

Preliminary Study of Ethno-medicinal Practices of the Tea Tribes in Titabor Sub-division of Jorhat District, Assam

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Traditional knowledge trapped amongst ethnic groups require appropriate documentation for resource conservation purpose and also invites authentic scientific validation. The study is henceforth directed towards documenting the traditional knowledge of herbal formulations utilized by tea tribes of Titabor sub-division of Jorhat district along with performing of a comparative analysis of these formulations used by the tea tribes of the entire Assam. Survey was conducted in tea garden areas of Titabor sub-division and in-depth literature exploration involving diverse articles published on ethno-pharmacology of therapeutic plants utilized by tea tribes of Assam was performed utilizing following keywords:- Medicinal plants, Herbal Formulations, Tea Tribes and Assam. Information about a total of 10 herbal formulations (5-Mono-Herbal Formulations/5-Poly-Herbal Formulations) were obtained through proper consultation from January 2022 to July 2022. Performing comparative analysis revealed that herbal formulations (91% were MHFs and 9% were PHFs) were used for treating human diseases like jaundice (20%), rheumatoid arthritis (16%) and respiratory diseases (13%) with around 37% preparation in paste or powdered form while 32% correspond to liquid form or juice. Majority of them are being administered orally (78%) and topically (22%). Around 8% of these plants belong to Lamiaceae family followed by Fabaceae (7%) and Asteraceae (5%) while leaves (35%), bark/roots (10%) and whole plant (8%) were mostly used. Successful pre-clinical and clinical trials involving these formulations for treating respective disorder will lead to patenting and commercialization in turn causing benefit sharing with the community.

Keywords: Documentation; Ethno-pharmacology; Herbal Formulations; Survey; Tea tribes.

India is regarded as one of the leading producers of medicinal plants specifically the North-eastern region which is one of the wealthiest bio-diversity region with numerous rare and endemic species.^{1,2} North-East India especially Assam is considered as the paradise for ethno-botanists with enormous vegetational wealth owing to topography and climatic conditions with more than 150 tribes existing in the state with the tea tribes being one amongst them.³ A rich diversity of both the population and flora in the

state have provided an edge to its inhabitants since ancient times. Traditional knowledge has played a significant role in conservation of resources, mostly of indigenous plant species important for indigenous ethnic communities.^{4,5} Ethnic groups possess significant traditional medicine knowledge which requires appropriate documentation.⁶ Around 65% of Indian population is dependent upon traditional therapies.⁷ The tea tribes are multi-ethnic tea garden workers with many sub-tribes pre-dominantly found in different districts of Upper Assam.

Authentic record-keeping of traditional knowledge of tea communities is important in understanding the usage of medicinal plants in a specific region which primarily ensures the preservation of native cultural heritage from being lost. Furthermore it can be considered as an essential tool for carrying out extrapolative research in the field of bioactive studies on specific plant species which might land us in discovering active pharmaceutical ingredients with promising drug candidate properties.^{8,9} This kind of study also aids in the investigation along with enumeration of the remarkable role played by pharmacologically important plant species within local socio-cultural context.¹⁰ Henceforth the present study is a preliminary work encompassing the formulations utilized by the tea tribes of Titabor sub-division of Jorhat district, Assam as well as a comparative analysis of the traditional knowledge amongst tea tribes spread across Assam.

MATERIALS AND METHODS

Survey was conducted in tea garden areas inhabited by the local tea tribes of Titabor sub-division (Latitudes 26°5462' N and 26°5441' N and Longitudes 94°12709' E and 94°14890' E) of Jorhat district. Data was collected through personal communication, interviews, discussions and observation. The respondents were mostly the traditional healers. Documentation was performed through interviews conducted with the aid of modified semi-structured questionnaire.^{11,12} The information about plants and plant parts utilized, procedure of preparation, mode of administration and dosage were noted. Additionally, information like the symptoms of diseases, age group, gender of patients and recovery percentage were also recorded.

Furthermore, an in-depth literature exploration involving a structured electronic and library search of different indexed and non-indexed journals and diverse articles published on ethno-pharmacology of medicinal plants involving databases like Scopus, Research Gate, ScienceDirect, PubMed, Google Scholar used by tea tribes of Assam was performed for a comparative analysis on the disease type, type of formulation, type of preparation, mode of administration, families of plants used and plant

part used. The researchers have used the following keywords or a combination of the following for extracting information:-

- Medicinal plants
- Herbal Formulations
- Tea Tribes
- Assam
- Human diseases

RESULTS

Socio-demographic data, plant samples and dosages

Conduction of thorough survey involving documentation of ethno-pharmacological knowledge landed us with interaction with the tea tribes of Titabor sub-division of Jorhat district, Assam. Although not all the healers were interested in sharing their knowledge thereby remaining sceptical about the unethical commercialization of their formulations while some shared their knowledge willingly. The demographic features of respondents of the survey area is being depicted in Table 1.

