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REVIEW ARTICLE

An Ethnobotanical Study of Medicinal Plants used against Jaundice by Tea Tribes of Morigaon District, Assam (India)

Rakhi Bhattacharyya[1*], Krishna Kanta Medhi[1], Sashin Kumar Borthakur[2] and Sarat Borkataki[1]

[1]Department of Botany, Nowgong College, Nagaon - 782001, Assam, India; rakhibhattacharyya06@gmail.com
[2]Department of Botany, Gauhati University, Guwahati - 781014, Assam, India

Abstract

The present study was conducted to document the ethnomedicinal plants used against jaundice by the tea tribes of Morigaon district of Assam, India. An ethnomedicinal field study was carried out from June 2016 - July 2017. Information was gathered by using a semi-structured questionnaire about the traditional knowledge of medicinal plants used against jaundice by the tea tribes of Morigaon district of Assam. Documented data was evaluated using the quantitative ethno-botanical indices of fidelity level (FL), Use Value (UV) and Family Use Value (FUV). From the ethno-botanical investigation, a total of 39 species of plants covering 36 genera and 27 families respectively have been enumerated. A total of 53 informants aged from 20-75 years were interviewed to record the ethnomedicinal data. Lamiaceae was the dominant family. Among the plant portions, leaves were most frequently used. Among the 39 medicinal plant species recognized mostly were herbs. The plants species having the highest use value were *Drymaria cordata* trailed by *Xylosma longifolia* and *Achyranthes aspera, Aegle marmelos, Alstonia scholaris* and *Justicia gendarussa.* The fidelity level was 100% for *Achyranthes aspera, Cheilocostus speciosus, Clerodendrum infortunatum, Justicia gendarussa, Lawsonia inermis, Coffea benghalensis* and *Saccharum officinarum*. The tea tribes of Morigaon district still relies on herbal therapies for curing jaundice. *Coffea benghalensis* has not been previously reported as a remedy of jaundice from Northeast India. Further research is needed to investigate the phytochemistry and pharmacological effectiveness of the plant species that could be the basis for the isolation and development of some novel phyto-therapeutic active compounds in the future.

Keywords: Ethnobotanical Study, Jaundice, Medicinal Plants, Morigaon District, Tea Tribes

Abbreviations Used

WHO: World Health Organization; FL: Fidelity Level; UV: Use Value; FUV: Family Use Value; Ass: Assamese name; TT: Tea Tribal name

1. Introduction

Ethno-medicine has evolved and developed since the prehistoric period. Traditional medicine is still the main source for treating health related problems around the planet[1]. Despite globalization and modernization, about 60-85% of the world's population in the developing countries relies on natural and traditional medicine[2]. According to WHO, around 21,000 plant species have been estimated which can be potentially used for medicinal purpose[3,4]. Ethnic groups store an immense knowledge on traditional herbal medicine and this need to be properly documented[5]. Ethnobotanical studies are the key sources for the discovery of novel drugs from

*Author for correspondence

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the plant species[6]. India is considered as the leading producer of medicinal plants and represents one of the greatest reservoirs of ethno-botanical wealth[7,8]. Nearly, 65% of the Indian population depends on traditional therapies[9]. North-east India including Assam is considered as the paradise for anthropologists and ethno-botanists as it has a rich vegetation wealth due to topographic and climatic specificity and is among the most diverse regions in the world with more than 150 tribes existing and the tea tribes are one among them[10,11].

Jaundice is a complex ailment caused due to the malfunctioning of the liver, which results in the excessive level of yellow-orange bile pigment i.e. bilirubin, which gets deposited in the tissues of skin, mucous membranes and the sclera[12]. The word jaundice is a derivative of French word 'Jaune' that means 'yellow'. The causes of jaundice are either acquired or congenital[13]. Jaundice is a symptom rather than a disease. There are several possible causes of jaundice viz., hepatitis (A, B, C, D and E), obstruction of bile ducts, liver cirrhosis, gall-bladder stones, inflammation of the liver, pancreatic cancer, alcoholic liver disease, tuberculosis, typhoid, malaria, haemolytic anaemia, yellow fever, certain medication, neonatal jaundice and pregnancy. A large number of plant species claim to possess the liver protecting activity[14]. Almost 160 phyto-compounds from 101 plants claim to possess the hepatoprotective activity[15]. The tea garden community of Assam uses a number of self-remedial medications and herbal therapies for the treatment of jaundice. This acquired knowledge about the traditional medicinal plants may be helpful for developing new medicines for Jaundice by identifying novel bioactive compounds[16]. The chief objective of the study was to measure and document the richness of indigenous knowledge on medicinal plants against jaundice used by the tea tribes of Morigaon district of Assam, so that the documented plant species can be used for phytochemical and pharmacological discoveries in the future.

