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Documentation of filamentous green algae (*Soh-Pailen*) used in ethnic medicine to relief pain associated with burns: A slowly eroding ethnomedicinal practice by the *Khasi* tribal communities of Meghalaya, India

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Abstract
The present study aim to shed some light on a unique ethno-based knowledge involving the use of filamentous green algae to relief pains associated with first degree burns practised by the *Khasi* tribal communities in the State of Meghalaya. This investigative study also focused on the documentation and identification of these algal species that were being used for the aforementioned purpose. Algal species belonging to three phyla *viz*., Charophyta, Chlorophyta and Ochrophyta were identified photographed and documented accordingly in this study. It has been found that *Spirogyra* with 9 recorded species which belongs to the phylum Charophyta and the family Zygnematophyceae was the most widely utilized algal genera for relieving pains associated with burns.

Keywords: filamentous green algae, burns, ethnomedicine, Meghalaya, *Khasi*

Introduction

Meghalaya, popularly known as "the abode of clouds", is one of the north-eastern states of India which is geographically located between 25°05' N and 26°10' N latitude and 89°47' E and 92°47' E longitude and spread over an area of 22,429 sq km. The state is one of the richest biodiversity provinces in the country which is bordered in the north and northeast by the Indian state of Assam and in the south and southwest by the country Banladesh. The tribal inhabitants of the state of Meghalaya were mostly Tibeto-Burman (*Garos*) or Mon-Khmer (*Khasis*) in origin. In a vast country like India with many caste systems, cultures, religion, ethnic tribal communities etc., the *Khasis* are the only social communities that speak a *Mon-Khmer* language [1]. The State is well known for its scenic beauty, breathe taking terrains, numerous water falls, rich biodiversity, beautiful rivers and countless tourist spots which attract thousands of nature's lovers throughout the year [2]. It comprises of 11 districts *viz*., East Khasi Hills, West Khasi Hills, South West Khasi Hills, Ri-Bhoi, East Jaintia Hills, West Jaintia Hills District, South Garo Hills, South West Garo Hills, North Garo Hills, West Garo Hills and East Garo Hills District. The total estimated population of Meghalaya is about 2,357,510 with a population density of around 104 individuals per sq km [3]. The study areas i.e. East Khasi Hills District, West Khasi Hills District and South West Khasi Hills District are mainly occupied by inhabitants belonging to the *Khasi* tribal groups/communities.

"Ethnomedicine" is a word that is being used in modern days as a synonym for traditional medicines or medicinal practices used by indigenous tribal people to cure ailments and diseases of various kinds [4]. The used of traditional medicines to cure illness, ailments and diseases of numerous kinds is frequently being used all over the globe [5]. Knowledge of traditional systems of medicines and medicinal practices has emerged all over the world in the current century under different ethnic and cultural conditions both in written as well as in oral pharmacopoeias [6]. Plants natural resources and forest based products of plant origin has been used since time immemorial in traditional system of medicines to cure various illnesses. In Meghalaya, the exploration and documentation of plant based ethnomedicines supposedly utilized by different tribal groups belonging to different ethnic communities was done by many authors [7, 11]. However, the used of algae in ethnic systems of medicines so far has not been reported. This study is the first report of an ethnomedicinal practice involving the use of filamentous green algae by the tribal inhabitants from the north-eastern region of India traditionally contributed by the *Khasi* tribes in the state of Meghalaya.

The influence of improved modern lifestyles, industrial and social media technologies, social developments and the emergence of modern improved clinical drugs to cure ailments has led to a rapid transformation of the tribal way of life into a more modern approach. All these changes that the 21st century brought on humanity has led to the loss of traditional knowledge and practices among younger generations in tribal communities. This is evident from the fact that very few traditional healers and community elders practiced traditional medicines and the art of traditional healing while the younger generations of these tribal communities lacks or are confined to only a very limited amount of traditional knowledge of natural medicinal products to cure local illnesses [12]. These transformational changes that are accompanied by the loss of tribal knowledge should be highly discouraged and younger folks in modern tribal societies should be made aware of the importance of such knowledge for future references and possible uses [13]. Therefore, owing to all these threats that modern days tribal communities faced, it became absolutely necessary to document all indigenous practices of ethnic tribal communities not only in India but all over the world.

