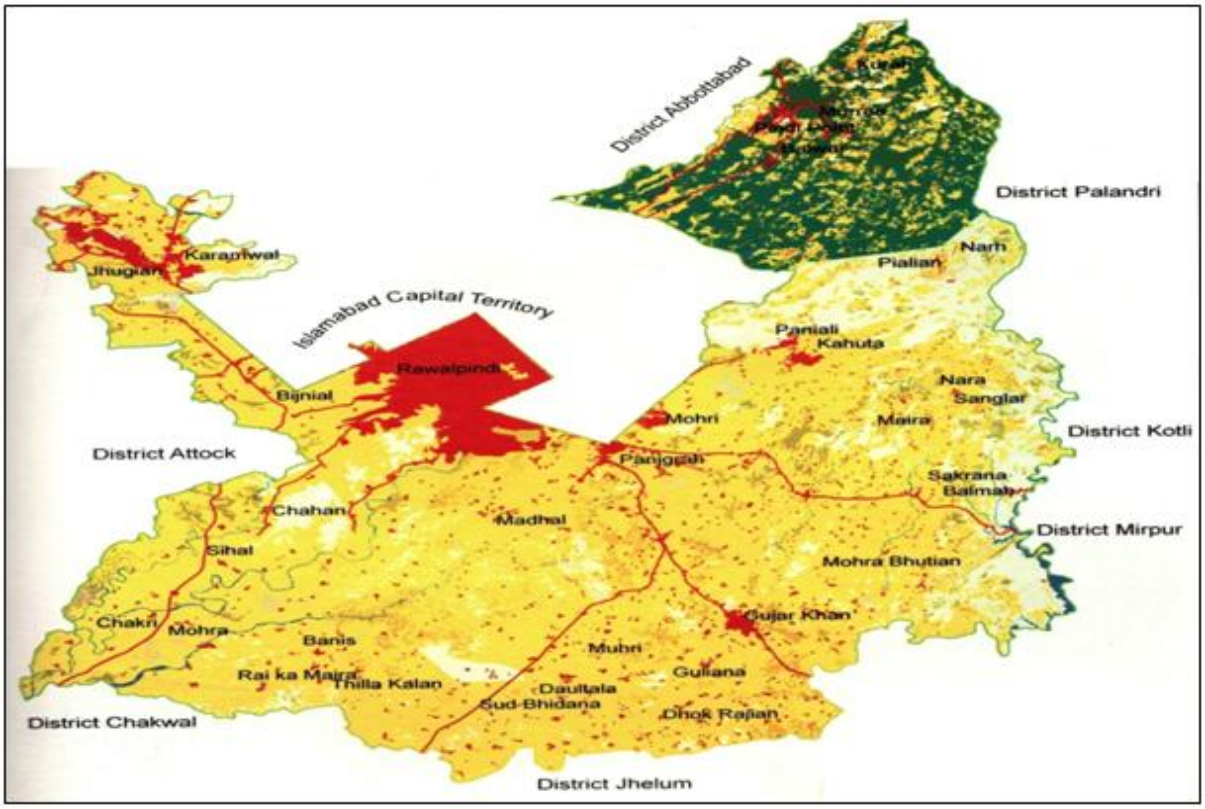

Fig. 1. Map of District Rawalpindi.

It is divided into seven Tehsils i.e. Gujar Khan, Kahuta, Kallar Syedan, Kotli Sattain, Muree, Rawalpindi and Taxila. The study area i.e. Tehsil Kahuta (Fig. 1) is situated in the Himalayan foothills in Rawalpindi District of Pakistan's Punjab province, approximately 30 km Southeast of Pakistan's capital Islamabad. The study area occur between 33°18′ to 33° 48′ North latitudes and 73°15′ to 73°39′ East longitude and cover an area of 206 km^2 . Tehsil Kahuta bounds on the East by Jhelum River and on the south by Tehsil Murree.

Field survey

Extensive field surveys were conducted in different localities of Kahuta region from July 2015 to September 2016 in different seasons for (i) exploration and collection of wound healing medicinal plantspecies, and (ii) documentation of traditional phytoremedies by investigating local community. For the purpose, randomly 117 informants (64 female and 53 male) of various age groups were targeted through well planned questionnaires and interviews in local languages like Urdu, Pahari and Pothwari. Medicinal plants were identified with the help of local informants along with their local names, habit, parts used, mode of utilization and therapeutic uses. Description of 117 informants investigated is given in Table 1:

Identification and preservation of medicinal plants

The collected medicinal plants specimens were tagged in the field and brought into the Herbarium of Quaid –i- Azam University, Islamabad for pressing and drying. The properly pressed and dried specimens were poisoned and mounted on standard herbarium sheets. The plant species were identified by the taxonomists of Quid-i-Azam University, Dr. Mushtaq Ahmad and Dr. Muhammad Zafar. The identified species were confirmed for their correct botanical names, author citation and family from Press *et al.*, 2000, MPNS (Medicinal plants names services), IPNI (International plant name index), Ali & Nasir (1970–2002) and Ali & Qaiser (1986). The specimens were deposited in the Herbarium, Institute of Natural & Management Sciences (INAMS) Rawalpindi, University of Sargodha, Pakistan, for future references.

Quantitative analysis of data

The reported wound healing medicinal plant species were tabulated according to alphabetically botanical names, family name, vernacular name, part used, method of administration, mode of utilization, recipes. The data was quantitatively analyzed by using statistical tools like i.e. Frequency citation (FC), Relative Frequency citation (RFC), Use value (UV) and Fidelity level (FL).