The data revealed that 80% of the healers were male while remaining (20%) were female. Age of the healers was between 30-73 years. Most of them had little formal education while only a few had the desirable qualification. A total number of 10 herbal formulations (MHFs/PHFs) were mentioned by the respondents utilized for the treatment of various human disorders (Table 2).

Survey and Documentation of traditional knowledge

The different herbal formulations prescribed by the healers is being listed in Table 2.

Comparative analysis of traditional knowledge

While analysing the traditional knowledge amongst the tea tribes of Assam performed through in-depth literature review, the different disorders, the type of formulations, herbal preparation forms, mode of administration, families of the plants used in these formulations and plant parts used in these formulations were taken into account and represented through Fig. 3, 4, 5, 6, 7 and 8 respectively.

While performing the comparative analysis, it was found that jaundice (20%) is mostly targeted followed by rheumatoid arthritis (16%) and respiratory disorders (13%) (Fig. 3) while

around 91% of the herbal formulations targeting the different disorders affecting the tea tribes of Assam are MHFs while remaining 9% correspond to PHFs as depicted through Fig. 4. Furthermore it has also been revealed through this study that most herbal formulations used by tea tribes are administered in paste or powder form (37%), followed by liquid form (32%) and decoction (13%) (Fig. 5). Around 78% of the formulations are administered orally (improved absorption, avoidance of molecular

interaction and targeted efficacious action) while remaining 22% of them have topical administration (massage/bath/inhalation) (Fig. 6). The plants utilized in preparing these herbal formulations mostly belong to Lamiaceae family (8%) followed by Fabaceae (7%), Asteraceae (5%), Apiaceae (4.44%), Acanthaceae (4.1%), Zingiberaceae (4.1%) and Piperaceae (4.1%) as visualized through Fig. 7. As leaves harbour a major proportion of bioactive compounds in them, they are being used

PROFORMA FOR COLLECTING FIELD DATA ON MEDICINAL PLANTS

1. Tribe:

- Gender (Male/Female):-
- Experience (5/5-10/10 above):-
- Age (below 15/15-40/40 above):-
- Locality:-
- Occupation:-

2. Name of disease:-

3. Number of diseases cured:-

4. Data on plant:

- (a) Scientific Name:-
- (b) Vernacular Name:-
- (c) Family:-
- (d) Habitat:-
- (e) Fruit characteristics:-
- (f) Flower colour:-
- (g) Stem characteristics:-
- (h) Leaf characteristics:-
- (i) Photograph:-

5. Description of the drug:-

- (a) Time of collection:-
- (b) Method of preparation of the drug (Natural form/Crushed/Juice/Decoction/Poultice/Soft Paste/Solid preparation/Powder):-
- (c) Zone of application (Internal/External):-
- (d) Ingredients used:-
- (e) Mode of administration:-
- (f) Preservation of the drug (Y/N):-
- (g) Plant part used as medicine (Root/Stem/Leaf/Flower/Fruit/Seed/Root bark/Stem bark/Latex/Gum):-
- (h) Therapeutic indications:
 - (1) Dosage:-
 - (2) Diet restrictions:-
 - (3) Side effects:-

6. Reason for considering it as a medicine:-

Fig. 1. Semi-structured questionnaire (slightly modified) for documenting information on medicinal plants.¹¹

mostly utilized in constituting the formulations (35%) followed by the utilization of bark/root (10%) and whole plant (8%) (Fig. 8).

DISCUSSION

The survey, documentation and comparative analysis of the traditional knowledge trapped in the tea tribes of Assam appears to be a very mild yet significant step in transcending the ethno-pharmacological knowledge from these tribal communities to the scientific community. In fact the study functions in bridging the knowledge gap and as such opens up naive formulations for scientific authentication and validation which in long run might lead to development of herbal drugs. The study disclosed the pre-dominance of male traditional healers (80%) with female healers accounting for remaining 20% with majority having little formal education. As reported by the healers, some of them have been taught about these formulations by their fore-fathers (grand-father) while others claim of learning about the formulations in their dreams.

