Anti-inflammatory plants used by the *Khamti* tribe of Lohit district in eastern Arunachal Pradesh, India

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Abstract

The pristine forest of Lohit valley, about 500 km journey towards east from Arunachal's capital city Itanagar fall within Indo-Burma Biodiversity Hotspot is mainly characterized by its rich wealth of medicinal plant diversity. This valuable medicinal plant wealth in wilderness is mostly guarded by the traditional wisdom of four ethnic communities inhabited in the valley such as *Tai Khamti*, *Singpho*, *Mishmi* and *Chakma*. The *Tai Khamtis* are originally belonging to the Royal Tai family of Southeast Asia and have acquired a high degree of knowledge on herbal medicines in comparison to rest of areas in the valley. The present paper contains 26 species of plants exclusively based on first hand ethnobotanical field reports and have been critically screened out as anti-inflammatory and wound healing agents.

Keywords: Anti-inflammatory plants, wound healing agents, Arunachal Pradesh, Biodiversity, *Tai Khamti*, *Singpho*, *Mishmi* and *Chakma* tribe.

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Introduction

The healing powers of traditional herbal medicines have been realized since antiquities. About 34% of all pharmaceutical preparations come from higher plants and it goes to 60% when bacteria and fungi origins are taken into account[1]. About 65% of the world population have access to local medicinal plant knowledge system while 70% of rural population struggling to access and afford modern allopathic medicines[2, 3]. India has an officially recorded list of 45,000 plant species and a various estimation have put the list of 7500 species of medicinal plants growing in its 16 agroclimatic zones under 63.7 million hectares of forest coverage[4]. Such diversity could open up enough scope to compete the global market of medicinal plants but current market performance of Indian medicinal plant sector in global level is only US$1.1 billion whereas China with a lesser floral wealth has a global market share of US$ 5 billion against the total global figure of US$ 62 billion[5]. The state of Arunachal Pradesh alone with 5000 species of angiosperms has also a recorded number of 500 species of important ethnomedicinal plants used by its culturally diverse 28 major tribes and 110 different sub-tribes which could be even more if all inaccessible areas are thoroughly explored[6, 7]. The forest of Arunachal Pradesh comprises of all the characteristic vegetation types of the country which favours the luxuriant growth of different types of flora and fauna in its different phytogeographic and agroclimatic zones[8].

Perusal of literature on plants exhibiting anti-inflammatory activity reveals that species of 96 genera belonging to 56 families have exhibited such potential[9-12]. Keeping in view the growing significance of anti-inflammatory related herbal medicines in global market, the present ethnobotanical study has been carried out in order to document such plants used by the *Khamti* tribe of Lohit valley in herbal formulation. The ethnobotanical information of most of the tribes in Arunachal Pradesh was reported by the earlier workers of the region[6, 13-23]. Taxonomic studies were done earlier in adjoining region of Assam by Hooker, Kanjilal *et al* and Kirtikar & Basu[24-26]. Though, the biodiversity of this region was highlighted by various workers, in the recent past such tribe specific ethnobotanical works emphasised on anti-inflammatory plants have not been documented so far[27]. The earlier botanical record available till date is only that of the first botanical expedition of Mishmi hills and Lohit valley by Kingdon Ward[28-29] however, his work was basically a taxonomic study.

Study Sites

Forest Status, Demography and Climatology

The present ethnobotanical survey was carried out in 7 villages of Namsai Reserve Forest (5409.9 sq. km.) of Lohit district in eastern Arunachal Pradesh to explore its hidden botanical wealth guided by the traditional wisdom of the *Khamti*

tribe. The area falls within a geographical tract of 96°13' and 96°50' E and 27°49' and 27°53'N[Ref.30]. Majority of the tribal communities are *Khamtis* with a total number of 24,723 persons out of its 38,217 scheduled tribe population found in the area[31, 32]. They are mostly the followers of Theravada sect of Buddhism and influenced by Buddhist ethics and morality. Other tribes found in the study area are *Singpho*, *Mishmi*, *Chakma* and migrated population from Assam residing in Mahadevpur Circle near the border of Tinsukia district of Assam. *Khamtis* practices both wet rice and *jhum* agriculture as major occupation besides fishing and hunting. They have acquired a rich repository of traditional knowledge on herbal medicines and some of their herbal formulations are sold by their local herbal vendor at Tinsukia district of Assam. Forests are mostly sub-tropical semi-evergreen type where no single species are dominant. The forest wilderness is further enhanced by the heavy showering of monsoon rainfall (750 to 800mm) during July and August with a relative humidity of 80%. Maximum temperature recorded was 25°C and 35°C during winter and summer, respectively[31, 32]. Such climatic factors have contributed to the luxuriant growth of different forest crops and proliferation of biodiversity wealth in this region.