Frequecy citation (FC)

Frequency citation shows the maximum cited medicinal plant species for a particular disease.

Relative Frequency Citation (RFC)

To determine the importance of each medicinal plant "RFC" values were determined by using the following formula (Tardio & Santayana, 2008):

$$RFC = \frac{FC}{N} (0<RFC<1)$$

FC here describes the frequency of each medicinal plant as mentioned by the informants and known as Frequency citation and it is divided by the total number of informants who participated in the survey. RFC reveals that how much a plant species is preferred by informants of the area and its association of indigenous people with local flora (Butt *et al.*, 2015).

Use value (UV)

The use value (UV) was calculated to determine the relative importance of a medicinal plant species (UV) for its traditional use by local population. It was calculated by using the following formula (Phillips *et al.*, 1994):

$$UV = \frac{\Sigma Ui}{Ni}$$

Where "Ui" indicates the number of use reports cited by each informant for a given medicinal plant species and "Ni" is the number of total informants interviewed for a specific medicinal plant species.

Fidelity level (%)

Fidelity level (%) was meant to quantify the importance of a species for a given purpose. It was calculated by using following formula (Hoffman & Gallaher, 2007):

FL (%) = Ip/Iu x 100.

Where, "Ip" refers to the number of informants who cited the species for the particular use, and "Iu" refers to the total number of informants that mentioned the plant for any use.

Results and discussion

Diversity of Wound healing medicinal plants in study area

During the study total 75 medicinal plants (36 herbs, 24 trees, 14 shrubs & 1 climber) belonging to 48 families were collected and documented as given in Fig 2. Among 48 families, Fabaceae was the largest family with 5 species followed by Malvaceae, Moraceae, Solanaceae and Lamiaceae with 4 species each, Combretaceae, Myrtaceae and Asteraceae with 3 species each, Boraginaceae, Rhamnaceae, Brassicaceae, Meliaceae and Apocynaceae with 2 species each, while all the remaining 35 families were represented by single species in study area as shown in Fig 3.

Plant parts usage

In study area various plant parts were used for treatment/healing of various types of wounds. Leaves were most frequently used (44.71%) followed by whole plant and bark (12.94% each), fruits (7.06%), roots and seeds (4.71% each), flowers (3.53), rhizome and latex (2.35% each), and stem, resin, tuber and bulb (1.18% each) as shown in Fig 4. Rahman *et al.*, (2016) in a research also reported leaves as the most frequently used (41%) plant part in the preparation of remedies for digestive disorders.

Table 1. Informants description.

Age Group	Male	Female	Total
30 – 45 years	8	17	25
46 – 60 years	31	26	57
61 – 80 years	14	21	35
Total	53	64	117
Education	Male	Female	Total
Literate	34	23	57
Illiterate	19	41	60
Total	53	64	117

Mode of administration

In study area different types of preparation and administration of phytoremedies for wounds healing were recorded as shown in Fig 5. The most common preparation and administration was as paste (34%) followed by poultice (18%), decoction (13%), extracts (10%), ointment and infusion (7% each), powder (4%), chewing and eaten raw (2% each), and juice and direct administration (1% each). The administration as paste and poultice are dominant as mostly women used these methods on skin burns and cuts injuries while performing daily domestic activities. These two methods are applied for quick relief.

Wounds and medicinal plant's categories

All types of wound disorders were categorized into 19 major types (Table.3).

The wound healing medicinal plants were also categorized according to these nineteen types. Total 75 folk herbal remedies were recorded for these 19 major wound disorders. Most species were used against bites (anti-venom) and external wounds (10 species each) followed by mouth ulcer and burns (9 species each) and wounds inflammations (7 species). It was recorded that some medicinal plants species are effective in more than one kind of wounds.

Table 2. Wound healing medicinal plants along with qualitative and quantitative features.

