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Ethnobotanical indices on wound healing medicinal plants in the Arjuna River of Virudhunagar District in Tamil Nadu, Southern India

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Abstract. *Shanmugam S, Rajagopal V, Balamurugan S, Muthupandi CP, Eswaran VM, Raveendraretnam K, Rajendran K. 2021. Ethnobotanical indices on wound healing medicinal plants in the Arjuna River of Virudhunagar District in Tamil Nadu, Southern India. Asian J Ethnobiol 4: 31-36.* Medicinal plants can perform a significant role in preventing pathogenic attacks in the body. Plants are a great source of primary health care due to certain chemical compounds. Research on the traditional knowledge related to plants used for wound healing still needs adequate attention. The present study was carried out to document the therapeutic uses of medicinal plants in the Arjuna Riverbank of Virudhunagar District in Tamil Nadu to heal various wounds. The frequent fieldwork was conducted from June 2018 to March 2019 in four villages selected for this study. The scientific name, family name, local name (in Tamil), part (s) used, mode of preparation, method of application, and medicine administration were recorded. The ethnomedicinal data were statistically analyzed by ethnobotanical indices such as Use Value (UV), Citation Frequency (CF), and Relative Importance (RI). A total of 23 medicinal remedies prepared from 23 plants were recorded. *Mimosa pudica* was found with the highest values in all three indices. Further research on the phytochemistry and pharmacology of these medicinal plants should be conducted.

Keywords: Arjuna River, ethnobotanical indices, medicinal plants, wound heal

INTRODUCTION

Wounds are accidental physical damage to the body by loss of skin. Due to less hygienic situations, mostly in rural areas, the wound is a common disorder for skin problems (Senthil et al., 2006). The complete healing of wounds depends on the degree of injury, human resistance capacity, infection potential of pathogens, and early effective treatment procedure. Applying plants for wound control is a beneficial process for repairing skin. Due to the presence of antibiotic or antiseptic nature's chemicals, plants are remarkable for the treatment of wounds (Kumarasamyraja et al., 2012).

Scrutinizing of the available sources was revealed that only a few monumental research works have been conducted on the ethnobotany of Virudhunagar District in Tamil Nadu (Arinathanet al. 2003; Muthukumarasamyet al. 2003a,b; Rajendran et al. 2004; Shanmugam et al. 2008). Having the facts mentioned above in mind, the present study is conducted to document the importance of medicinal plants in wound healing therapy among the local people living in and around the bank of the Arjuna River of Virudhunagar District.

MATERIALS AND METHODS

Study area

A total of four different study areas, i.e., Vadamalapuram-Aathupaalam, Vadamalapuram, Sorampatti, and Pethusettypatti, are located at the bank of Arjuna River, were selected to collect the ethnomedicinal information. The longitude and latitude of the study areas were as follow: (i) Vadamalapuram-Aathupaalam: 77º 80' 81" E and 9º 48' 07" N, (ii) Vadamalapuram: 77º 84' 10" E and 9º 50' 51" N, (iii) Sorampatti: 77º 85' 25" E and 9º 50' 28" N Latitude, (iv) Pethusettypatti: 77º 85' 43" E and 9º 50' 17" N. The altitudes of the study areas were about 90 – 107 m above mean sea level (MSL). All the study areas were located within 3.5 km; there was no fluctuation in temperature and rainfall. The temperatures of the study areas ranged from 20º to 41º C. The average annual rainfall reached 60-95 mm.

Data collection

Fieldworks were conducted frequently from June 2018 to March 2019. The ethnomedicinal data were collected following the methodology of Jain (1989), using direct field interviews with the herbal healers and non-herbal healers. A total of 11 informants (8 males and 3 females) were interviewed, and their current age, educational status, and occupation were also recorded. The information gathered was reconfirmed in other localities. The medicinal plants were botanically identified following the books of regional floras (Matthew 1983; 1991).

Ethnobotanical indices

Use Value (UV)

The importance of a medicinal plant was analyzed using Use Value (UV) for species I with the following

formula: UVi = Ui / Ni. Where, Ui is the number of use-reports cited by each informant for a given plant species I, and Ni is the total number of informants interviewed for a given plant species I. Use value is high when there are many use-reports for a plant, and low when there are a few reports for a plant related to its use (Trotter and Logan 1986).

Citation Frequency (CF)

Citation Frequency was calculated as follows: CF = (Number of citations of a particular species mentioned / Total number of citations of all species mentioned) × 100. The CF is high when maximum informants quoted a species as medicine and low when less of them reproduced.