This study is one such attempt to preserve, collect and document knowledge of the used of algae by the tribal healers and local inhabitants in three districts of the state of Meghalaya in India with an aim to conserve this knowledge for future references.

Materials and Methods

An ethnobotanical study was conducted in remote localities of East Khasi Hills, West Khasi Hills and South West Khasi Hills Districts of Meghalaya during a period from August 2020 to April 2021 (Figure 1). Through survey and interview with the local inhabitants of these three districts who possessed this unique traditional knowledge, the ethno-medicinal information about several filamentous algal genera (*soh-pailen*) primarily used in first degree (1°) burn were recorded. The inhabitants includes traditional medical healers, aged people (>30 and 90+), and people who were willing to share this traditional knowledge, acquired by virtue of ancestral knowledge or past experiences all of which permanently resides in these study areas. The algal sample identified by traditional informants to be used in ethnic medicines to relief pains associated with burns were collected and were preserved in 4% formaldehyde solution and brought to the laboratory for further study. Algal sample were observed under a trinocular microscope and photographed (using Delphi-X observer series microscope). Taxonomic classifications up to species level were carried out with the help of standard books and monographs [14, 20]. Taxonomy was updated using the online database, Algae Base [World-wide electronic publication (www.algaebase. org)] [21].

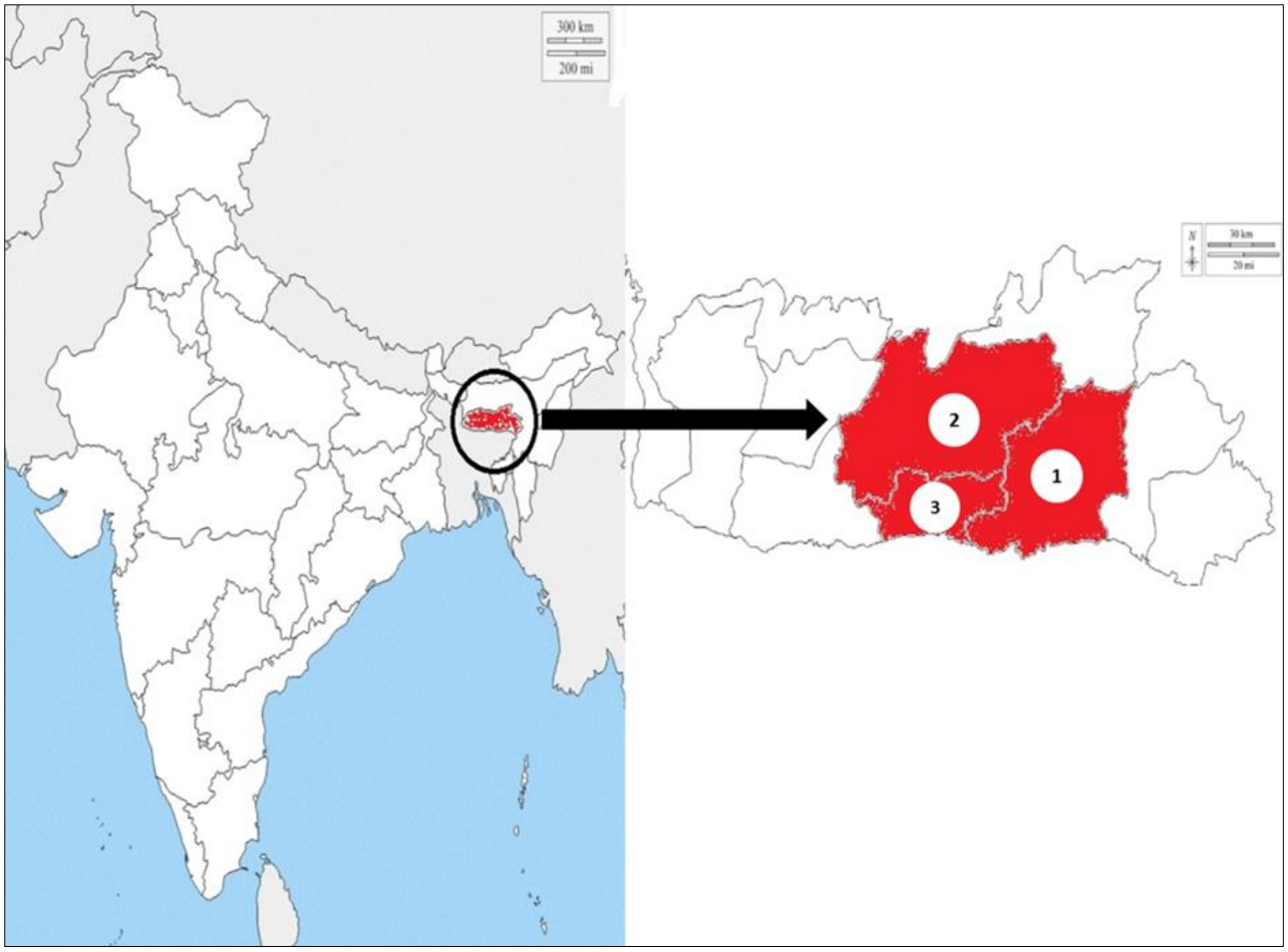

Fig 1: Geographical location of the study sites: 1: East Khasi Hills District; 2: West Khasi Hills District; 3: South West Khasi Hills District.

Results and Discussion

Filamentous algal biomass containing mixtures of various algal species (discussed below) are taken in bulk from running streams. The algal biomass is squeezed to remove excess water. The wet/moistened biomass was then laid on top of any first degree burn areas of the skin. This ethno medicinal practice provided relief to burning sensation and act as a pain reliever.

A total of 565 informants belonging to 231 households were interviewed during the course of this investigation. Of these, 380 were male informants and 185 were female informants respectively. The highest number of traditional respondents belongs to the 30-40 age groups with 156 numbers of informants while only 8 respondents were interviewed from the 90 and above age groups category (Table 1, Figure 2). The medicinal filamentous algae recorded during this study are listed below according to their algal groups (Table 2). It is to be noted that all the filamentous algae that were identified in this study have the same vernacular name (i.e. *soh-pailen*) and were used for the same purpose in ethnic medicines (i.e. to relief pain associated with burn).