S. No	Botanical name	Family	Local name	Habit	Part used	Mode of utilization	Medicinal Uses	FC	RFC	UV	FL (%)
1	*Acacia modesta* Wall.	Fabaceae	Kikar	Tree	Leaves & bark	Paste	Secretion & bleeding	26	0.22	0.09	84.62
2	*Acacia nilotica*(L.) Delile	Fabaceae	Kikar	Tree	Bark	Chewing & decoction	Mouth ulcer	13	0.11	0.08	100
3	*Achyranthes aspera* L	Amaranthaceae	Puthkanda	Herb	Leaves	Extract, decoction & poultice	Blood purification & internal wounds	20	0.17	0.15	65
4	*Allium cepa* L	Alliaceae	Thoom	Shrub	Bulb	Paste	External wounds	10	0.09	0.10	100
5	*Aloe vera* (L.) Burm. f.	Asphodelaceae	Kunwar-ghandal	Shrub	Resin	Ointment	Burns & wounds	18	0.15	0.13	83.33
6	*Althaea officinalis* L	Malvaceae	Khatmi	Shrub	Leaves & roots	Infusion & decoction	Throat infection & mouth ulcer	27	0.23	0.14	77.78
7	*Aristolochia bracteolata* Lamk.	Aristolochiaceae	Kabar	Herb	Leaves	Poultice	Skin diseases	15	0.13	0.07	100
8	*Azadirachta indica* Juss.	Meliaceae	Neem	Tree	Leaves & bark	Paste	Eczema & external wounds	17	0.15	0.20	58.82
9	*Bambusa vulgaris* Schrad	Bambusoideae	Baans	Tree	Leaves	Paste	External wounds, bleeding & infection	21	0.18	0.12	80.95
10	*Berberis lyceum* Royle	Berberidiaceae	Sumblo	Shrub	Bark	Powdered	External wounds	5	0.04	0.20	100
11	*Bombax ceiba* L	Malvaceae	Sunbal	Tree	Bark	Paste	External wounds & burns	24	0.21	0.10	83.33
12	*Bryophyllum pinnatum* (Lam.) Oken	Crassulaceae	Pathar chat	Herb	Leaves & roots	Powder	Skin diseases	7	0.06	0.14	100
13	*Calendula officinalis* L	Calendulaceae	Sat berga	Herb	Flower	Paste	Burns	8	0.07	0.13	100
14	*Calotropis procera* (Aiton) Dryand.	Apocynaceae	Aak	Shrub	Leaves & latex	Poultice	External wounds	7	0.06	0.14	100
15	*Carica papaya* L	Caricaceae	Papeeta	Tree	Fruit & roots	Extract & paste	Skin wounds & ulcer	24	0.21	0.10	87.50
16	Carthamus oxyacantha M. Bieb	Asteraceae	---	Herb	Seed	Paste	Ulcer	8	0.07	0.13	100
17	*Cassia angustifolia* M. Vahl	Fabaceae	Sana makki	Tree	Leaves	Decoction	Inflammation & swelling	19	0.16	0.13	78.95
18	*Chrysanthemum indicum* L	Asteraceae	Guledahoodi	Herb	Flowers	Paste	External wounds	6	0.05	0.17	100
19	*Cordiamyxa* L.	Boraginaceae	Lasoora	Tree	Leaves & bark	Poultice	External wounds	14	0.12	0.07	100
20	*Crinum assiaticum* L	Amaryllidaceae	Sukhdarshan	Herb	Leaves	Decoction	External wounds	9	0.08	0.11	100
21	*Cucurbita maxima* Duch	Cucurbitaceae	Pumpkin	Herb	Fruit	Ointment	Burns	9	0.08	0.11	100
22	*Curcuma longa* L	Zingiberaceae	Haldi	Herb	Rhizome	Paste	Inflammations & joint pain	19	0.16	0.12	89.47
23	*Cuscuta reflexa* Roxb.	Cuscutaceae	Aakas bail	Climber	Whole plant	Poultice	External wounds & skin diseases	21	0.18	0.13	76.19
24	*Cynodon dactylon* (L.) Pres.	Poaceae	Khabbalghaas	Herb	Whole plant	Paste	External wounds	9	0.08	0.11	100
25	*Dalbergia sissoo* Roxb.	Fabaceae	Shisham	Tree	Leaves	Paste	Skin diseases	6	0.05	0.17	100
26	Datura innoxia Mill.	Solanaceae	Aamdatuara	Shrub	Leaves	Paste	Swellings	15	0.13	0.07	100
27	*Dodonaea viscosa* Jacq.	Sapindaceae	Sanatha	Shrub	Leaves	Paste	External wounds	11	0.09	0.09	100
28	*Eucalyptus globules* Labill.	Myrtaceae	Safeeda	Tree	leaves	Extract	Skin diseases	9	0.08	0.11	100
29	*Euphorbia neriifolia* L	Euphorbiaceae	Tohar	Shrub	Latex	Ointment	Injury & skin diseases	24	0.21	0.11	75.00
30	*Ficus benghalensis* L	Moraceae	Banyan	Tree	Leaves	Paste	Pimples	11	0.09	0.09	100
31	*Ficuscarica* L	Moraceae	Anger	Tree	Fruit	Decoction	Throat infection & inflammation	17	0.15	0.18	64.71
32	*Ficus religiosa* L	Moraceae	Peepal	Tree	Leaves	Extract	Inflammation & skin diseases	16	0.14	0.14	87.50
33	*Foeniculum vulgare* Mill.	Apiaceae	Sonaf	Shrub	Seeds	Ointment	Snake bite	13	0.11	0.08	100