Relative Importance (RI)

Relative Importance was calculated with the following formula: RI = (RCF + RNU)/2. Where RCF is the relative citation frequency, it is obtained by the number of citations of a species dividing with the full citation of all species obtained (RCF = CF/max CF). RNU is the relative number of use categories; it is obtained by dividing the number of uses of the species by the maximum number of benefits of all species obtained (RNU = NU/max NU). THEORETICALLY, the RI index varies from 0, when nobody mentioned any plant use, to 1, when the plant was most frequently mentioned as medicine (Tardío and Pardo-De-Santayana 2008).

RESULTS AND DISCUSSION

Demographic profile of informants

The medicinal uses of plants were collected from 11 informants living in four different localities situated at the bank of the Arjuna River to predict and define the exact nature of the traditional knowledge on medicinal plants utilized to treat the wound. The number and percentage of informants in terms of age category, age at becoming healers, educational status, and occupation are provided in Table 1.

Medicinal plants for wound healing

This study recorded 23 medicinal remedies prepared from 23 plants to treat various wounds. Out of 23 plants, 21 species were used to treat common injuries, one species to cure chronic wounds, and one species for mouth wounds (Table 2). It was noted that the 23 species belonged to 23 genera and 19 families (Table 3). Among the 23 species recorded, dicots were represented by 18 species belonging to 18 genera and 14 families, while monocots were five species belonging to five genera and five families (Table 3). Caesalpiniaceae was the dominant family and contributed to wound healing with 3 species. Euphorbiaceae and Mimosaceae were represented by two species each, and the remaining 16 families were recorded with single species only (Table 4). The entire reported genera were found as mono-specific (Table 2).

Life form

According to species' life form, most of the plants were herbs (12 species), followed by trees (6 species) and shrubs (4 species). Only one climber species was obtained (Table 2; Table 5). The previous ethnobotanical studies conducted in various regions of Tamil Nadu have strongly evidenced that herbs possessed the medicinal values than other life forms (Shanmugam et al. 2008; Sankaranarayanan et al. 2010; Rajalakshmi et al. 2016; Jespin Ida and Augustus Arul 2016). The frequent use of herbs by the informants is a result of occurring herbaceous plants in their surrounding environments.

Table 1. Number and Percentage (in parenthesis) of informants based on their basic profiles

Basic profiles	Non-Herbal healers			Herbal healers			Total informants		
	Male (*n* = 5)	Female (*n* = 2)	Total (*n* = 7)	Male (*n* = 3)	Female (*n* = 1)	Total (*n* = 4)	Male (*n* = 8)	Female (*n* = 3)	Total (*n* = 11)
Current age									
< 40 years	1 (20.0)	0	1 (14.28)	0	0	0	1 (12.5)	0	1 (9.10)
41 – 60 years	3 (60.0)	1 (50.0)	4 (57.14)	1 (33.33)	0	1 (25.0)	5 (62.5)	1 (33.33)	6 (54.54)
> 60 years	1 (20.0)	1 (50.0)	2 (28.58)	2 (66.67)	1 (100)	3 (75.0)	2 (25.0)	2 (66.67)	4 (36.36)
Age at becoming healers									
Below 30 years	–	–	–	1 (33.33)	0	1 (25.0)	1 (12.5)	0	1 (9.10)
Above 30 years	–	–	–	2 (66.67)	1 (100)	3 (75.0)	2 (25.0)	1 (33.33)	3 (27.27)
Education									
Literate	4 (80.0)	1 (50.0)	5 (71.42)	1 (33.33)	0	1 (25.0)	5 (62.5)	1 (33.33)	6 (54.54)
Illiterate	1 (20.0)	1 (50.0)	2 (28.58)	2 (66.67)	1 (100)	3 (75.0)	3 (37.5)	2 (66.67)	5 (45.46)
Occupation									
Farmer	3 (60.0)	0	3 (42.86)	2 (66.67)	0	2 (50.0)	5 (62.5)	0	5 (45.46)
Cattleman	1 (20.0)	2 (100.0)	3 (42.86)	1 (33.33)	1 (100)	2 (50.0)	2 (25.0)	3 (100.0)	5 (45.46)
Agriculture laborer	1 (20.0)	0	1 (14.28)	0	0	0	1 (12.5)	0	1 (9.08)