From this study, 3 algal phyla *viz*., Charophyta, Chlorophyta and Ochrophyta had been recorded to be used by the Khasi tribal communities in Meghalaya as natural relievers of first degree burns. Phylum Charophyta is represented by 18 number of algal

species belonging to 3 families *viz*., Desmidiaceae (6 species), Klebsormidiaceae (1 species) and Zygnematophyceae (11 species) respectively. Similarly, phylum Chlorophyta is represented by 7 algal species belonging to 4 families *viz*., Chaetophoraceae (2 Species), Microsporaceae (2 species), Oedogoniaceae (1 species), Cladophoraceae (1 species) and Ulothricaceae (1 species) while phylum Ochrophyta is represented by only one species belonging to the family Tribonemataceae (Table 2, Figure 3-6). It has also been found through this study that even though these filamentous algae were used as some sort of pain relievers, they were never belief to cure the cause of the pain (i.e. burns) but rather to simply ease it which is then often followed by the used of other plants for the healing purposes immediately after the burning sensation/pain stopped. Interestingly enough, filamentous algae seem to be the first options for these tribal inhabitants in every case of a first degree burns. Ethnic system of medicines and traditional healing practices plays a very important role in the primary healthcare status of individuals in tribal communities living in inaccessible places around the globe with no real access to modern health care facilities and medicines [22]. This knowledge of using natural resources to cure ailments enabled these tribal groups to prepare crude medicinal extracts that could cure various illnesses. It is a well document fact that a sizable proportion of the human race still performs and practiced the art of using tribal medicinal knowledge and herbal healing belief to cure local ailments all over the world [23]. Ethnic medicinal systems and traditional knowledge of herbal remedies Often based on age old beliefs and ideas are hot topics of debates among the scientific communities in the 21st century. This is because of the fact that these traditional knowledge and ideas formed the core of many scientific researches in modern days and has led to the detection, identification, extraction and commercialization of numerous novel chemical constituents that are useful in the manufacturing of potential life-saving drugs [24, 28]. Despite all these potentials that tribal knowledge could offer to the scientific community and the world as such, very little information is available on this regard. Therefore, it is an urgent requirement that such ethnic botanical knowledge and information that are embraced and practiced by countless tribal communities around the world be properly and thoroughly documented [29, 30].

Table 1: Age and gender distribution of 565 traditional Informants.