As visualized from Table 2, almost all the plants prescribed by the healers have respective therapeutic property for its usage in the form of herbal formulation for treating specific disease as scientific experiments carried out validates and henceforth substantiates the claims of these healers, for example, the chloroform fraction of the methanolic *Drymaria cordata* leaf extract demonstrated hepato-protective effect in Mono-Sodium Glutamate (MSG)-induced rat liver injury,¹³ while the essential oils from *Piper nigrum*

reversed the CCl₄-enhanced hepatic marker enzymes [alanine transaminase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (AKP) and malondialdehyde (MDA)],¹⁴ and *Zinziber officinale* also exerted hepato-protective effect in HgCl₂ induced hepatotoxic rat livers.¹⁵ The fact that the seeds of *T. arjuna* is being used in jaundice correlates to its remarkably high anti-oxidant potential.¹⁶ Experimental evidence suggests the capability of a triterpenoid isolated from *Centella asiatica*, asiatic acid in lowering inflammatory disorders while the anti-nociceptive and anti-inflammatory property of *Tagetes erecta* leaf extract was manifested in rat and mice model.^{17,18} Even *Cannabis sativa* stem extract showed both anti-bacterial (*Staphylococcus aureus*) and anti-fungal activity (*A. niger*, *Aspergillus parasiticus* and *Aspergillus oryzae*).^{19,20} Ethanolic *Pouzolzia zeylanica* extract demonstrated anti-fungal activity against *Blastomyces dermatitides*, *Microsporium spp.*, *Candida albicans*, *Trichophyton spp.* etc.,²¹ while topical garlic (*Allium sativum*) extract application is efficacious against psoriasis, alopecia areata, keloid scar, wound healing, cutaneous corn, leishmaniasis, skin aging and rejuvenation.²² A capsular *Phyllanthus niruri* dosage (500 mg twice daily) in alcoholic hepatitis patients ameliorated the total antioxidant levels along with an appetite stimulant activity compared to a placebo justifying its usage as a herbal formulation by the healers.²³ Furthermore, methanolic *Drymaria cordata* extract exhibited significant anti-tussive activity comparable to that of codeine phosphate, a prototype anti-tussive agent in a concentration-dependent manner.²⁴

Table 1. Demographic characteristics (n=10) of respondents in the study area

	Characters	Frequency
Gender	Male	8
	Female	2
Age	<30 years	0
	30-60 years	4
	>60 years	6
Education	Primary	6
	Secondary	3
	Education above higher secondary	1
Religion	Hindu, Christian	
Years of experience	0-10 years	7
	>10 years	3

Table 2. Herbal Formulations (Mono/Poly) used for treatment of human diseases.

No.	Scientific Name of the plants	Plant Parts used	Mode of administration	Method of preparation	Dosage	Diet restrictions	Disease treated
1	<i>Drymaria cordata</i> <i>Piper nigrum</i> <i>Zinziber officinale</i>	Leaf Fruit Rhizome	Oral	Leaf of <i>Drymaria cordata</i> is crushed along with fruit of <i>Piper nigrum</i> and rhizome of <i>Zinziber officinale</i> and the mixture is then mixed with water The seed of <i>Terminalia arjuna</i> is crushed along with Mishri (Rock sugar) and the mixture is mixed with water for consumption The whole plant of <i>Centella asiatica</i> , young leaves of <i>Tagetes erecta</i> and apical portion of the stem of <i>Cannabis sativa</i> are crushed together to obtain a paste that can be applied over the affected area.	1 full glass for adult /3 times a day; 1/2 glass for children /3 times a day.	Consumption of highly oily food, fish, meat and egg is prohibited	Jaundice
2	<i>Terminalia arjuna</i>	Seed	Oral	The seed of <i>Terminalia arjuna</i> is crushed along with Mishri (Rock sugar) and the mixture is mixed with water for consumption	1 full glass for adult/ 3 times a day; 1/2 glass for children/ 3 times a day.	Consumption of highly oily food, fish, meat and egg is prohibited	Jaundice
3	<i>Centella asiatica</i> <i>Tagetes erecta</i> <i>Cannabis sativa</i>	Whole plant Young leaves Apical portion of the stem	Topical	The whole plant of <i>Centella asiatica</i> , young leaves of <i>Tagetes erecta</i> and apical portion of the stem of <i>Cannabis sativa</i> are crushed together to obtain a paste that can be applied over the affected area.	Applied for 12 hours at a stretch for three days continuously with 12 hours interval preferably at night. Dose is same for children and adult.	Food that cause irritation like brinjal should be avoided.	Septic Infection
4	<i>Pouzolzia zeylanica</i> <i>Allium sativum</i>	Whole plant Bulb	Topical	The whole plant of <i>Pouzolzia zeylanica</i> is grinded along with <i>Allium sativum</i> and combined with alandhu (carbon black) to obtain a paste to be applied over the affected area.	Applied for 12 hours at a stretch for three days (five days if not cured) continuously with 12 hours interval preferably at night. Dose is same for children and adult.	Food that cause irritation like brinjal should be avoided.	Dermatitis
5	<i>Phyllanthus niruri</i>	Whole plant	Oral	The whole plant of <i>Phyllanthus niruri</i> is crushed to obtain atleast 3 teaspoonful of the juice and 2 teaspoonful of yoghurt is combined.	The juice mixture is allowed to take orally in empty stomach in the morning for 3 days at a stretch (5 days if not treated well). Dose is same for children and adult.	Highly spicy food should be avoided.	Jaundice
6	<i>Drymaria cordata</i>	Whole plant	Oral	The whole plant of <i>Drymaria cordata</i> should be crushed well and theobtained juice is grinded well along with <i>Bora chaul</i> (which is immersed in water prior to grinding). The product is then fried in the pan with mustard oil and is then served on the leaf of banana plant in the form of small pancakes.	The pancakes should be consumed in the morning in empty stomach accompanied by lukewarm water	The slimy food should be avoided along with red meat.	Asthma
7	<i>Cyperus rotundus</i>	Rhizome	Oral	The underground rhizome of <i>Cyperus rotundus</i> is grinded well and is then mixed with honey to	The soft paste is taken in the morning in empty stomach for 3 days continuously by the	Brinjal and large fish should be avoided.	Pneumonia