Table 2. List of ethnomedicinal plants used for wound healing

Botanical name	Family name	Vernacular name (Tamil)	Habit	IUCN status*	Medicinal use	UR	UV	CF	RI
Acacia leucophloea (Roxb.) Willd.	Mimosaceae	Velvaelam	Tree	NE	Stem bark paste is applied to heal the wound	5	0.45	4.95	0.75
Aponogeton natans (L.) Engler & K.Krause	Aponogetonaceae	Kottaikkizhangu	Herb	LC	The wound caused by heat is treated with entire plant extract	3	0.27	2.97	0.65
Bauhinia variegata (L.) Benth.	Caesalpiniaceae	Mandhaarai	Tree	LC	Leaf paste is applied to treat the wound	4	0.36	3.96	0.70
Bergia ammannioides Roxb.	Elatinaceae	Neervaatti	Herb	NE	Leaf paste is applied to cure the wound	2	0.18	1.98	0.60
Cleome viscosa L.	Capparidaceae	Naaikkadugu	Herb	NE	Leaf paste is applied to heal the wound	6	0.54	5.94	0.80
Cocos nucifera L.	Arecaceae	Thennai	Tree	NE	Oil extracted from the fruit is applied to heal the wound	9	0.81	8.91	0.95
Croton bonplandianum Baill.	Euphorbiaceae	Vettukkaayappoondu	Herb	NE	Stem latex is applied to heal the wound	8	0.72	7.92	0.90
Cyperus articulatus L.	Cyperaceae	Korai	Herb	LC	Leaf paste is applied to heal the wound	5	0.45	4.95	0.75
Euphorbia cyathophora Murray	Euphorbiaceae	Paalperukki	Shrub	NE	Leaf latex is applied to treat the wound	1	0.09	0.99	0.55
Heliotropium indicum L.	Boraginaceae	Thealkodukku	Herb	LC	Entire plant paste is applied to treat the wound	4	0.36	3.96	0.70
Hydrilla verticillata (L.f.) Royle	Hydrocharitaceae	Kodippaasi	Herb	NE	Entire plant paste is applied externally to heal the wound	2	0.18	1.98	0.60
Hydrolea zeylanica (L.) Vahl	Hydrophyllaceae	Ponnaangannichakkalathi	Herb	NE	Entire plant paste is applied with coconut oil to heal the wound	2	0.18	1.98	0.60
Ipomoea carnea Jacq.	Convolvulaceae	Urachedi	Shrub	NE	Leaf paste is applied to heal the wound	4	0.36	3.96	0.70
Lawsonia inermis L.	Lythraceae	Maruthaani	Tree	NE	Leaf powder is mixed with coconut oil and applied to treat the wound	6	0.54	5.94	0.80
Luffa cylindrica (L.) M.Roem.	Cucurbitaceae	Soppukkaai	Climber	NE	Leaf paste mixed with turmeric powder are applied to heal the wound	1	0.09	0.99	0.55
Mimosa pudica L.	Mimosaceae	Thottaalsurungi	Herb	LC	Leaf paste is applied to treat the wound	10	0.90	9.90	1.0
Senna alata L.	Caesalpiniaceae	Seemaiagathi	Shrub	NE	Paste of flower is applied to cure the wound	4	0.36	3.96	0.70
Sida acuta Burm. f.	Malvaceae	Arivaalmanaipoondu	Herb	NE	Leaf paste is applied to heal the wound	3	0.27	2.97	0.65
Stachytarpheta jamaicensis (L.) Vahl	Verbenaceae	Seemainaayuruvi	Herb	NE	Stem paste is applied to heal the wound	3	0.27	2.97	0.65
Tamarindus indica L.	Caesalpiniaceae	Puli	Tree	LC	Stem bark paste is applied to treat the chronic wound	5	0.45	4.95	0.75
Tridax procumbens L.	Asteraceae	Thaathaappoo	Herb	NE	Entire plant paste is applied to treat the wound	7	0.63	6.93	0.85
Typha angustifolia L.	Typhaceae	Sambai	Shrub	NE	Leaf juice is gargled to cure the mouth wound	4	0.36	3.96	0.70
Ziziphus mauritiana Lam.	Rhamnaceae	Yilandhai	Tree	NE	Stem bark powder is applied to heal the wound	3	0.27	2.97	0.65

Abbreviations: *NE: Not Evaluated; LC: Least Concerned; UR: Use Reports; UV: Use Value; CF: Citation Frequency; RI: Relative Importance