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34	*Fumaria indica* (Hausskn.) Pugsley.	Fumariaceae	Fumitory	Herb	Whole plant	Infusion	Eczema & skin infection	21	0.18	0.14	66.67
35	*Helianthus annuus* L	Asteraceae	Soraj-mukkhi	Herb	Seeds	Powder	External wounds	9	0.08	0.11	100
36	*Heliotropium strigosum* Willd.	Boraginaceae	Rattan joot	Herb	Whole plant	Extract	Skin diseases	11	0.09	0.09	100
37	*Hibiscus rosa-sinensis* L	Malvaceae	Gulkand	Shrub	Whole plant	Infusion	Mouth ulcer	9	0.08	0.11	100
38	*Justicia adhatoda* L	Acanthaceae	Bekkar	Shrub	Leaves	Paste	Skin diseases	11	0.09	0.09	100
39	*Lantana camara* L	Verbenaceae	Panjphool	Shrub	Leaves	Decoction	Swelling	9	0.08	0.11	100
40	*Lawsonia inermis* L.	Lythraceae	Mehendi	Shrub	Leaves	Paste	Burns & wounds	17	0.15	0.15	76.47
41	*Linum usitatissimum* L.	Linaceae	Alsi seed	Herb	Bark	Ointment	External wounds	4	0.03	0.25	100
42	*Malvestrum coromandelianum* (L.) Garcke.	Malvaceae	Sonchal	Sub-shrub	Leaves	Paste	External wounds	11	0.09	0.09	100
43	*Maranta arundinacea* L	Marantaceae	---	Herb	Rhizome	Paste	Snake bites	13	0.11	0.08	100
44	*Medicago sativa* L	Fabaceae	Alfalfa	Herb	Whole plant	Direct	Inflammation	9	0.08	0.11	100
45	*Melia azedarach* L	Meliaceae	Dharek	Tree	Leaves & bark	Decoction & extract	Mouth ulcer & external wounds	21	0.18	0.13	71.43
46	*Menthaarvensis* L	Lamiaceae	Jangli-podina	Herb	Leaves	Paste	Snake bites	11	0.09	0.09	100
47	*Mentha longifolia* (L.) Huds	Lamiaceae	Podina	Herb	Whole plant	Extract	Pimples & skin infection	20	0.17	0.13	80.00
48	*Mentha piperiata* L	Lamiaceae	Poodna	Herb	Leaves	Paste	External wounds	9	0.08	0.11	100
49	*Mirabilis jalapa* L	Nyctaginaceae	Gul-e-abbasi	Herb	Leaves	Paste	Inflammation	8	0.07	0.13	100
50	*Morusnigra* L	Moraceae	She-toot	Tree	Leaves	Extract	Snake bite	6	0.05	0.17	100
51	*Myrtus communis* L	Myrtaceae	---	Shrub	Whole plant	Poultice	Internal wounds	7	0.06	0.14	100
52	*Nasturtium officinale* R.Br.	Brassicaceae	Jangli-sarson	Herb	Leaves	Infusion	Throat Infection, Skin Infection	19	0.16	0.15	68.42
53	*Nerium oleander* L.	Apocynaceae	Kundair	Shrub	Roots	Paste	Scorpion bite	6	0.05	0.17	100
54	*Ocimum basilicum* L.	Lamiaceae	Niaz-bo	Herb	Leaves	Paste & juice	External wounds	6	0.05	0.17	100
55	*Oxalis corniculata* L	Oxalidaceae	Khattiboti	Herb	Leaves	Extract	Skin diseases & snake bite	17	0.15	0.17	70.59
56	*Pinus roxburghii* Sargent.	Pinaceae	Cheer	Tree	Resin	Poultice & paste	Bleeding	7	0.06	0.14	100
57	*Pistacia integerrima* J. L. Stewart	Anacardiaceae	Kangur	Tree	Bark	Poultice	External wounds	11	0.09	0.09	100
58	*Portulaca oleracea* L	Portulaceae	Kulfa	Herb	Whole plant	Decoction	External wounds	6	0.05	0.17	100
59	*Prunus persica* (L.) Batsch.	Rosaceae	Aaru	Tree	Leaves	Poultice	Bleeding	9	0.08	0.11	100
60	*Punica granatum* L	Puniacaceae	Doroni	Shrub	Fruit& flower	Eaten	Nose bleeding & skin Inflammation	23	0.20	0.13	65.22
61	*Quercus semecarpifolia* Smith	Fagaceae	Jufatbaloot	Tree	Bark	Eaten raw	Swelling & skin inflammation	14	0.12	0.22	64.29
62	*Rumex dentatus* L	Polygonaceae	Janglipalak	Herb	Leaves	Paste & poultice	External wounds	10	0.09	0.10	100
63	*Sesamum indicum* L	Pedaliaceae	Til	Herb	Seed	Paste	Eczema & burns	21	0.18	0.12	80.95
64	*Sisymbrium irio* L	Brassicaceae	Tara meera	Herb	Leaves	Infusion	Skin infection & pimples	23	0.20	0.11	82.61
65	*Solanum incanum* L	Solanaceae	Kachmach	Herb	Whole plant	Poultice	External wounds	13	0.11	0.08	100
66	*Solanum nigrum* L	Solanaceae	Makko	Herb	Leaves	Decoction	Mouth ulcer	14	0.12	0.07	100
67	*Solanum tuberosum* L	Solanaceae	Aalo	Herb	Tuber	Ointment, decoction & paste,	Internal wounds, inflammation & external wounds	29	0.25	0.14	72.41

68	*Swertia chirayita* Roxb.	Gentianaceae	Chiriata	Herb	Stem & leaves	Infusion	External wounds	5	0.04	0.20	100
69	*Syzygium cumini* L Skeels	Myrtaceae	Jamun	Tree	Leaves	Chewing	Mouth ulcer	9	0.08	0.11	100
70	*Terminalia arjuna* Wight and Arn.	Combretaceae	Arjun	Tree	Fruit & bark	Poultice	External wounds & blood purification	20	0.17	0.13	75.00
71	*Terminalia belerica* Roxb.	Combretaceae	Bahera	Tree	Fruit	Paste & decoction	External wounds	12	0.10	0.08	100
72	*Terminalia chebula* Retz.	Combretaceae	Sabazharhar	Tree	Whole plant	Poultice	Mouth ulcer	15	0.13	0.07	100
73	*Viola odorata* L	Violaceae	Banafsha	Herb	Leaves	Poultice paste, &	Swelling & external wounds	15	0.13	0.22	60.00
74	*Ziziphus jujuba* Mill.	Rhamnaceae	Jujube	Tree	Leaves	Poultice	Pimples & burns	17	0.15	0.15	76.47
75	*Ziziphus nummularia* (Burm. f.) Wight &Arn.,	Rhamnaceae	Beri	shrub	Leaves	Paste	External wounds	7	0.06	0.14	100

Quantitative analysis of data

The collected data were analyzed through following Statistical tools for its authentication and validity.

Frequency citation (FC)

Frequency citation showed us the maximum cited medicinal plant species for a particular disease in study area as shown in Table 2. Results showed that in Kahuta Tehsil *Solanum tuberosum* was recorded as highly cited plants species by 29 respondents for healing of wounds. This plant is commonly used against internal wounds and external wounds. *Acacia modesta* is another most cited wound healing plant with 26 citations, which is famously used for secretion of blood from wound. It was observed that the local inhabitants are very familiar with the use of these plants for the preparation of wound healing recipes.