8	<i>Azadirachta indica</i> <i>Caesalpinia bonduc</i> <i>Solanum spirale</i>	Bark Seed Root	Oral	The bark of <i>Azadirachta indica</i> , seed of <i>Caesalpinia bonduc</i> , the root of <i>Solanum spirale</i> are grinded separately, mixed together and the obtained formulation is again mixed in half cup of water. About 6-7 leaves of <i>Ocimum tenuiflorum</i> , 5-6 leaves of <i>Azadirachta indica</i> and 3 nos of <i>Piper nigrum</i> are crushed together and the mixture is prepared. A number of leaves (handful) of <i>Psidium guajava</i> is warmed in about 1 litre water and half litre of the preparation is then taken, salt is added and the preparation is shaken well and is then subjected to fine filtering through a strainer.	adult with 24 hour interval between the doses. While for children, the paste is just applied over the lips or to the tongue The liquid is taken for stretch of 3 days with 24 hour interval in empty stomach in the morning.	Non vegetarian items like egg, meat and fish should be avoided.	Pneumonia
9	<i>Ocimum tenuiflorum</i> <i>Azadirachta indica</i> <i>Piper nigrum</i>	Leaf Leaf Fruit	Oral		The resulting mixture is consumed in the morning in empty stomach for a period of 6-7 days.	High salt intake should be prohibited or compounds having high salt content should be avoided Milk products should be consumed in lesser amounts or should be avoided	Hypertension
10	<i>Psidium guajava</i>	Leaf	Oral		The liquid (about 1/2 cup) coming out through the pores of the strainer is orally consumed daily once. The consumption is done anytime during the day.		Chronic dysentery

The different root and rhizome solvent extracts viz. ethanolic, chloroform, aqueous, petroleum ether extract of *Cyperus rotundus* exhibited anti-oxidant activity in terms of percent inhibition of haemoglobin glycosylation,²⁵ while rhizome ethanolic extract is reported to be more efficacious against *Staphylococcus epidermidis*, *Bacillus cereus* and *Pseudomonas aeruginosa*.²⁶ The leaf and bark extracts of *Azadirachta indica* possess significant anti-oxidant property with the bark being more potent with high phenolic content,²⁷ while the methanol and chloroform extracts were found to be more efficient than the conventional antibiotics against *Staphylococcus aureus* and *P. Aeruginosa*.²⁸ The chloroform seed extract of *Caesalpinia bonduc* demonstrates anti-oxidant activity,²⁹ while the aqueous and ethyl acetic acid *C. bonduc* seed extracts demonstrates significant anti-fungal activity against numerous fungi including *C. albicans* and *Aspergillus niger*.³⁰ The essential oils of *Solanum spirale* Roxb. unripe fruits and leaves demonstrated anti-bacterial activity against *Mycobacterium tuberculosis* H37Ra, *Escherichia coli* and *Staphylococcus aureus* while the anti-oxidant potential demonstrated by the methanolic shoot and berry extract of *Solanum spirale* Roxb. is attributable to their flavonoid and phenolic content.^{31,32,33} Furthermore the amalgamation of *Ocimum tenuiflorum* and *Azadirachta indica* leaves aid in lowering diabetic symptoms and blood pressure of non insulin dependent male diabetic individuals.³⁴ Even *Piper nigrum* which contains piperine is found to alleviate hypertension in wistar rats.³⁵ The ethanolic leaf extract of *Psidium guajava* inhibited *E. coli* and *Salmonella enteridis* growth with ZOI diameters in the range of 10-15 mm at 50 mg/disk.³⁶ The plant species in these formulations definitely possess therapeutic potential owing to the presence of phyto-compounds in them. The fact that the healers have been able to preserve this knowledge and transcend it through time by prescribing them for treatment of various disorders is truly remarkable as each of these formulations target a specific disease. Furthermore the manner of preparation, dosage prescribed and diet restrictions associated with their prescription adds value to the formulation's therapeutic property exhibition. Diet restrictions are useful because the compounds in those diets might hinder mechanism of action, delay recovery, minimize effectiveness, induce