Materials and Methods

Survey of Anti-inflammatory Plants

During present study assistance was taken from the Divisional Forest Officer, Namsai and district Statistical officer of Lohit district, Tezu for all necessary data of forest area, climate and total population prior to our ethnobotanical collection[30,31]. The survey of ethnomedicinal plants used as anti-inflammatory agent were conducted during 2003-05 in 7 villages namely Chongkam, Nalung, Pankaw, Gunanagar, Momong, Darsuk and Lathoa guided by 10 herbal practitioners (5 male and 2 female herbalist) in Namsai Reserve Forest. The field methods of Jain and Rao[33] were followed during the course of ethnobotanical field survey. To ensure the proper authentication of first hand field data collected in first field tour, extensive and repeated field surveys were made within a selected villages of *Khamti* dominated forest and their mode of herbal preparation were recorded. The individual interview with traditional herbalists was supplemented by group interviews for comparative statement to avoid proxy information that might surface during personal interviews. The taxonomic identification of the collected plant specimens was done with the help of scientists at Botanical Survey of India, Arunachal Field Station, Itanagar; and taxonomic descriptions, botanical names and their authorities were compared with standard Indian Flora. The herbarium samples of pteridophytes and angiosperm were deposited in the Herbarium of Department of Botany, Rajiv Gandhi University, Itanagar for future reference. The methods of herbal formulations reported here are based on informant reports which are being presented in Table 1.

Table 1 : Anti-inflammatory plants used by the *Khamti* tribe of Lohit valley forest in eastern Arunachal Pradesh

S. No.	Botanical/Family Name/ Ecological status	Local Name	Parts Used	Herbal formulation and dosage
1	**ALGAE** ***Batrachospermum atrum* (Huds.)Harvey** (Rhodophyceae) Aqa/Fw/T/ST/Tm/C	*Langmai*	Whole plant	About 300g of sample collected from running stream bed are applied on burnt skin caused by fire and hot water.
2.	***Chlorella vulgaris* Beijerinck** (Chlorophyceae) Aqa/Fw/T/ST/Tm/C	*Suansok*	Whole plant	About 20g of small green algae is collected from smooth rock surface near streams and quickly applied over burnt skin caused by fire and hot water.
3.	**BRYOPHYTES** ***Marchantia palmata* Nees** (Marchantiaceae) Liv/S/ST/Tm/C	*Matakain*	Whole plant	Fleshy leaf paste is directly applied during acute inflammation caused by the touch of fire and hot water.
4.	***Marchantia polymorpha* Linn.** (Marchantiaceae) M/S/ST/Tm/C	*Matakain nung*	Whole plant	The juice is used in relieving inflammation on skin and eruption of pimples on face and body. The other uses are same as of ***M. palmata***.