2. Materials and Method

2.1 Study Area and the People

An explorative investigation was undertaken in the tea gardens of Morigaon district of Assam, which is located in the central region of Assam. The district lies between 26º 45' North Latitudes and 93º 50' East Longitude, covering a geographical area of 1,704 square kilometers (658 square miles). The Morigaon district is bordered by river Brahmaputra in the North, West Karbi-Anglong district in the south, Nagaon district in the east, and the Kamrup district in the west, where it also shares a small border with Meghalaya. The climate is of general monsoon type with an average rainfall of about 1,753 mm. The tea tribes of Morigaon district were originally from Andhra Pradesh, Bihar, Jharkhand, Orissa, Tamilnadu and West Bengal including *Bhumij, Bhil, Bhuyan, Kohar, Kurmi, Khariya, Garh, Munda, Mahanty, Tanti, Telenga, Lohar, Orang, Oriya, Sundi, Ghatwal, Goala, Kalindi, Kaul, Santhal,* and *Gonju* tribes[17,18]. The main languages spoken by the tea tribes are *Assamese, Baganiya bhasa* / Tea tribal language (amalgamation of *Bengali, Oriya* and *Shadri* languages). The major sources of livelihood for the tea tribes are working as laborers in the tea gardens and also as traditional herbal practitioners (*bej*). The present communication provides results of indigenous uses of phyto-medicines against jaundice used by the tea tribes of the Morigaon district.

2.2 Documentation and Collection of Ethnomedicinal Data

Extensive field surveys conducted in the tea gardens of Morigaon district during June 2016 -September 2017 and maximum information provided by the tea tribes were collected (Figure 1). In total 53 informants were interviewed within the age group of 20-75 years. The

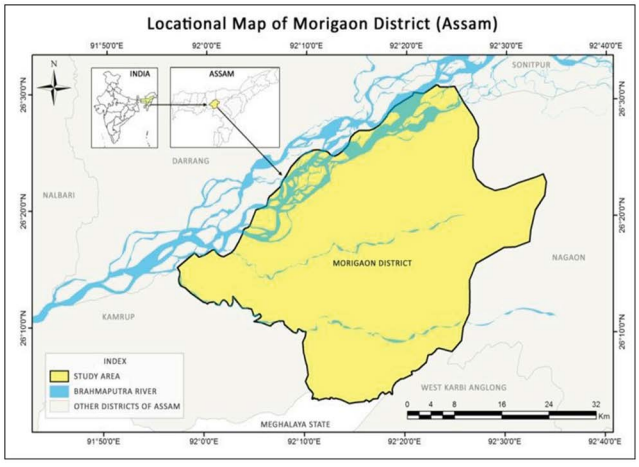

Figure 1. Geographical location of Morigaon district.

information was obtained through semi-structured questionnaires, interviews, consultations and group discussions on the medicinal use of the plants against jaundice and detailed information about mode of preparation (i.e., decoction, infusion, juice or extract, paste, powder and external use) was documented[19,20]. Prior permission was sought from the concerned authorities of the tea gardens for the collection of the ethnomedicinal data along with the plants and also the related plant parts required from the study area. Before proceeding with the interview, consent of the respondents was also obtained to carry out the study. The collected specimens were processed and mounted in a herbarium using convenient techniques and were cross-checked and identified with the help of relevant floras and were matched at the Gauhati University Herbarium and Nowgong College Herbarium and then their identity was confirmed[21,22]. Nomenclatures of plants were updated using The Plant List and the specimens are deposited at Department of Botany, Nowgong College (Nagaon) for future references [23]. All the recorded plant species are presented in tabular format, alongside the family, common names and the ethnomedicinal usage information.

2.3 Quantitative Analysis of Ethnomedicinal Data

An illustrative method of using the frequencies and percentages was used to evaluate the socio-demographic data of the informants. The ethnomedicinal usage of plants was quantitatively accessed using the Fidelity Level (FL), Use Value (UV) and Family Use Value (FUV).