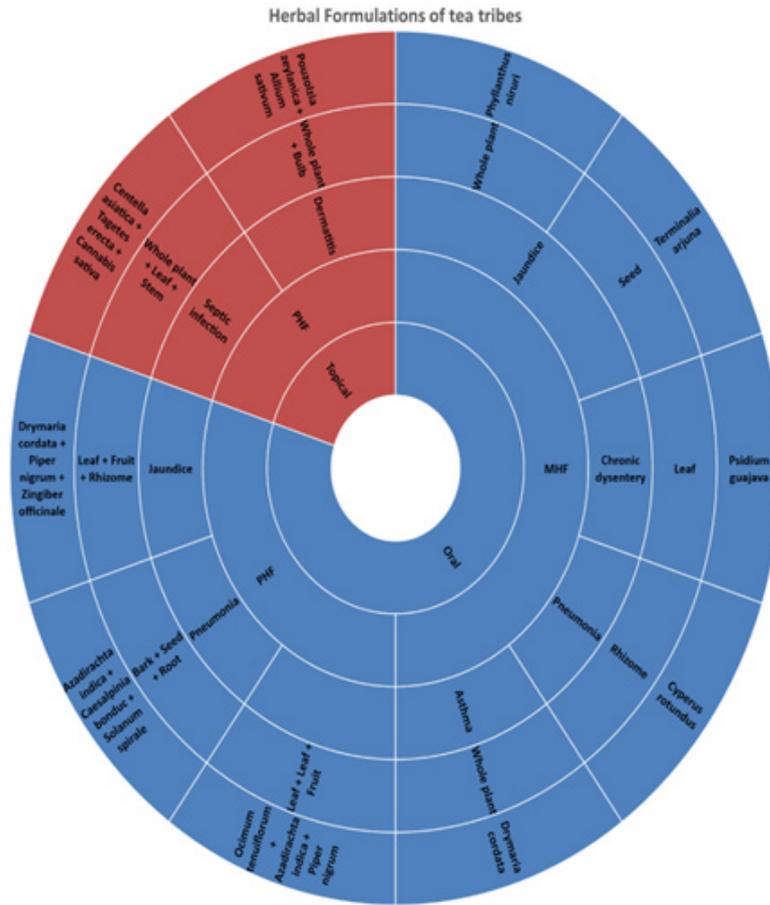


Fig. 2. Herbal formulations used by the tea tribes of in Titabor sub-division

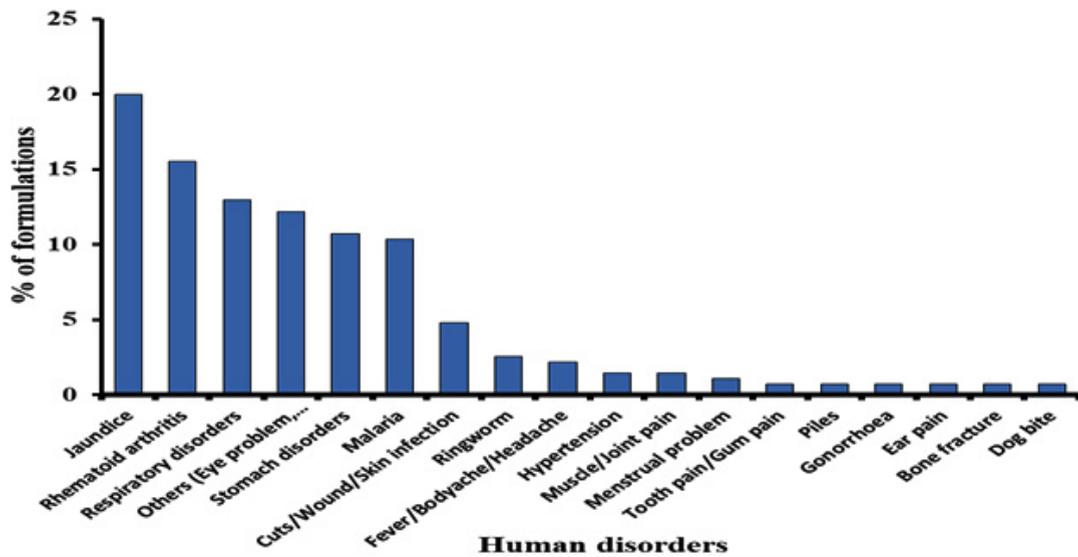


Fig. 3. Bar graph showing the human diseases treated by herbal formulations

allergic reactions and even prevent interactions with other compounds. Moreover the traditional knowledge trapped in these tea communities definitely pave way for proper clinical trials for treating the respective disease post successful pre-clinical trials. When such formulations successfully cross the barriers (pre-clinical and clinical trials), these can be incorporated to form a herbal drug with reduced side effects, equivalent efficacy and higher acceptability as compared to allopathic medicines to treat various human diseases. These herbal drugs are safe and produce desired pharmacological

effects, making them one of the highly selected drugs of choice. The commercialization of the herbal drug following successful trials will also lead to benefit sharing with these respondents/traditional healers and generation of livelihood for them.