S. No.	Botanical/Family Name/ Ecological status	Local Name	Parts Used	Herbal formulation and dosage
	PTERIDOPHYTES			
5.	***Blechnum orientale* (Linn.) Holtt.** (Blechnaceae) H/T/ST/Tm/R	*Kalasana*	Young shoot	Paste of young frond and underground rhizome are mixed with a dried powder of ***Zingiber officinale* Rosc.** and applied over freshly cut wound to cure pain and to stop bleeding.
6.	***Lycopodium clavatum* Linn.** (Lycopodiaceae) Mos/S/ST/Tm/C	*Luanha*	Young shoot	The young shoot is sun dried and crushed into fine powder. It is then mixed with powdered seeds of ***Sesamum indicum* Linn.** and used for body massaging during muscle pain and tiredness.
	ANGIOSPERMS			
7.	***Ageratum conyzoides* Linn.** (Asteraceae) H/T/ST/Tm/C	*Padribha*	Leaf	Juice is mixed with resin of ***Ficus villosa* Blume** and applied on fire burnt skin. About 500g of crushed leaves are tied over knee joint to cure rheumatic arthritis. Fresh juice extract is applied on freshly cut wound.
8.	***Alpinia galanga* (Linn.) Willd.** (Zingiberaceae) H/T/ST/Tm/C	*King Pang*	Rhizome	About 200g fresh paste of rhizome is mixed with young leaf (<30g) paste of ***Euphorbia neriifolia* Linn.** and applied in localized inflammation and skin allergy caused by insect bites or microbes.
9.	***Artemisia nilagirica* (C. B. Clarke) Pamp.** (Asteraceae) Sr/T/ST/Tm/C	*Makampi*	Leaf	Fresh paste is applied over swelling, boil, eruption and old wound to prevent microbial infection. Fresh juice is spread over joint and muscle to relieve pain.
10.	***Blumea fistulosa* (Roxb.) Kurz** (Asteraceae) H/T/ST/Tm/C	*Yanang hak*	Leaf	About 100g leaves are squeezed and extracted juice is applied over affected portion of skin to reduce swelling caused by the poisonous sting of wasp.
11.	***Bombax ceiba* Linn.** (Bombacaceae) Tr/T/ST/Tm/C	*Simul*	Bark	About 400g paste of fresh bark is mixed with cow dung and spread over back muscle of leg during feeling of hotness and inflammation at night hour.
12.	***Canarium strictum* Roxb.** (Burseraceae) Tr/T/ST/Tm/R	*Duna*	Latex	Fresh resins are melted and applied on skin affected by poisonous brown hairs of caterpillar larvae.
13.	***Coleus blumei* Benth.** (Lamiaceae) H/T/ST/Tm/C	*Myamuksi*	Leaf/Stem	Fresh juice is mixed with the juice of raw Citrus fruits and applied over the skin during scorpion bite.
14.	***Commelina benghalensis* Linn.** (Commelinaceae) H/T/ST/Tm/C	*Sukbon*	Leaf/Stem	About 1kg of fresh leaves paste is grinded with powdered leaves (200g) of ***Mentha piperita* Linn.** The prepared paste is spread over whole body to relieve body hotness and back pain.
15.	***Curcuma caesia* Roxb.** (Zingiberaceae) H/T/ST/R	*Homen*	Rhizome	The paste of fresh rhizome is applied during snake and scorpion bite. The dried powder is mixed with powdered seeds of ***Andrographis paniculata* Wall. ex Nees** and applied during insect and snake bite.

S. No.	Botanical/Family Name/ Ecological status	Local Name	Parts Used	Herbal formulation and dosage
16.	***Eria pannea* Lindl.** (Orchidaceae) EH/T/ ST/Tm/R	*Seppu*	Leaf	About 300g of fresh leaf paste is applied over dislocated portion of joint to relieve pain, swelling, dislocation and fracture.
17.	***Euphorbia neriifolia* Linn.** (Euphorbiaceae) Sr/T/ST/C/ENR	*Sepak*	Leaf/Stem	About 300g of fresh leaves and thinly sliced fleshy stem are crushed with leaves of ***Hemidesmus indicus* R.Br.** and applied during joint pain and fractured/dislocated bone.
18.	***Hedychium coccineum* Buch.-Ham. ex Smith** (Zingiberaceae) Sr/T/ST/Tm/R	*Mansila*	Rhizome	About 600g of rhizome paste is applied over swollen foot caused by some unknown agent.
19.	***Hemerocallis fulva* Linn.** (Liliaceae) H/T/ST/Tm/R/Cult.	*Kuankai*	Rhizome	The paste of rhizome is applied on fire burn skin. The powdered rhizome is mixed with cooled water and taken during feeling of hotness in chest and stomach.
20.	***Jatropha curcas* Linn.** (Euphorbiaceae) Sr/T/ST/Tm/C	*Randgula*	Leaf/Bark	Juice of leaves is applied on itched and blistered skin. About 700g paste of the fresh bark is applied over whole body during muscle pain and inflammation.
21.	***Kalanchoe pinnata* (Lam.) Pers.** (Crassulaceae) H/T/ST/Tm/C	*Hurroreshia*	Leaf/Stem	About 200g of crushed leaves and stems are applied on burnt skin caused by fire and hot water. The fresh juice is also taken directly during sensational urination.
22.	***Ocimum sanctum* Linn.** (Lamiaceae) H/T/ST/Tm/C	*Tulosi*	Leaf	Fresh juice of leaves is dropped into eyes during eye pain caused by germ infection. The paste is applied on freshly cut wound to enhance the process of healing.
23.	***Ricinus communis* Linn.** (Euphorbiaceae) Sr/T/ST/Tm/C	*Kunkaw*	Leaf/Seed	The fresh leaves are warmed up on the burning flame and spread over whole body to relieve body pain, inflammation/localized swelling. The paste of raw seeds is applied on swollen foot.
24.	***Stephania glandulifera* Miers.** (Menispermaceae) Cl/T/ST/Tm/C	*Bhimraj*	Tuber	The paste of tuber is applied over knee joint during rheumatic arthritis. Fresh juice of tuber is applied on inflamed skin caused by the accidental touch of chilly in old wound.
25.	***Sterculia villosa* Roxb. & G. Don** (Sterculiaceae) Tr/T/ST/C	*Iswarai*	Root bark	A mixture of powdered root bark and leaves of ***Clerodendrum thomsoniae* Balf.** are applied between the finger tip and nail to relieve pain and inflammation caused by sudden pricking of thorn or metallic objects.
26.	***Xanthium indicum* (Linn.) Koenig** (Euphorbiaceae) H/T/ST/Tm/C	*Changruk*	Leaf	The juice of fleshy young stem is spreaded on strained part of muscle for 3-4 times per day to reduce pain and to enhance internal healing of injured muscle tissues.