Table 3. Species distribution in different taxa

Taxa	Dicot	Monocot	Total
Species	18	5	23
Genus	18	5	23
Family	14	5	19

Table 4. List of families with several genus and species

Family name	No. of genus	No. of species
Aponogetonaceae[#]	1	1
Arecaceae[#]	1	1
Asteraceae	1	1
Boraginaceae	1	1
Caesalpiniaceae	3	3
Capparidaceae	1	1
Convolvulaceae	1	1
Cucurbitaceae	1	1
Cyperaceae[#]	1	1
Elatinaceae	1	1
Euphorbiaceae	2	2
Hydrocharitaceae[#]	1	1
Hydrophyllaceae	1	1
Lythraceae	1	1
Malvaceae	1	1
Mimosaceae	2	2
Rhamnaceae	1	1
Typhaceae[#]	1	1
Verbenaceae	1	1
Total	23	23

Notes: [#]Monocot families; Others are dicot

Table 5. Species distribution in different life forms

Life form	Dicot	Monocot	Total
Climber	1	0	1
Herb	9	3	12
Shrub	3	1	4
Tree	5	1	6

Parts used

In the case of plant parts used, the leaf was the most used plant part in 11 preparations with 47.82% to treat the wound, followed by the whole plant in five preparations with 21.74%, stem bark in three preparations with 13.04%, and stem in two practices with 8.70%. Flower and fruit were the least used parts in one preparation with 4.35% each (Figure 1).

The results are in line with the findings of many monumental studies carried out in different localities of Tamil Nadu, and they showed that leaves were frequently used plant part (Kottaimuthu 2008; Shanmugam et al. 2008; Vanila et al. 2008; Shanmugam et al. 2011a; 2011b; 2012a; 2012b; Jeyakumar et al. 2014; Kathirvelmurugan et al. 2014; Disticraj and Jayaraman 2015; Krishnamoorthy et al. 2015; Prabhu and Vijayakumar 2016). The reason behind the extensive use of leaves is, they are active in photosynthesis which leads to the production of secondary metabolites in high concentration when compared to other parts of the plant, and these metabolites are actively implicated in remedial activity (Ghorbani 2005; Shanmugam et al. 2007; Ayyanar et al. 2008).

Mode of preparation

The informants prepared and prescribed the medicine mainly in the form of paste (69.55%), followed by latex (8.70%), and powder (8.70%). The slightest use was recorded for extract, juice, and oil (0.45% each) (Figure 2). The following reasons might cause these findings: while preparing the medicine as a paste, in most cases, it does not need water for the preparation and, if water is added, the therapeutic properties will become deluded, as in the case of infusion and juice preparations. Meanwhile, the active secondary metabolites in the plant used to treat particular ailments are involved in the anti-disease activity.

Mode of administration

Among the medicinal remedies recorded from the informants, the standard method of medicinal administration route was applied for the medicine topically (91.30%). Some preparations were taken through the following ways: the medicinal preparation was used as washed and gargled (4.35% each) (Figure 3). These observations follow the results of most of the previous studies conducted in Tamil Nadu (Sandhya et al. 2006; Shanmugam et al. 2009; Pandikumar et al. 2011; Ganesh et al. 2016).

Use of medicine with ingredients

In general, the healers in the present study area prepared the medicine from a single plant. In a few cases, they designed the treatment and other plant products. For example, whole plant paste of *Hydrolea zeylanica* is mixed with coconut oil and applied, leaf powder of *Lawsonia inermis* is mixed with coconut oil and used, and leaf paste of *Luffa cylindrica* is mixed with turmeric powder and applied to treat wound (Table 2).

The frequent use of multiple plant products and other materials could be attributed to synergic reactions among the traditional healers (Giday et al., 2010). It is also believed that the multi-herbal treatment has more healing power than that of a single plant (Teklehaymanot and Giday 2007; Shanmugam et al. 2020).

Conservation status

According to IUCN conservation status (IUCN 2020), it was noted that the Arjuna River harbors six Least Concerned (LC) plants, i.e., *Aponogeton natans*, *Bauhinia variegata*, *Cyperus articulates*, *Heliotropium indicum*, *Mimosa pudica*, and *Tamarindus indica*, and the remaining species were under Not Evaluated (NE) category (Table 1).