Jaundice (20%), rheumatoid arthritis (16%) and respiratory disorders (13%) are the three most formulation targeted diseases (Fig. 3). The reason for jaundice mostly treated might be because of the inadequate nutrition and substandard living conditions of the tea tribes with tremendous

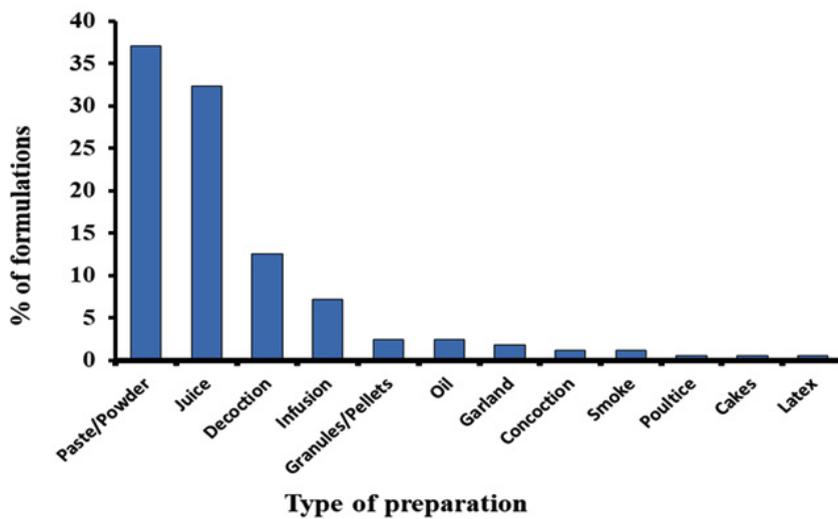


Fig. 4. Bar graph depicting the herbal formulation types used for treating human diseases

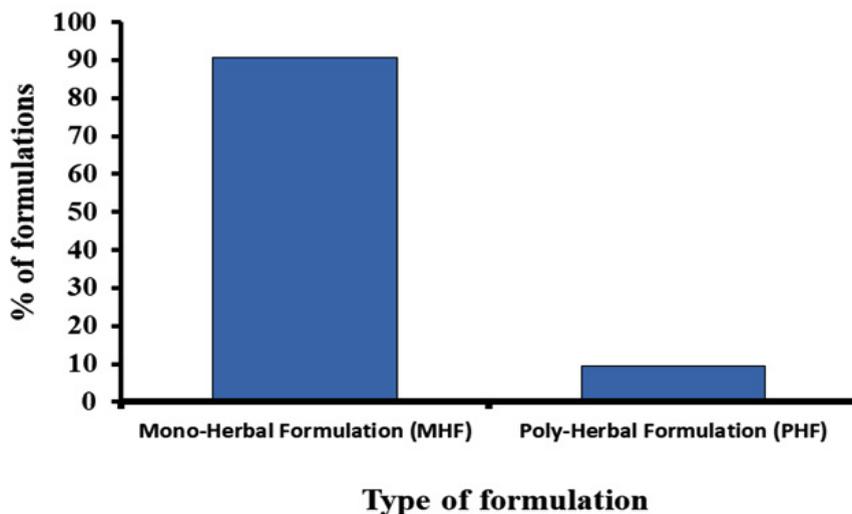


Fig. 5. Bar graph showing the different forms of herbal formulations

water scarcity and deteriorating water quality. Furthermore poor sanitary conditions and low personal hygiene add to the causation of jaundice.³⁷ Studies have identified a high prevalence of hemoglobinopathies, such as sickle cell anaemia and alpha-thalassemia, amongst tribals working in

Assam’s tea gardens. These genetic disorders can lead to anaemia, which may strain liver function and potentially contribute to jaundice.³⁸ Secondly, rheumatoid arthritis, an auto-immune disorder is being targeted as the repetitive and strenuous nature of perform physically demanding tasks, such as