Table 3. Phytotherapies used by the local people of Kahuta for different types of wounds.

S.No	Wound type	Plants used	Parts used	Recipes
1	Secretion and bleeding	*Acacia Arabica*	Leaves and bark	5grams Leaves and the 2 g bark is crushed and mixed with water to make paste. The paste is applied.
		Bambusa vulgaris	Shoots	Juice of 5 kg shoots is dried to make a paste and then applied OR powdered shoots are mix with 3 spoons of mustard oil to make a paste. This paste is applied topically.
		Myrtus communis	Whole plant	Whole plant is dried and ground into powder and 10 g is sprinkled. Or this powder is mix with sugar and taken orally twice a day.
		Pinus roxburghii	Resins	Resin obtained is warmed slightly and applied.
		Prunus persica	Leaves	Leaves are ground into powdered form and sprinkled.
		Terminalia belerica	fruit	Powdered fruit is mixed with 5 g of wheat flour and applied two times a day.

2	Mouth ulcer	*Acacia nilotica*	Bark	Bark is chewed.
		Althaea officinalis	Leaves	Leaves infusion is mixed with slightly warm water and gargled.
		Carica papaya	Fruit & milky sap	5 ml milky sap or latex from fruit is mixed with 3ml of mustard oil and applied twice a day.
		Hibiscus rosa-sinensis	Whole plant	Infusion of flower is taken along with cow's milk twice a day to reduce burning sensation.
		Melia azedarach	Bark	The bark is boiled for 30 min and mix with 3 g alum. The mixture is used twice a day.
		Quercus semecarpifolia	Bark	The bark is burnt to ash and mix with small amount of honey and applied twice a day.
		Solanumnigrum	Leaves	Leaves are chewed.
		Syzigium cumini	Leaves	Decoction of leaves is taken orally twice a day.
		Terminalia chebula	Whole plant	The dry plant is grounded into powder; 5 g of butter milk is added and taken.
3	Internal wounds	*Achyranthes aspera*	Leaves	2 g sugar is added in 5 ml leaf extract water and taken along with ghee in morning.
		Solanum tuberosum	Tuber	Small amount of raw sugar is added in potato tuber juice and taken orally.
4	Burns	*Aloe vera*	Leaf gel	Leaf gel is applied.
		Bombax ceiba	Bark	Cotton from the bark of plant is burnt to ash and applied.
		Calendula officinalis	Flower	Infusion of flower is used as lotion.
		Cucurbita maxima	Fruit	Mixture is prepared by adding 2 g of honey and one table spoon of rose water into paste of fruit and applied.
		Lawsonia inermis	Leaves	Mustard oil is mixed in powdered leaves and applied.
		Sesamum indicum	Seed oil	Seed oil is applied gently.
		Solanum incanum	Leaves	Leaf poultice is applied.
		Ziziphus jujuba	Leaves	Mustard oil is mixed in powdered leaves and paste is applied.
5	Gastric ulcer	*Althaea officinalis*	Leaves	Decoction of leaves is taken orally twice a day.
6	Anti-venom	*Aristolochia bracteolata*	Leaves	Powdered leaves are sprinkled over bitten area to lessen poison.
		Calotropis procera	Milky latex	Milky latex of leaves is mixed in

				sesame oil and applied.
		Carica papaya	Fruit	Fruit is grinded and mixed with honey. The paste is applied.
		Cordia myxa	Leaves and bark	Infusion of leaves and bark is applied.
		Foeniculum vulgare	Seeds	Powdered seeds are mixed in water and taken orally.
		Maranta arundinacea	Rhizome	Grounded rhizome is applied topically for scorpion and black spider bite.
		Mentha arvensis	Leaves	Leaf juice is applied.
		Morus nigra	Leaves	Leaf paste is applied.
		Nerium oleander	Roots	Turmeric is mixed in fine powder of root and paste is applied.
		Oxalis corniculata	Leaves	Leaf extract is mixed with onion extract and applied.
7	Boils and blister	*Ficus religiosa*	Leaves	Powdered leaves are mixed in honey to make tablets. One tablet is taken daily.
		Terminalia chebula	Whole plant	Whole plant is burnt, grinded and mix with Vaseline and applied.
8	External wounds	*Malvestrum coromandelianum*	Leaves	Powdered leaves are mixed with warm water to make paste and applied.
		Melia azedarach	Leaves	Leaf extract is mixed with rose water and applied.
		Mentha piperiata	Leaves	Leaf juice is applied.
		Ocimum basilicum	Leaves	Powdered leaves are mixed with lemon juice and paste is applied.
		Pistacia integerrima	Bark	Powdered bark is sprinkled over the external wounds thrice a day.
		Rumex dentatus	Leaves	Leaves are warmed slightly and used as poultice on external wounds.
		Swertia chirayita	Leaves	Leaf extract is mixed with coconut oil and applied.
		Terminalia arjuna	Bark	Wounds are washed with decoction of bark.
		Ziziphus jujuba	Leaves	Powdered leaves are mixed with lemon juice and used as poultice.
		Ziziphus nummularia	Leaves	Leaves are heated with castor oil and paste is applied.
9	Sore and abscesses	*Bryophyllum pinnatum*	Leaves and roots	Root is crushed and mixed with sesame oil and used as poultice.
		Mentha longifolia	Whole plant	Decoction of whole plant is applied.
		Portulaca oleracea	Whole plant	Decoction of whole plant is mix with 1