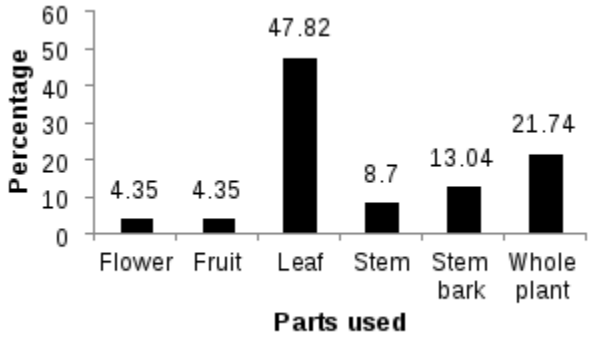

Figure 1. Percentage of plant parts used

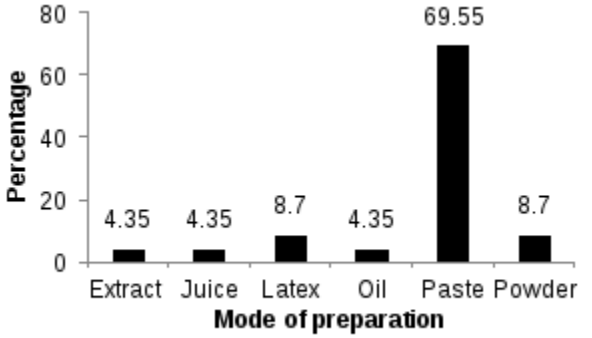

Figure 2. Percentage of the mode of preparation

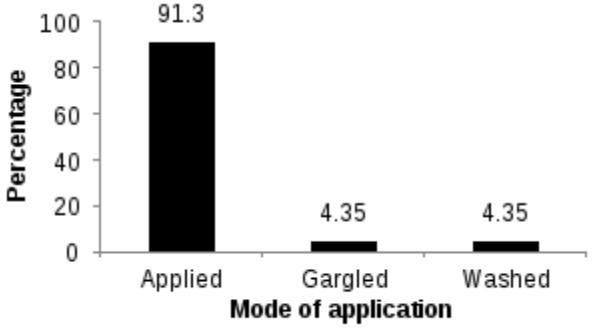

Figure 3. Percentage of the mode of application

Ethnobotanical indices

Use value (UV)

Use values are high when there are many valuable reports for a plant and low when few reports are related to its use (Trotter and Logan 1986). According to the UV analysis, the most frequently used species to heal the wound in the study area was *Mimosa pudica* (UV: 0.90, use reports: 9), followed by *Cocos nucifera* (0.81, 9), *Croton bonplandianum* (0.72, 8), *Tridax procumbens* (0.63, 7), *Cleome viscosa* (0.54, 6) and *Lawsonia inermis* (0.54, 6). The least frequently used species were *Euphorbia cyathophora* and *Luffa cylindrica* (UV: 0.09 with a single-use report each) (Table 1). The highest use values shown by some medicinal plants indicated that these species are highly preferred to heal various types of wounds. The low UV is due to the less effective use of particular species in the study area.

Citation Frequency (CF) and Relative Importance (RI)

In the present study, CF values ranged from 0.99 to 9.90, and RI ranged from 0.55 to 1.0 (Table 2). The highest value was recorded for *Mimosa pudica* (CF: 9.90, RI: 1.0), followed by *Cocos nucifera* (8.91, 0.95), *Croton bonplandianum* (7.92, 0.90), *Tridax procumbens* (6.93, 0.85), *Cleome viscosa* (5.94, 0.80), and *Lawsonia inermis* (5.94, 0.80), while the lowest values of CF: 0.99 and RI: 0.55 were recorded for *Euphorbia cyathophora* and *Luffa cylindrica* each (Table 2). The plants with high CF and RI values indicated their multi-use, widely known local communities, and abundantly distributed. The local communities collected the plants from the wild habitat and cultivated some adjacent to homes, churches, and pagodas for their immediate need.

Pharmacological evidence

Previous studies that examined the wound healing potential of some plants recorded in the present study are as follows: Neto et al. (2011) evaluated the wound healing potential of lectin and its recombinant isoform extracted from *Bauhinia variegata* on mice, and the study indicated that the phytoconstituents possess healing properties and may be employed in the treatment of acute skin wounds. Panduraju et al. (2011) reported that Isoliquiritigenin, a natural phenol isolated from *Cleome viscosa* as an antitumor promoter, and the ethanolic extract of this plant showed significant wound healing activity. Likewise, some other studies also confirmed the wound healing potential of aqueous extract of *Ipomoea carnea* (Khalid et al. 2011), ethanolic extract of *Lawsonia inermis* (Kaur et al. 2014), and ethyl acetate extract of *Tridax procumbens* (Abubakar et al. 2012) in clinical trials by using animal models.

In conclusion, human clinical experiments should be conducted on these plants to prove their pharmacological efficacies related to wound healing potential. Phytochemical and pharmacological values of all these medicinally important plants should be tested, which ultimately leads to a new drug's birth. Attention should also be made to proper exploitation and utilization of these plants; otherwise, there will be the possibility of extinction of particular species in the future.

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