2.3.1 Fidelity Level (FL)

The Fidelity Level (FL) was calculated to determine the percentage of informants who mentioned the uses of certain plant species to treat a particular ailment in the study area.

$$FL\ (\%) = \left(\frac{lp}{lu}\right) \times 100$$

Where, lp is the number of informants who independently claimed the utilization of a plant species for the same major ailment and lu is the number of informants who mentioned the plant for any major ailment[24,25].

2.3.2 Use Value (UV)

The Use Value (UV) determines the relative importance of plants known in locally. It was calculated using the following formula[26].

$$UV = \frac{\sum Ui}{N}$$

Where, U_i is the number of uses mentioned by each informant for a given species and N is the total number of informants.

2.3.3 Family Use Value (FUV)

The significance of the plant families were identified by calculating the Family Use Value (FUV) using the following formula[27].

$$FUV = \frac{UVs}{Ns}$$

Where, UVs is the use value of the species and Ns is the total number of species within each family.

3. Results and Discussion

3.1 Socio-Demographic Data of the Study

A total of 53 informants have participated in the present study. The age groups of the informants were confined between 20 and 75 years are represented in Table 1.

A total of 53 informants were interviewed and all were indigenous people with ages ranging from 20 years to 75 years (Table 1). They comprised of 73.58% men 26.41% women. A large number of people were in the age of 50-60 years (33.96%) and 40-50 years (24.52%). Most of the people in the study area were laborers (79.24%) and traditional health practitioners (13.2%). Regarding the level of education, 67.92 % were illiterate and 32.07 % were literate.

3.2 Plant Species, Botanical Families, Mode of Remedy Preparation and Quantitative Values

The plant species recorded in the present study are arranged in an alphabetical order and are enumerated

Table 1. Socio-demographic data of the tea tribe informants of Morigaon district, Assam (N=53)

Sl. No.	Variable	Categories	No. of informants	Frequency (%)
1.	Gender	Male	39	73.58 %
		Female	14	26.41 %
2.	Age	20 - 30 years	6	11.32 %
		30 - 40 years	9	16.98 %
		40 - 50 years	13	24.52 %
		50 - 60 years	18	33.96 %
		60 - 75 years	7	13.20 %
3.	Category of the informants	Indigenous people	53	100 %
		Traditional health practitioners	17	13.20 %
		Laborer	32	79.24 %
		Service man	4	7.54 %
4.	Experience of the Traditional Health Practitioner	≤ 1 year	1	1.89 %
		1 - 10 years	4	7.54 %
		10 - 20 years	7	13.20 %
		20 - 30 years	3	5.66 %
		≥ 30 years	2	3.77 %
5.	Literacy rate	Literate	17	32.07 %
		Illiterate	36	67.92 %

along with their correct botanical names, family, parts used, mode of preparation, and route of administration, UV and FL are summarized in Table 2. A total of 39 medicinal plants belonging to 36 genera and 27 families recorded to be used by the tea tribes as a remedy for jaundice in the study area.

The medicinal plant species documented from the study were distributed amongst 27 families and 36 genera. The highest numbers of plants were documented in the family Lamiaceae (5) followed by Leguminosae (3) and Acanthaceae (2), Oxalidaceae (2), Phyllanthaceae (2), Piperaceae (2), Poaceae (2) and Rutaceae (2) shown in Figure 2. Plant parts used by the tea tribes to treat jaundice were mainly aerial part, leaf, stem, bark of stem, fruit, rhizome, root, bark of root and whole plant. The most frequently used plant portion for the traditional remedies was the leaf (35.89%) trailed by fruit (17.94%), stem and whole plant (12.82%), aerial part of plant, rhizome, root (5.12%), calyx, flower, seed, stem bark and root bark (2.56%) (Figure 3). There is no specific time to collect the plant materials used for herbal therapy as reported by the informants of the study area. Amongst the 39 medicinal plant species recognized, 33.33 % are herbs followed by shrubs and trees (25.64%) and lastly climbers and under-shrubs (7.69%) (Figure 4).

Several forms of remedial preparation are used by the tea tribes in the study area and the most frequently used preparation was juice or extract with 43.58 % trailed by infusions (20.51 %), paste (15.38%), decoction and powder (7.69%), concoction and garland (5.12%) (Figure 5). The commonly used route of administration was oral (94.87%) followed by external or topical use (2.56 %) and both oral and external use (2.56%).