				table spoon of rose water and taken against sore mouth thrice a day for one week.
10	Wounds Inflammation	*Ficus religiosa*	Leaves	Powdered leaves are mixed in warm water and paste is applied.
		Medicago sativa	Whole plant	Powdered plant is added in water, slightly warmed and drunk.
		Mirabilis jalapa	Leaves	Powdered leaves are mixed with honey and paste is applied.
		Punica granatum	Fruit and flower	Dried flowers are make into paste and applied.
		Quercus semecarpifolia	Bark	Powdered bark is boiled in water and taken orally.
		Solanum tuberosum	Tuber	Peel is applied.
		Viola odorata	Leaves	Leaf extract is mixed with cucumber juice in equal amount and applied.
11	Joints pain	*Curcuma longa*	Rhizome	Powdered rhizome is mixed with olive oil and applied.
12	Skin excoriation	*Heliotropium strigosum*	Whole plant	Decoction of whole plant is mixed with leaf gel of *Aloe vera* and paste is applied.
		Allium cepa	Bulb	Scales are warmed with one spoon of mustard oil and paste is applied.
		Dalbergia sissoo	Leaves	Powdered leaves are mixed with sweet oil and paste is applied.
		Fumaria indica	Whole plant	Infusion of whole plant is applied.
13	Swelling	*Datuara innoxia*	Leaves	Paste of boiled leaves is applied.
		Euphorbia neriifolia	Latex	Latex of leaves is applied.
		Lantana camara	Leaves	Decoction of leaves is applied.
14	Pimples and acne problems	*Cuscuta reflexa*	Whole plant	Paste of whole plant is applied and washed after 30 minutes.
		Ficus benghalensis	Leaves	Fresh leaves are grinded and make into paste with rose water and applied.
		Mentha longifolia	Whole plant	Leaves are added in 2 cups of hot water. After cooling, cotton is soaked and massaged.
		Nasturtium officinale	Leaves	Equal amount of powdered leaves, saffron and turmeric are mixed in butter milk and applied.
		Ziziphus jujuba	Leaves	Leaves are crushed and mixed with sweet oil to make paste and applied.
15	Scabies	*Aristolochia bracteolate*	Leaves	Powdered leaves are taken along with pepper powder twice a day.

		Justicia adhatoda	Leaves	Leaves are boiled in mustard oil till leaves turn black. This oil is applied.
		Oxalis corniculata	Leaves	Leaves are boiled in water taken orally.
16	Sore throat	*Althaea officinalis*	Leaves	Leaves are crushed in water, pulp is removed and warmed. Add 2ml of honey in it. Use slightly warm water as gargle twice a day.
		Ficus carica	Fruit	Fruit decoction is applied.
		Sisymbrium irio	Leaves	Infusion of the leaves is used twice a day.
17	Eczema	*Azadirachta indica*	Bark and leaves	Powdered leaves are make into paste with water and applied.
		Fumaria indica	Whole plant	Infusion of plant is applied.
		Sesamum indicum	Seeds	Seeds are crushed and boiled in mustard oil and applied.
18	Skin allergies	*Malvestrum coromandelianum*	Leaves	Powdered leaves are mixed in sesame oil and applied.
		Nasturtium officinale, Sisymbrium irio and *Cuscuta reflexa*	Leaves	Powdered leaves of all are mixed in honey and applied.
19	Blood purification	*Terminalia arjuna*	Bark	65 g bark is boiled in I kg of water and then 250 g of raw sugar is added. This juice is taken orally twice a day.

Relative frequency citations (RFC)

RFC values were determined in order to calculate the most frequent medicinal species used for wound healing and clarify that the particular species is well known to the practitioners.

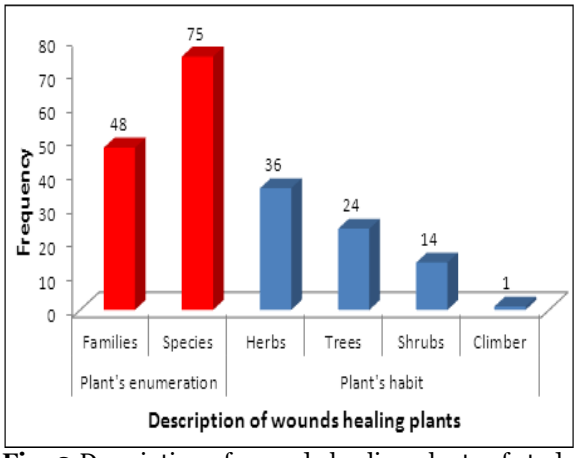

Fig. 2. Description of wounds healing plants of study area.

In current study it was reported that RFC values ranges from 0.03 - 0.25. The highest value of RFC was for *Solanum tuberosum* (0.25), *Althaea officinalis* (0.23), *Acacia modesta* (0.22), *Carica papaya*, *Bombax ceiba*, *Euphorbia neriifolia* (0.21), *Sisymbrium irio* & *Punica granatum* (0.20 each), *Fumaria indica*, *Sesamum indicum*, *Bambusa vulgaris* & *Cuscuta reflexa* (0.18 each) *Terminalia arjuna* & *Achyranthes aspera* (0.17 each) as shown in Table 2. The main reasons of these high RFC values of medicinal plants are their easy availability and maximum traditional knowledge about their therapeutic values (Rahman *et al.*, 2016). Lower RFC values were recorded for *Linum usitatissimum* (0.03), *Swertia chirayita* & *Berberis lyceum* (0.04 each) *Nerium oleander*, *Morus nigra*, *Chrysanthemum indicum*, *Dalbergia sissoo*, *Ocimum basilicum* & *Portulaca oleracea* (0.05 each), *Bryophyllum pinnatum*, *Myrtus communis* & *Pinus roxburghii* (0.06 each), *Carthamus oxycantha*,