Abbreviations: Aqa = Aquatic; AqH = Aquatic herb; C = Common; Cl = Climber; Cult = Cultivated; EH = Epiphytic herb; ENR = Endangered; ESr = Epiphytic shrub; FW = Freshwater; H = Herb; Liv = Liverworths; Mos = Mosses; R = Rare; Sr = Shrub; ST = Subtropical; T = Tropical; Tm = Temperate; Tr = Tree.

Kalanchoe pinnata

Hemerocallis fulva

Curcuma caesia flowers

Curcuma caesia plant

Blechnum orientale

Stephania glandulifera

Results and Discussion

The present ethnomedicinal survey revealed that 26 plant species belonging to 17 families and 25 genera are widely used as anti-inflammatory agents. Two species each of bryophytes, algae and pteridophytes have also been included. The species reported are used to heal pain and inflammation such as rheumatic swelling, cut wound, accidental bone fracture, boil eruption, thorn penetration, insect bites, wasp sting and burn by fire and hot water. On analysis of plant parts used, it is found that leaves of twelve species; underground parts of six species; young shoot of two species; bark of three species; stem of four species; and whole parts of four species are used for various purposes. On the basis of species habit, 12 species used are found to be herbs, 5 species are shrubs, 1 climber and 2 species of trees. A majority of the *Khamtis* herbal medicines are used either in paste, crude juice or sometime in dry powder form.

Furthermore, our shrewd analysis also revealed that the *Khamtis* are health conscious and rich repository of traditional herbal based bio-cultural knowledge. Both male and female folk have a competent knowledge on village medicobotany and herbal formulation for treating various ailments of their respective locality. Among the most widely used anti-inflammatory agent and easily grown species are: ***Alpinia galanga*** **(Linn.) Willd.**, ***Commelina benghalensis*** **Linn.**, ***Hedychium coccineum*** **Buch.-Ham. ex Smith,** ***Hemerocallis fulva*** **Linn.**, ***Jatropha curcas*** **Linn.**, ***Kalanchoe pinnata*** **(Lam.) Pers.**, ***Ocimum sanctum*** **Linn.** and ***Ricinus communis*** **Linn.** These species are found to be of cost effective and they can be cultivated easily in any soil conditions since they can retain high moisture content in their cells for a longer period which can tolerate dry and hot sunny weather. Such species are widely grown in their small home garden, which also serves ornamental and fencing purposes (e.g. ***Jatropha curcas***) apart from meeting their medicinal needs.

Some rare species of lower plants such as ***Blechnum orientale*** **Linn.** and ***Lycopodium clavatum*** **Linn.** (Pteridophytes) are also grown in shade habitat near their home which are difficult to get immediately from the wild. Two species of ***Marchantia*** (Bryophyte) and 2 species of freshwater algae (***Chlorella*** and ***Batrachospermum*** **Roth**) are only used by the villagers of most interior locality like Darsuk, Pankaw and 8th miles areas that are located near running streams and natural ponds with rich forest. They use such species during acute skin inflammation caused by the touch of fire and hot water. Since, inflammation caused by fire and hot water need immediate treatment as a substitute, they use the paste of ***Kalanchoe pinnata*** and ***Commelina benghalensis*** which are grown near their backyards. The leaves of ***Ricinus communis***, ***Ocimum sanctum*** and ***Hemerocallis fulva*** are widely used to treat rheumatic arthritis and muscle swelling.

In the absence of modern medical facilities in remote dense forest, and with only one pharmacy and one primary health care centre in Namsai area, *Khamtis* of Lohit valley primarily rely on herbal medicines to meet their healthcare need. Furthermore, it is evident that the states of North-East India and Arunachal Pradesh in particular, with rich plant biodiversity have not been properly explored. Subsequent exploration work could unfold many potential botanical drugs of commercial significance.

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