Most of the plants documented during the field study are wild in nature and are also available in the estates, residences, roadside, river-side and in hills and forest. *Aloe vera, Averrhoa carambola, Cajanas cajan, Curcuma longa, Hibiscus sabdariffa, Lawsonia inermis, Mentha arvensis, Passiflora edulis, Piper nigrum, Saccharum officinarum* are mainly cultivated

Table 2. Ethno-medicines used against jaundice by tea tribes of Morigaon district, Assam

Sl. No.	Name of Plant and Collection Number	Family	Local name(s)	Habit	Part(s) used	Mode of prepa-ration(s)	Route of admint-ration	Use Value (UV)	Fidelity Level % (FL)
1.	*Achyranthes aspera* L. RBNG-03	Amaranthaceae	*Ubhotakata* (Ass); *Apamargo* (Ass and TT)	Under-shrub	Stem	Worn as garland (chest length long).	External	0.15	100
2.	*Aegle marmelos* (L.) Correa RBNG-02	Rutaceae	*Bel* (Ass and TT)	Tree	Leaf	Infusion	Oral	0.15	87.5
3.	*Aloe vera* (L.) Burm.f. RBNG-01	Xanthorrhoeceae	*Salkuwori* (Ass); *Ghritokumari* (Ass and TT); *Dahidahiya* (TT)	Herb	Leaf	Juice/ Ex-tract	Oral	0.09	60
4.	*Alstonia scholaris* (L.) R.Br. RBNG-05	Apocynaceae	*Satiana* (Ass and TT); *Rani Gamari* (TT)	Tree	Stem	Powder	Oral	0.15	75
5.	*Argemone mexicana* L. RBNG-25	Papaveraceae	*Siyalkata* (Ass and TT); *Udishmari* (TT)	Herb	Leaf	Juice/ Ex-tract	Oral	0.05	33.3
6.	*Averrhoa carambola* L.RBNG-52	Oxalidaceae	*Kordoi* (Ass and TT)	Tree	Fruit	Juice/Ex-tract	Oral	0.09	57.1
7.	*Azadirachta indica* A. Juss RBNG-20	Meliaceae	*Mohaneem* (Ass); *Neem* (TT)	Tree	Leaf	Paste	Oral	0.11	71.4
8.	*Cajanus cajan* (L.) Millsp. RBNG-09	Leguminosae	*Rahar* (Ass); *Arhar* (TT)	Shrub	Leaf	Juice/Ex-tract	Oral	0.05	66.6
9.	*Cassia fistula* L.RBNG-06	Leguminosae	*Sonaru* (Ass); *Sonari gocho* (TT)	Tree	Seed	Decoction	Oral	0.05	66.6
10.	*Cheilocostus speciosus* (J.Konig) C. Specht RBNG-08	Costaceae	*Jomlakhuti* (Ass); *God* (TT)	Under-shrub	Rhi-zome	Decoction	Oral	0.07	100
11.	*Clerodendrum indicum* (L.) Kuntze RBNG-18	Lamiaceae	*Akal bih* (Ass); *Nagrikhari* (TT)	Shrub	Leaf, Stem	1.Juice/ Extract (leaf) 2. Worn as garland (stem)	Oral and external	0.07	28.5
12.	*Clerodendrum infortunatum* L. RBNG-10	Lamiaceae	*Bhet-tita* (Ass); *Kumotia* (TT)	Under-shrub	Leaf	Paste	Oral	0.09	100
13.	*Coffea benghalensis* B. Heyne ex Schult. RBNG-47	Rubiaceae	*Sagoliphul* (Ass and TT)	Shrub	Root	Powder	Oral	0.05	100