Age Group	Gender		Total respondents	Percentage (%)
	Male	Female		
30-40	98	58	156	27.61
41-50	82	47	129	22.83
51-60	80	26	106	18.76
61-70	64	22	86	15.22
71-80	42	18	60	10.62
81-90	11	9	20	3.54
90>	3	5	8	1.42
Total	380	185	565	100

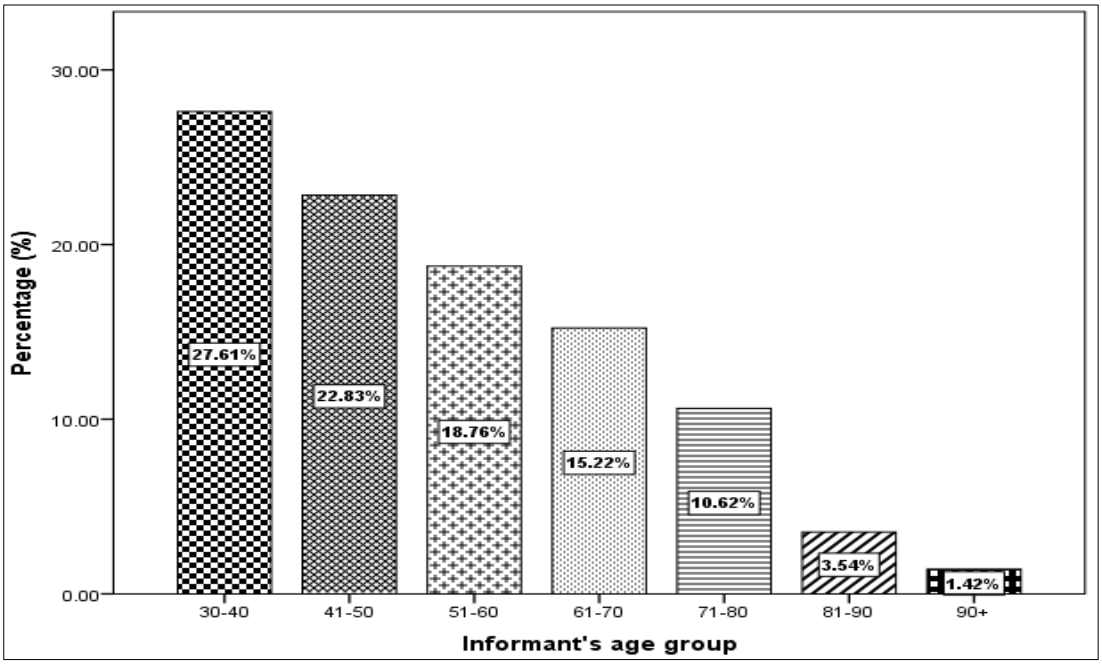

Fig 2: Percentage distributions of traditional informants on the basis of different age groups.

Table 2: List of algal species on the basis of their phyla and taxonomical orders

Sl No.	Charophyta			Chlorophyta					Ochrophyta
	Desmidiales	Klebsormidiales	Zygnematales	Chaetophorales	Sphaeropleales	Cladophorales	Oedogoniales	Ulothricales	Tribonematales
1	*Bambusina brebisonii* Kützing ex Kützing	*Klebsormidium flaccidum* (Kützing) P.C.Silva,	*Mougeotia scalaris* Hassall	*Chaetophora elegans* (Roth) C.Agardh	*Microspora pachyderma* (Wille) Lagerheim	*Cladophora glomerata* (Linnaeus) Kützing	*Oedogonium anomalum* Hirn	*Ulothrix cylindrica* Prescott	*Tribonema aequale* Pascher

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2	*Desmidium baileyi* (Ralfs) Nordstedt	-	*Spirogyra crassa* (Kützing) Kützing	*Stigeoclonium subsecundum* (Kützing) Kützing	*Microspora willeana* Lagerheim	-	-	-	-
3	*Desmidium swartzii* C.Agardh ex Ralfs	-	*Spirogyra flavescents*(Hassall) Kützing	-	-	-	-	-	-
4	*Hyalotheca dessiliens* Brébisson ex Ralfs	-	*Spirogyra fluviatilis* Hilse	-	-	-	-	-	-
5	*Hyalotheca mucosa* Ralfs	-	*Spirogyra fuellebornei* Hilse	-	-	-	-	-	-
6	*Spondylosium planum* (Wolle) West & G.S.West	-	*Spirogyra hyalina* Cleve	-	-	-	-	-	-
7	-	-	*Spirogyra lutetiana* Petit	-	-	-	-	-	-
8	-	-	*Spirogyra mirabilis* (Hassall) Kützing	-	-	-	-	-	-
9	-	-	*Spirogyra poticalis* (O.F.Müller) Dumortier	-	-	-	-	-	-
10	-	-	*Spirogyra pseudomaxima* Kadlubowska	-	-	-	-	-	-
11	-	-	*Zygnema pectinatum* (Vaucher) C.Agardh	-	-	-	-	-	-