Ziziphus nummularia, *Calendula officinalis* & *Mirabilis jalapa* (0.07 each), *Lantana camara*, *Helianthus annuus*, *Syzygium cumini*, *Cucurbita maxima*, *Medicago sativa*, *Mentha piperiata*, *Hibiscus rosa-sinensis*, *Eucalyptus globules*, *Cynodon dactylon* & *Prunus persica* (0.08 each) and *Heliotropium strigosum*, *Malvestrum coromandelianum*, *Ficus benghalensis*, *Rumex dentatus*, *Mentha arvensis*, *Dodonaea viscosa* (0.09 each) & *Terminalia belerica* (0.10) as shown in Table 2. For the reason of lowest RFC value of a species is that these are not commonly known to local inhabitants and not very common in use due to lesser traditional knowledge.

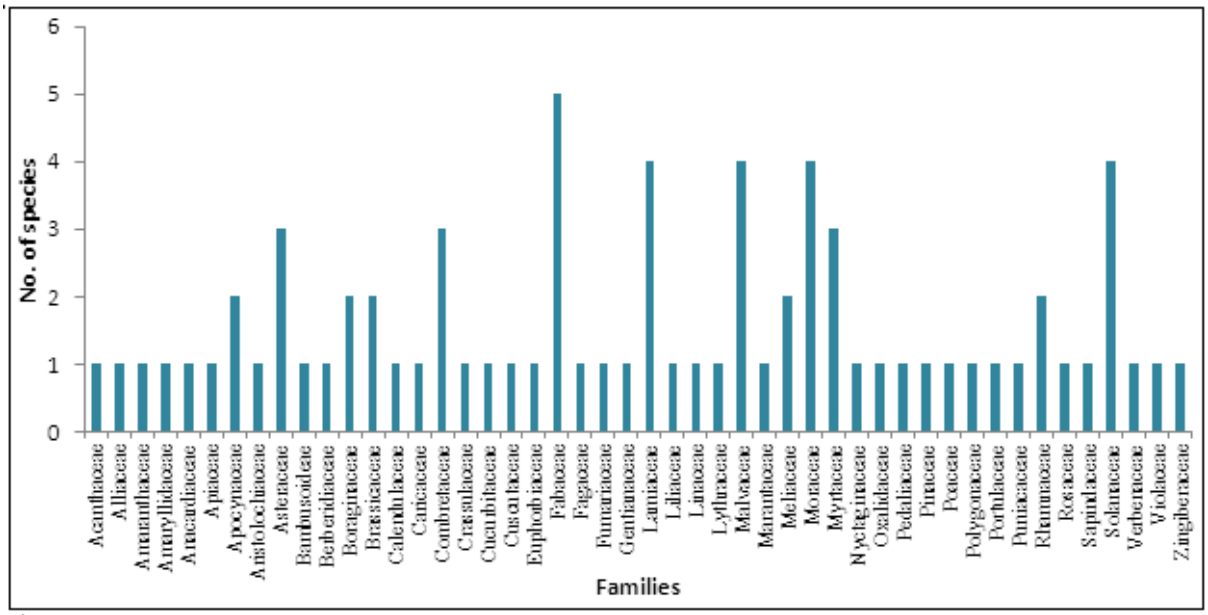

Fig.3. Number of species per family reported for wounds healing.

Use value (UV) of wounds healing plant species

Use value (UV) determines the significance level of a species for the community or population (Ullah *et al*., 2014).

The use value of wounds healing plants in study area was ranging from 0.07 to 0.25.

The plants with high use values in study area were *Linum usitatissimum* (0.25), *Viola odorata* & *Quercus semecarpifolia* (0.22 each), *Berberis lyceum* & *Swertia chirayita* (0.20 each), *Ficus carica* (0.18), *Ocimum basilicum*, *Oxalis corniculata*, *Portulaca oleracea*, *Morusnigra*, *Dalbergia sissoo*, *Chrysanthemum indicum* and *Nerium oleander* (0.17 each) as shown in Table 2.

The high use values of the species may represent their wider geography and abundance, more preference due to easy availability and practitioners first choice for treatment (Rahman *et al*., 2016). While the lowest use values were recorded for species like *Terminalia chebula*, *Cordiamyxa*, *Aristolochia bracteolate*, *Datura innoxia* & *Solanum nigrum* (0.07), *Terminalia belerica*, *Foeniculum vulgare*, *Acacia nilotica*, *Acacia modesta*, *Maranta arundinacea* & *Solanum incanum* (0.08 each), *Justicia adhatoda*, *Pistacia integerrima*, *Heliotropium strigosum*, *Mentha arvensis*, *Malvestrum coromandelianum*, *Ficus benghalensis* & *Dodonaea viscosa* (0.09 each) and *Rumex dentatus*, *Allium cepa*, *Carica papaya* and *Bombax ceiba* (0.10 each) as shown in Table 2. The maximum UV values of medicinal plant species show the effectiveness of remedy for that disease (Butt *et al*., 2015).

Fidelity level (%) of wound healing medicinal plants

Fidelity level was measured to show preference of medicinal plant species by indigenous people in study area to treat wounds.