14.	*Curcuma longa* L. RBNG-13	Zingiberaceae	*Halodhi* (Ass); *Haldhi* (TT)	Herb	Rhi-zome	Paste or Powder	Oral	0.09	80
15.	*Cynodon dactylon*(L.) Pers. RBNG-21	Poaceae	*Dubori bon* (Ass and TT); *Dub bon* (TT)	Herb	Whole plant	Paste	Oral	0.11	42.8
16.	*Drymaria cordata* (L.) Willd. ex Schult. RBNG-23	Caryo-phyllaceae	*Laijabori* (Ass and TT)	Herb	Whole plant	Infusion	Oral	0.22	90.9
17.	*Ficus racemosa* L. RBNG-19	Moraceae	*Dimoru* (Ass and TT); *Dimri* (TT)	Tree	Fruit	Decoction	Oral	0.05	66.6
18.	*Glycosmis pentaphylla* (Retz.) DC. RBNG-16	Rutaceae	*Chaul-dhowa, Bon nemu* (Ass); *Bon nimbu, Ashhoura* (TT)	Shrub	Leaf	Juice/ Extract	Oral	0.07	75
19.	*Hibiscus sabdariffa* L. RBNG-26	Malvaceae	*Khaseng-tenga, Mesta-tenga* (Ass); *Tengamora* (Ass and TT)	Shrub	Calyx and Fruit	Juice/ Ex-tract	Oral	0.07	75
20.	*Houttuyunia cordata* Thunb. RBNG-29	Saururaceae	*Masundori* (Ass and TT)	Herb	Leaf	Infusion	Oral	0.07	60
21.	*Hydrocotyle sibthorpioides* Lam. RBNG-30	Araliaceae	*Sarumani-muni* (Ass); *Chhoto-manimuni* (TT)	Herb	Whole plant	Juice/Ex-tract	Oral	0.09	55.5
22.	*Justicia adhatoda* L. RBNG-04	Acanthaceae	*Vahak* (Ass); *Vasak, Basanti, Hej* (TT)	Shrub	Leaf	Juice/Ex-tract		0.07	44.4
23.	*Justicia gendarussa* Burm. f. RBNG-32	Acanthaceae	*Jatrasiddhi* (Ass); *Kaliadama, Brindaban* (TT)	Shrub	Leaf	Paste	Oral	0.15	100
24.	*Lawsonia inermis* L. RBNG-34	Lythraceae	*Jetuka* (Ass); *Mehndi* (TT)	Shrub	Root	Con-coction	Oral	0.07	100
25.	*Leucas aspera* (Willd.) RBNG-31	Lamiaceae	*Durun* (Ass and TT)	Herb	Leaf	Juice/ Extract	Oral	0.05	60
26.	*Mangifera indica* L. RBNG-33	Anacardiaceae	*Aam* (Ass and TT)	Tree	Bark of Stem	Paste	Oral	0.07	30.7
27.	*Mentha arvensis* L. RBNG-40	Lamiaceae	*Podina* (Ass); *Pudina* (TT)	Herb	Aerial part	Juice/Ex-tract	Oral	0.05	50
28.	*Ocimum tenuiflorum* L. RBNG-35	Lamiaceae	*Koliyatulosi* (Ass); *Tulsi* (TT)	Shrub	Leaf	Infusion of crushed leaves	Oral	0.13	58.3
29.	*Oxalis corniculata* L.RBNG-43	Oxalidaceae	*Tengesi tenga* (Ass); *Jhunjhuni* (TT)	Herb	Whole Plant	Juice/ Extract	Oral	0.07	44.4
30.	*Passiflora edulis* Sims RBNG-41	Passifloraceae	*Lota-bel* (Ass); *Kointho* (TT)	Climber	Flower and Fruit	Juice/ Extract	Oral	0.09	83.3
31.	*Peperomia pellucida* (L.) Kunth RBNG-36	Piperaceae	*Pananua* (Ass and TT)	Herb	Aerial part	Juice/Ex-tract	Oral	0.02	33.3
32.	*Phyllanthus emblica* L. RBNG-43	Phyllanthaceae	*Amlokhi* (Ass and TT); *Amlokhu* (TT)	Tree	Fruit	Juice/Ex-tract	Oral	0.09	45.4

33.	*Phyllanthus fraternus* G.L. Webster RBNG-39	Phyllanthaceae	*Mati-amlokhi* (Ass); *Bhui-aaola* (TT)	Herb	Whole Plant	Infusion	Oral	0.11	85.7
34.	*Piper nigrum* L. RBNG-43	Piperaceae	*Jaluk* (Ass); *Gul-morich* (TT)	Climber	Fruit	Concoction	Oral	0.07	44.4
35.	*Plumbago zeylanica* L. RBNG-46	Plumbaginaceae	*Agyasit* (Ass); *Agniboth, Chitamool, Raiputi* (TT)	Shrub	Bark of root	Infusion	Oral	0.07	57.1
36.	*Saccharum officinarum* L. RBNG-48	Poaceae	*Kuhiyar* (Ass and TT)	Herb	Stem	Juice/ Ex-tract	Oral	0.09	100
37.	*Tamarindus indica* L. RBNG-49	Leguminosae	*Teteli* (Ass); *Tetul* (TT)	Tree	Fruit	Infusion	Oral	0.04	66.6
38.	*Tinospora sinensis* (Lour.) Merr. RBNG-24	Menispermaceae	*Amar-lota* (Ass); *Guduchi, Choidoguni, Amar-lot, Gulchhi* (TT)	Clim-ber	Stem	Infusion	Oral	0.13	77.7
39.	*Xylosma longifolia* Clos. RBNG-51	Salicaceae	*Mota-koli* (Ass); *Kataponial* (Ass and TT)	Tree	Leaf	Juice/ Ex-tract	Oral	0.17	69.2