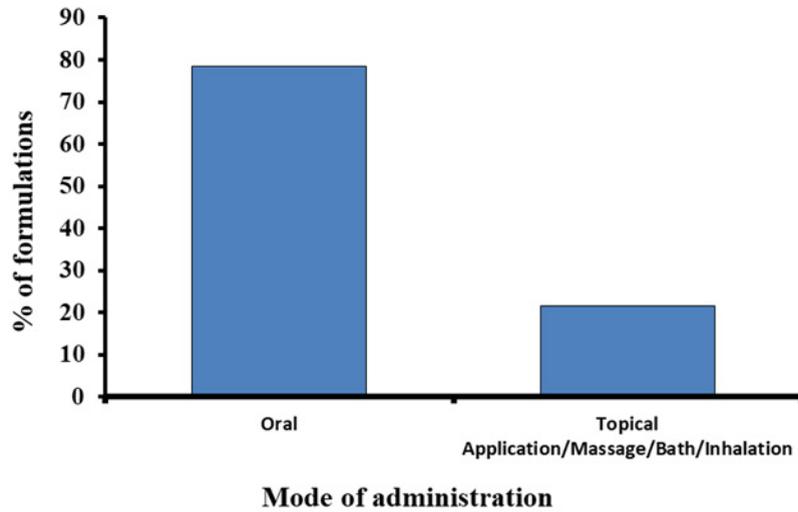


Fig. 6. Bar graph showing the proportion of the different modes of administration of the herbal formulations

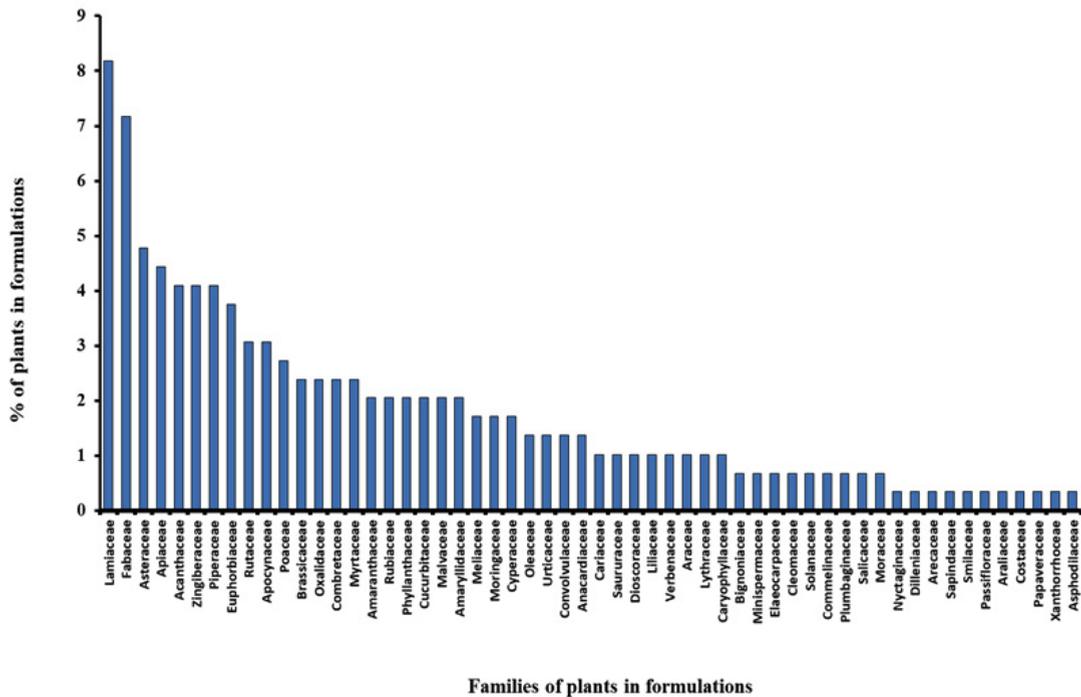


Fig. 7. Bar graph showing the families of the plants present in the herbal formulations

plucking tea leaves for long hours, bending, and carrying heavy loads can put immense strain on the joints, which may exacerbate or potentially trigger autoimmune responses, especially in individuals who are genetically predisposed to RA. Thirdly even the respiratory disorders like tuberculosis are affecting the tea population in a remarkable manner for which the formulations are also being designed.³⁹

Mostly MHFs (91%) are prepared for treating the disorders while a meagre 9% formulations are PHFs (9%) as certain issues concerning the sources and manufacturing processes, patients, drug-herb interaction and toxicity arise with respect to PHFs.⁴⁰ Moreover these MHFs are easier to study, standardize and understand in terms of pharmacological effects and mechanisms while the clinical reproducibility of most of the ayurvedic PHFs is difficult to accomplish pushing for the usage of MHFs.⁴¹ Majority of these formulations are administered in paste (improved absorption, topical application, easy to use) or powdered form (longer shelf life, precise dosage, versatility) (Fig. 5).