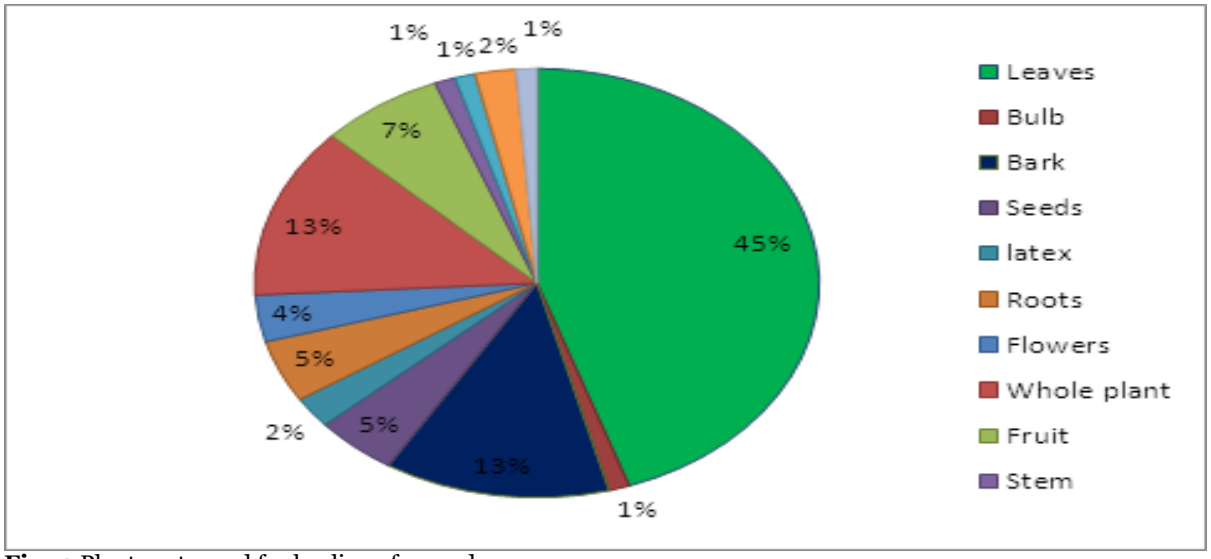

Fig. 4. Plant parts used for healing of wounds.

The fidelity level was in between 58% to 100%. We found 47 medicinal plant species with highest fidelity level i.e 100%. Some are *Justicia adhatoda, Allium cepa, Crinum assiaticum, Pistacia integerrima, Foeniculum vulgare, Nerium oleander, Solanum nigrum, Datuara innoxia, Dodonaea viscosa, Ziziphus nummularia, Prunus persica, Ziziphus nummularia* etc. and as shown in Table 2. The Maximum Fidelity shows the informants choice of selecting that particular plant for treatment of a specific disease (Rajakumar & Shivanna, 2009).

These species may be confirmed as medicinally important for further evaluation of phytochemical and biological activities (Ilker *et al.,* 2009). However the lowest FL among plant species is *Azadirachta indica* (58 %).

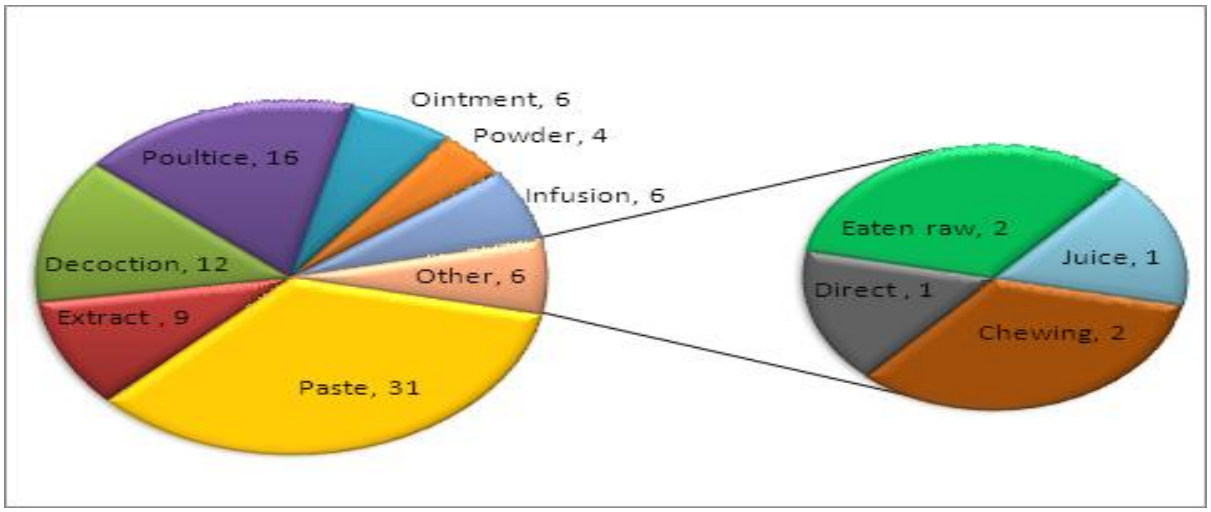

Fig.5. Mode of administration.

Plant species with low Fidelity level should be given conservation priority because they are under threat of loss in the future generations (Chaudhary *et al.*, 2006).

Conclusion and recommendations

The current study revealed that the study area has rich wounds healing flora and allied traditional knowledge. The reported 75 wound healing medicinal species has high role in cure of different wounds and play significance role in the primary health care in the

study area. This study has contributed in the conservation of traditional knowledge and provides base line for future studies such as phytochemical and pharmacological actions. This could result in the discovery of new drugs with high potential against different types of wounds.

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