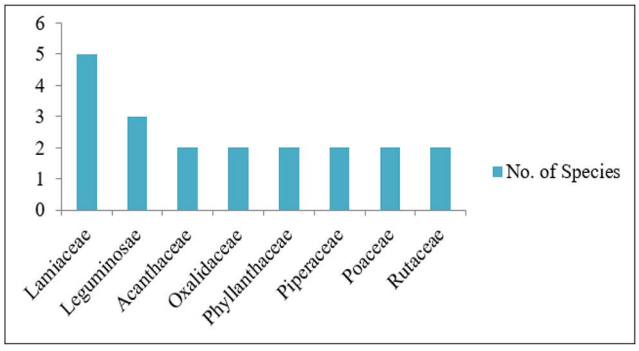

Figure 2. Dominant of the distributed medicinal plants.

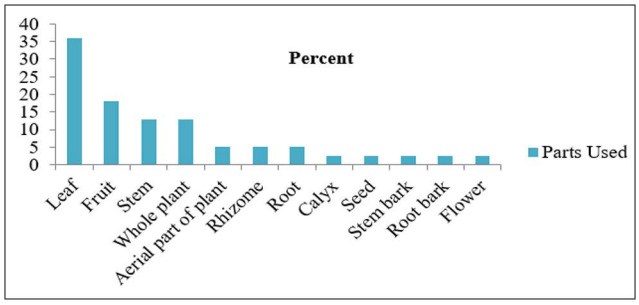

Figure 3. Plant parts used in the study area against jaundice.

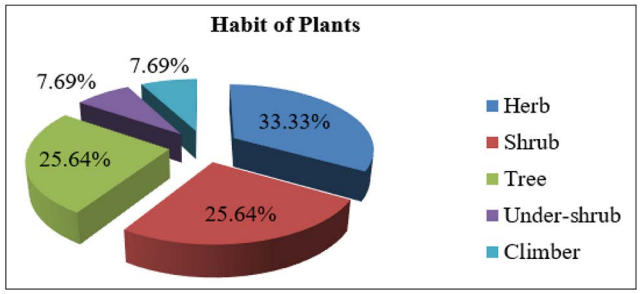

Figure 4. Habit of the plant species recorded in thestudy area.

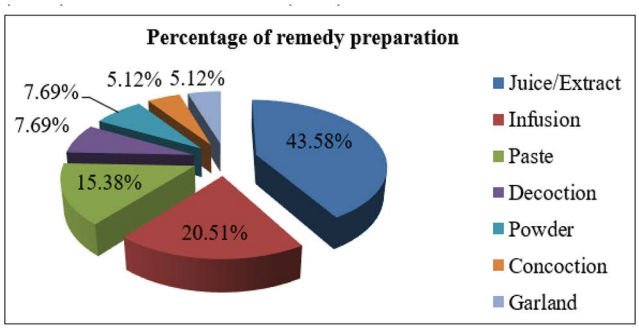

Figure 5. Mode of remedy preparation.

in the study area. During the field study, systematic and proper care was taken in the collection methods.

This is the first quantitative ethnobotanical study conducted in this study area The highest UV ranked the *Drymaria cordata (0.22)* first, followed by *Xylosma longifolia (0.17), Achyranthes aspera, Aegle marmelos, Alstonia scholaris and Justicia gendarussa* (0.15) as second and third respectively. The Family Use Value (FUV) ranged between the lowest values (0.05) and the highest value (0.30). Lamiaceae family (0.30) was the highest FUV trailed by Caryophyllaceae (0.22) and Rutaceae (0.18) shown in Table 3. The high values of UV and FUV can be explained by the fact that these plants are highly used and acknowledged by the majority of the informants in the study area. The Fidelity Level (FL) of the recorded plants have been calculated which showed the highest percentage of 100% for *Achyranthes aspera, Cheilocostus speciosus, Clerodendrum infortunatum, Justicia gendarussa, Lawsonia inermis, Coffea benghalensis* and *Saccharum officinarum* followed by *Drymaria cordata* (90.9%) and *Aegle marmelos (*87.5%).