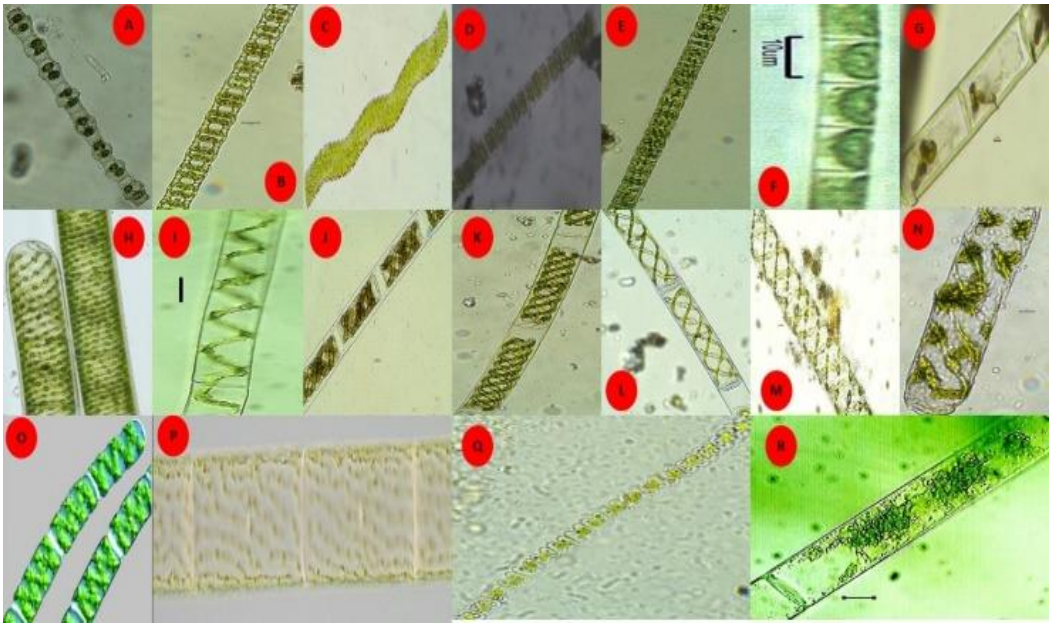

Fig 3: Filamentous algae belonging to the Phylum Charophyta: A:*Bambussina brebissioni*; B: *Desmidium baileyi*; C: *Desmidium swartzii*; D: *Hyalotheca dessiliens*; E: *Hyalotheca mucosa*; F: *Klebsormidium flaccidum*; G: *Mougeotia scalaris*; H: *Spirogyra crassa*; I: *Spirogyra flavescens*; J: *Spirogyra fluviatilis*; K: *Spirogyra fuellebornei*; L: *Spirogyra hyalina*; M: *Spirogyra lutetiana*; N: *Spirogyra mirabilis*; O: *Spirogyra porticalis*; P: *Spirogyra pseudomaxima*; Q: *Spondylosium planum*; R: *Zygnema pectinatum*.