Furthermore oral administrations account for 78% owing to improved absorption, avoidance

of molecular interaction and targeted efficacious action while remaining 22% of them have topical administration (massage/bath/inhalation)(Fig. 6). As visualized through Fig. 7, the plants belonging to Lamiaceae family (8%) followed by Fabaceae (7%) and Asteraceae (5%) are utilized in herbal formulations. The plants belonging to Lamiaceae family harbour an array of bio-active compounds like phenolic acids, flavonoids, alkaloids and other phyto-chemicals including omega-3,⁴² which are responsible for exhibiting the required therapeutic properties in turn making them use in these herbal formulations. Moreover these herbal formulations make use of leaves as a major proportion of bioactive compounds are being present in the leaves (35%) followed by bark/root (10%) and whole plant (8%) (Fig. 8).

Research in ethno-pharmacology has gained quite attention for the fact that these herbal medicines come with added benefits compared to allopathic ones in the market. Furthermore the ethno-medicinal researchers form the base for the development of novel herbal drug formulations. Prompt urbanization has led to the undermining of traditional knowledge which has an immediate need for conservation. However the traditional

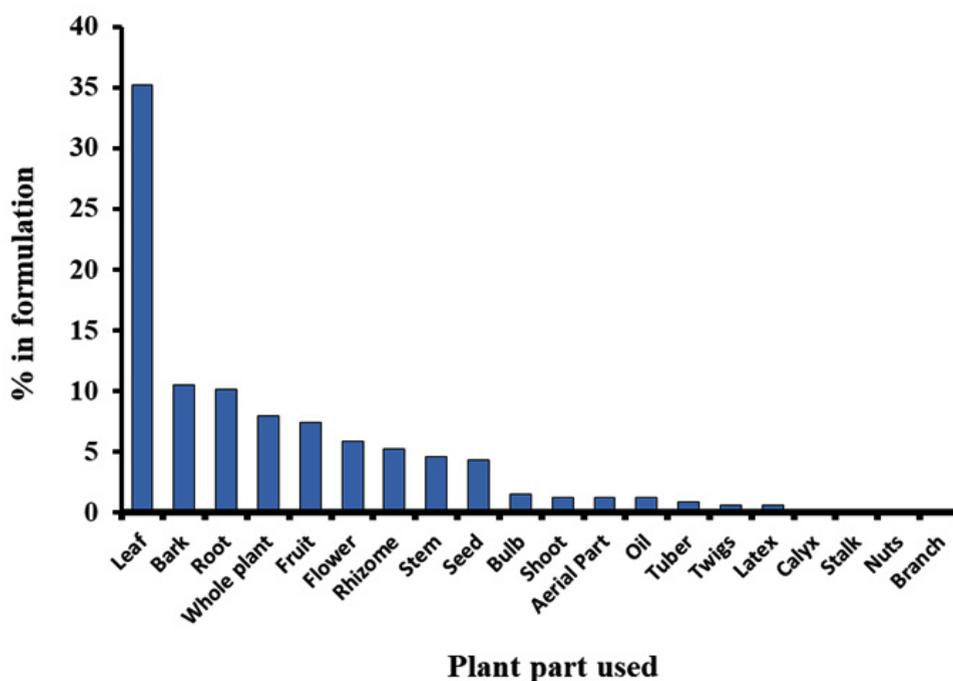


Fig. 8. Bar graph showing the plant parts used in herbal formulations (in percentage)

fermented foods prepared by these communities also ameliorate digestibility, detoxification, and overall nutrition content which in turn is human health beneficial.⁴³ Thus, ethno-medicinal study indeed paves the way for developing traditional as well as modern drugs for the welfare of the human society.

CONCLUSION

The present study is significant in the sense that it emphasizes on the ethno-medicinal utilization of most of the recorded plant species that have an important role in providing primary health care to the community. As all the prescribed plant species in the formulations possess scientifically validated therapeutic properties, the usage of these species in treating human disorders have been successfully justified. Total documentation of the medicinal plants used by these tea tribes is far from complete. Furthermore authentic scientific validation of the claims of these tribes may lead to the development of herbal drugs. Commercialization of these drugs in turn will bring about benefit sharing with the tea tribes/traditional healers. Henceforth extrapolative comprehensive and exploratory scientific studies need to be undertaken for understanding the complete picture.

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Conflict of Interest

The authors do not have any conflict of interest.

Data Availability Statement

This statement does not apply to this article.

Ethics Statement

As no experimental work was associated with the work, ethical permission is not required.

Informed Consent Statement

Consent was taken from the respondents for carrying out the study involving surveying and documentation.

Clinical Trial Registration

This research does not involve any clinical trials.

Permission to reproduce material from other sources

Not applicable.

Author Contributions

Manas Das: Conceptualization, Resources, Supervision, Methodology; Aashis Dutta: Data curation, Formal analysis, Methodology, Writing-original draft;

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