Table 3. FUV of the plant families calculated from the actual and estimated UV of the plant species

Family	FUV
Acanthaceae	0.15
Amaranthaceae	0.15
Anacardiaceae	0.07
Apocynaceae	0.15
Araliaceae	0.09
Caryophyllaceae	0.22
Costaceae	0.07
Lamiaceae	0.30
Leguminosae	0.12
Lythraceae	0.07
Malvaceae	0.07
Meliaceae	0.11
Menispermaceae	0.13
Moraceae	0.05
Oxalidaceae	0.13
Papaveraceae	0.05
Passifloraceae	0.09
Phyllanthaceae	0.15
Piperaceae	0.05
Plumbaginaceae	0.07
Poaceae	0.16
Rubiaceae	0.05
Rutaceae	0.18
Salicaceae	0.16
Saururaceae	0.07
Xanthorrhoeceae	0.09
Zingiberaceae	0.09

In Morigaon district, jaundice is a common problem among the tea tribes due to their poor food habits, preventive care, and hygiene. They have gained the traditional knowledge on medicinal plants from the elders of their family and the village chiefs by word of mouth. However, there is a threat to the indigenous knowledge due to modernization; the knowledge may eventually be lost following the decease of the elderly and knowledgeable inhabitants of the study area. The documentation of this traditional knowledge is valuable for the indigenous people and their future generations for the wider use of the plants against jaundice. The majority of the informants were males (73.58%) and females (26.41%). Most of the ethno-pharmacological studies confirm that leaves are the major parts used for treating jaundice and resembles the present study[14,28,29]. Most informants preferred to use fresh juice or extract of the plants to treat jaundice. The plants used by the informants are mostly wild in nature (71.8%) while the cultivated plants represent only (28.2%).

3.3 A Brief Review on the Hepato-protective Activity of the Documented Plants of the Study

In-vivo and in-vitro hepatoprotective activity of crude extracts of 29 of the 39 plant species identified in this study have been reported in the literature namely *Achyranthes aspera*, *Aegle marmelos, Aloe vera*, *Alstonia scholaris, Argemone mexicana*, *Averrhoa carambola*, *Cajanus cajan, Cassia fistula*, *Cheilocostus speciosus*, *Clerodendrum infortunatum*, *Curcuma longa*, *Cynodon dactylon*, *Ficus racemosa, Glycosmis pentaphylla, Justicia adhatoda, Justicia gendarussa, Lawsonia inermis, Mentha arvensis, Passiflora edulis, Ocimun tenuiflorum*, *Oxalis corniculata, Phyllanthus emblica, Phyllanthus fraternus, Piper nigrum, Plumbago*

Table 4. Literature review of hepatoprotective effects of the documented plants of the study area