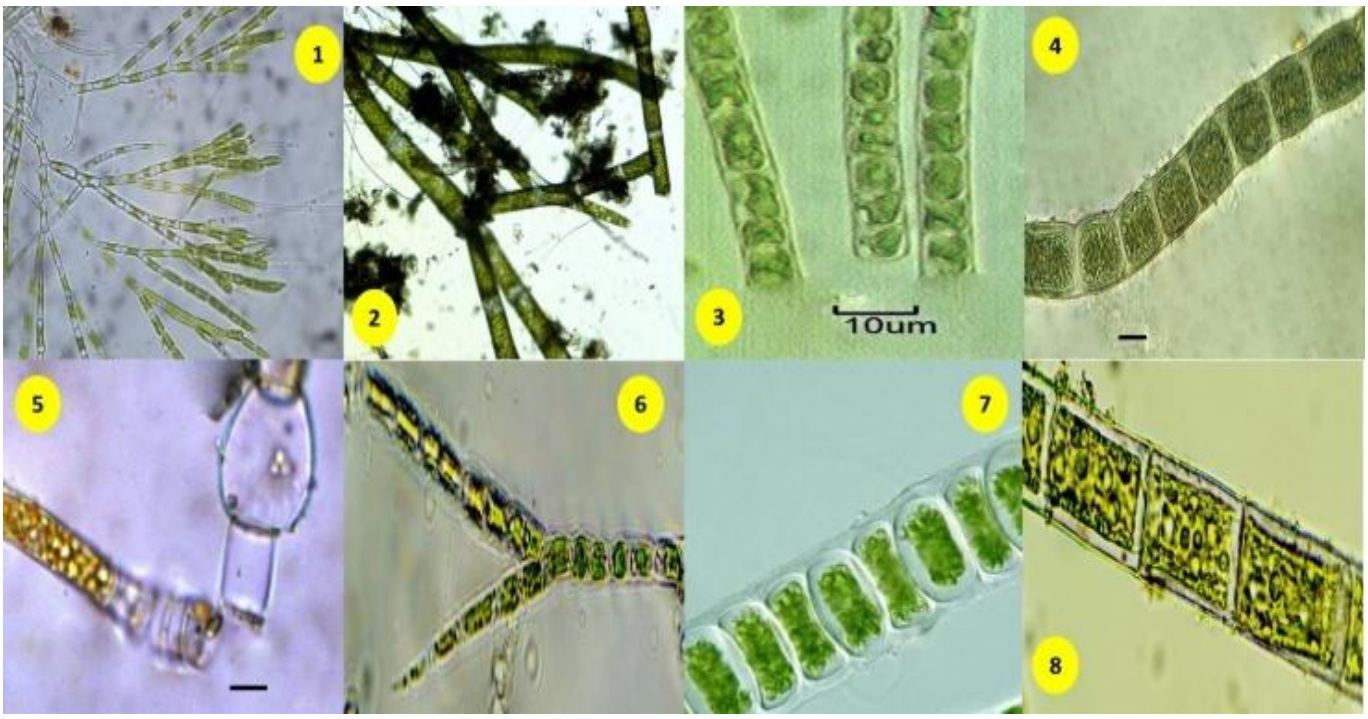

Fig 4: Filamentous algae belonging to the Phylum Chlorophyta (1-7) and Ochrophyta (8): 1:*Chaetophora elegans*; 2: *Cladophora glomerata*; 3: *Microspora pachyderma*; 4: *Microspora willeana*; 5: *Oedogonium anomalum*; 6: *Stigeoclonium subsecundum*; 7: *Ulothrix cylindrica*; 8: *Tribonema aequale*.

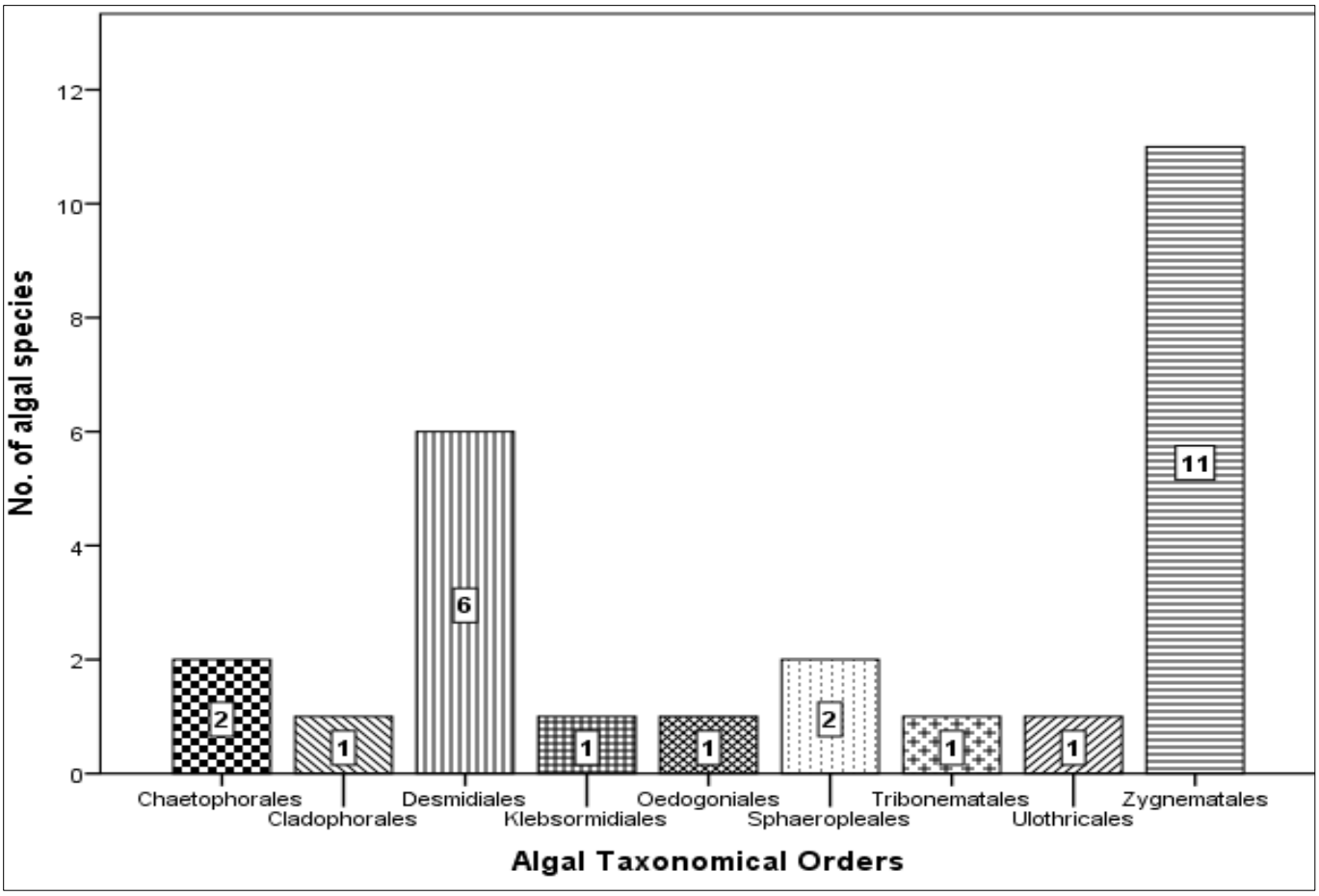

Fig 5: Showing numbers of algal species belonging to taxonomical orders.