Name of the species	Hepatoprotective activity
Achyranthes aspera L.	Effect of methanolic extract on rifampicin-induced hepatotoxicity and bi-herbal ethanolic extract against paracetamol induced hepatic damage in albino rats[30,31]
Aegle marmelos (L.) Correa	Effect of the methanolic extract of leaves in paracetamol intoxicated albino rats[32]
Aloe vera (L.) Burm.f.	Hepatoprotective activity of the gel against paracetamol induced hepatotoxicity in albino rats[33]
Alstonia scholaris (L.) R.Br.	Effect of methanolic extract of stem bark [34]
Argemone mexicana L.	In vivo activity of aerial part extract on CCl_4 induced liver damage in wister rats [35]
Averrhoa carambola L.	Effect against CCl_4 and paracetamol induced liver toxicity[36,37]
Azadirachta indica A. Juss	Protective effect of leaf extract in rats against paracetamol induced hepatic damages[38]
Cajanas cajan (L.) Huth	Effects on tissue defense system in D-galactosamine induced hepatitis in rats[39,40]
Cassia fistula L.	Effect of aqueous extract of leaf and stem against CCl_4 induced liver damage in rats[41-43]
Cheilocostus speciosus (J.Konig) C. Specht	Hepatoprotective effect on paracetamol induced liver injury[44]
Clerodendrum indicum (L.) Kuntze	No reference
Clerodendrum infortunatum L.	Potentiality of methanol extract against CCl_4 induced hepatotoxicity in rats[45]
Coffea benghalensis (Roxb. ex. Schult.) J.-F.Leroy	No reference
Curcuma longa L.	Protective effects on $CuSO_4$ induced hepatotoxicity and nephrotoxicity. Immunomodulatory and hepatoprotective properties of aqueous extract against CCl_4 intoxicity in swiss albino mice[46,47]
Cynodon dactylon (L.) Pers.	Protective effects of aerial plants against CCl_4 induced hepatotoxicity in rats[48]
Drymaria cordata (L.)Willd.ex Schult.	No reference
Ficus racemosa L.	Activity of leaf extract on liver damage in rats caused by CCl_4. And hepatoprotective effects of stem bark in albino rats against CCl_4 hepatic damages[49,50]
Glycosmis pentaphylla (Retz.) DC.	Activity against paracetamol induced hepatotoxity in swiss albino rats[51]
Hibiscus sabdariffa L.	No reference
Houttuyunia cordata Thunb.	No reference
Hydrocotyle sibthorpioides Lam.	No reference
Justicia adhatoda L.	Hepatotoprotective activity of aqueous, ethanol and methanol extracts against liver injury in albino mice caused by CCl_4[52]
Justicia gendarussa Burm. f.	In vitro hepatoprotective effects of stem against hepatotoxicity induced by CCl_4 in rats[53]
Lawsonia inermis L.	Effect of warm aqueous extract in wister rats in CCl_4 and 2-acetylaminoflourene induced hepatic injury[54,55]
Leucas aspera (Willd.)	No reference
Mangifera indica L.	No reference
Mentha arvensis L.	Protective effect of leaves against CCl_4 induced liver damages in rat[56]
Ocimum tenuiflorum L.	Alcoholic effect of leaf extract against paracetamol induced liver damage in rats[57]
Oxalis corniculata L.	Activity of ethanolic extract against paracetamol induced hepatotoxicity in wister rats[58]
Passiflora edulis Sims	Hepatoprotective effect of peel extract of the Passion fruit in albino rat[59]
Peperomia pellucida (L.) Kunth	No reference
Phyllanthus emblica L.	Hepatoprotective effects of ethanol extract[60]

Phyllanthus fraternus G.L. Webster	Effect of whole plant extracts on liver of *Staphylococcus aureus* intoxicated albino rats [61]
Piper nigrum L.	Effect of methanolic extract against ethanol-CCl_4 hepatotoxicity in wister rats[62]
Plumbago zeylanica L.	Effect on paracetamol induced liver toxicity in rats[63]
Saccharum officinarum L.	Effect of juice in isoniazed induced hepatotoxicity in male albino rats[64]
Tamarindus indica L.	Ameliorating, anti-oxidant and hepatoprotective activity[65,66]
Tinospora sinensis (Lour.) Merr.	Aqueous extract hepatoprotective activity[67]
Xylosma longifolia Clos.	No reference

zeylanica, *Saccharum officinarum, Tamarindus indica* and *Tinospora sinensis* (Table 4).

Plant species like *Clerodendrum indicum, Drymaria cordata, Hibiscus sabdariffa, Houttuyunia cordata, Hydrocotyle sibthorpioides, Leucas aspera, Mangifera indica, Peperomia pellucida, Coffea benghalensis* and *Xylosma longifolia* are needed to analyze their hepatoprotective and other biological properties for development of some novel phyto-therapeutic active compounds.

4. Conclusion

The field studies carried out in the tea gardens of Morigaon district have led to the documentation of ethnomedicinal uses for 39 plant species. The reports provided by the tea tribal people of the study area, certainly increases the validity of the said purpose. From the above results and discussions, the tea tribes of the Morigaon district are still dependent on wild plants to cure jaundice. From the best of our knowledge *Coffea benghalensis* has not been reported earlier as a remedy for jaundice from Northeast India. The most widely used plants against jaundice recorded in this study such as *Drymaria cordata, Xylosma longifolia, Achyranthes aspera, Cheilocostus speciosus, Clerodendrum infortunatum, Justicia gendarussa, Lawsonia inermis, Coffea benghalensis, Saccharum officinarum* and *Aegle marmelos* and some plant species that have not yet been analyzed for the hepatoprotective properties should be prioritized for further phytochemical and pharmacological studies to identify the unknown compounds and their functional groups. Isolation of the bioactive compounds and elucidation of their chemical structures will help to develop new medicines for the treatment of jaundice in the future.

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6. Conflict of Interests

No conflict of interest.

7. References

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