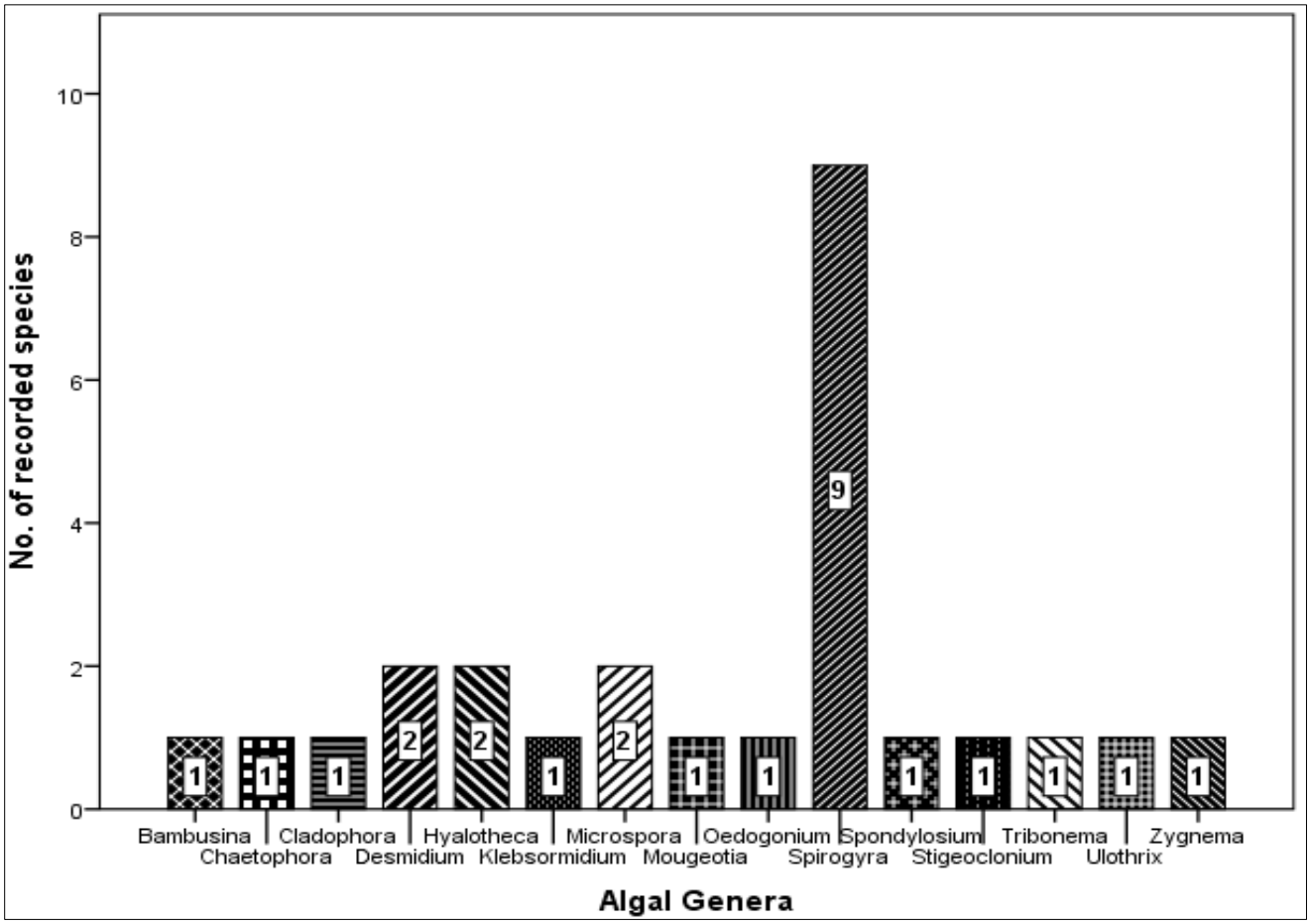

Fig 6: Showing number of species belonging to algal genera.

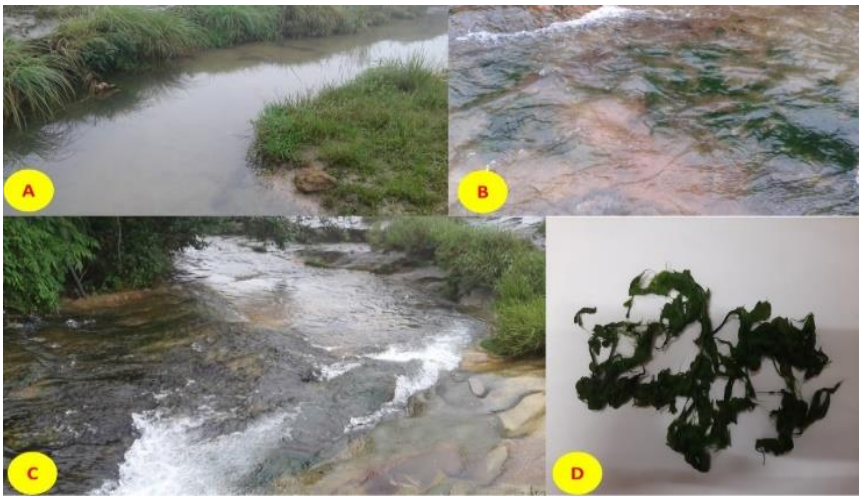

Fig 7: Some photographs of filamentous algae from the study sites A, B, C: Filamentous algal biomass in their natural habitat D: Wet biomass of algae used for 1st degree burn.

Conclusion

From thus study, it may be concluded that such ethnomedicinal information could contribute significantly in the preservation of indigenous knowledge and practices of the use of medicinal plants. Further, since this is the first record from the north-eastern region of India on the use of algal flora in ethnomedicine contributed by the *Khasi* tribal inhabitants in the state of Meghalaya, it may be argue that such study could also help unearth other unique and potentially useful traditional practises that were once extensively used in this region and elsewhere in the world.

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