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An inventory of ethnobotanicals used as medicines: A case study of the Juang tribe in Gonasika Hill range of Keonjhar district in Odisha

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Abstract

The tribal individuals and ethnic races throughout the world have their own customs, traditions, religions, devout ceremonies, taboos, legends, witchcrafts, nourishments and frameworks of restorative practices. They know the utilization of wild plants for their basic needs including food, shelter, and medicine and have created a one of kind understanding of forest assets. The information of the tribal related with the conventional healing practices utilizing wild plants is quickly vanishing due to advanced healthcare system. An ethnobotanical survey in Gonasika hill range and its adjoining areas of Keonjhar district (Odisha) have revealed a wealth of traditional knowledge on medicinal plants and their uses amongst the local Juang healers. The indigenous knowledge of local traditional healers and the native plants used for medicinal purposes were collected through semi-structured questionnaire and personal interviews during the course of investigation. The investigation revealed that, the traditional healers and the inhabitants of the area use 77 species of plants distributed in 67 genera belonging to 43 families to treat various diseases. The study also revealed that fresh plant materials were invariably preferred for the disease management. Several promising medicinal plant species were found growing in their natural habitat while others are domesticated. The forest tenants as a rule collect these uncommon plants from the adjacent forest regions which are readily available and medications are arranged under the supervision of local medicine men. The present paper dealt with the ethnobotanical exploration, identification and documentation of potential medicinal plants used by the Juang tribe in Keonjhar district of Odisha. The findings of the present study will be of immense help to Pharmaceutical industries to isolate bioactive compounds and development of new drug.

Keywords: Ethnomedicines**,** Juang tribe, Gonasika hill range, Keonjhar district, Odisha

Introduction

Ethnobotany is the study of the interactions and relationships between plants and people over time and space. There have been several reports of ethnobotanical surveys in Italy [1], Western Nigeria [2, 3], Tanzania [4], China [5], Morocco [6, 7], Trinidad and Tobago [8], Eastern Cape Province, South Africa [9] of various ethnic communities regarding the use of medicinal plants for the management and treatment of diseases. Ethnomedicines have been in use in India and other parts of the world since ancient times to treat various human ailments and is still the mainstay for the most part of the developing countries. It is based on the knowledge of plants by the native people and their usefulness as understood by people of a particular ethnic community, since information concerning a particular plant varies from one ethnic group to another. According to World Health Organization (WHO) as many as 80% of the world's population depend on traditional medicine for their particular health care need. Therefore, the use of traditional medicines in various therapies by indigenous people, all over the world, cannot be overlooked. It is often noted that 25% of all drugs prescribed today come from plants. This estimate suggests that plant-derived drugs make up a significant segment of natural product based pharmaceuticals. India is a home to almost more than half of the world's tribal population. Over 84 million people belonging to 698 communities are identified as members of scheduled tribes constituting 8.2% of the total Indian population and is larger than of many other country in the world. There exist millions of herbal based traditions in the form of traditional birth attendants, vaidyas, bone setters, herbal healers, barefoot doctors, witch doctors and wondering monks to cure different ailments. Besides, there are millions of elderly men and women who have traditional knowledge on herbal household remedies. The informal system of folk medicine, which exists in these ethnic communities, is passed orally from one generation to other, for which there is little documentation. This knowledge is

mostly restricted in elder members of tribal communities.

Odisha ranks fifth among the states of India, with 7 million tribal populations, categorized under 62 notified communities. The tribal population is nearly 24% in comparison to the total population of the state and mostly restricted to rural areas. The tribes of Keonjhar district of Odisha constitute 43.88% of the total district population (as per 2001 census) and about 86.36% of these populations live in the rural areas. As per 1991 census there were 46 scheduled Tribes in the district. The principal tribes inhabiting in this district are Bathudi, Bhuyan, Bhumij, Gond, Ho, Juang, Kharwar, Kisan, Kolha, Kora, Munda, Oram, Santal, Saora, Sabar and Sounti, which constitute 96.12% of the total tribal population of the district. These forest dwellers possess vast knowledge on various aspects of plants to cure their common ailments.

The Juangs are an austro-asiatic ethnic group inhabiting in the Gonasika hill range located in Keonjhar district of Odisha and claims the place of their origin in the earth at the source of the Baitarani river [10]. They were initially hunter-gatherers and cultivated few crops. This tribal community was skilled at basket-weaving, which was in demand in nearby villages and exchanged their baskets for salt, oil, food, money from the village traders. Formerly the 'Juangs' were used to be known as *Patuas*, literally "leaf-wearers" [11]. The diversification among different tribes in the state of Odisha provides huge scope for ethnobotanical studies. From the very beginning Botanical Survey of India has carried out studies on the tribals of Odisha. A detailed work on the ethnobotanical records reveals that a good number of botanists have done extensive ethnobotanical studies in different parts of Odisha. [12-34]. However, information is very scanty on native medicinal plants used by the Juang community inhabited in and around Gonasika hill range located in Keonjhar district of Odisha. Therefore, this study has been undertaken to record less-known ethnobotanicals from the tribal communities of the area under study. The present investigation has great potentials to contribute to the sustainable livelihood of the 'Juang people' living in the Keonjhar district by ensuring access to affordable traditional medicines for common ailments. This study aims at documenting plants and plant parts used exclusively for the management of various diseases by the 'Juang' tribe in the study area.

Materials and Methods

Study area

Keonjhar, a land locked district of Odisha on its northern part and is lying between 21º 1′ N to 22º 10′ N latitude and 85º 11′ E to 86º 22′ E longitude. The district has an area of 8240 km^2 and bounded by the districts of Mayurbhanj, Balasore and Bhadrak in the east, Jajpur in the south, Dhenkanal, Angul and Sundergarh districts in the west, and Singhbhum district of Jharkhand in the north (Fig.1). A range of hills containing peaks such as Gandhamardan (3477 ft), Mankadnacha (3639 ft), Gonasi ka (3219 ft) and Thakurani (3003 ft) located on the western part is another topographic feature of the district of Keonjhar. It is a predominantly tribal district endowed with rich minerals such as iron ore, manganese and chromites apart from the luxuriant forest wealth. Half of the district nearly 4043 sq. km. is covered by forest of northern tropical moist deciduous type. The climate of the district is characterized by hot summer with high humidity. The temperature in the district begins to rise rapidly in the spring with the highest temperatures recorded in the month of May rising up to 38 °C. The weather cools during the monsoon in June and remains cool until the end of October while the temperature in the month of December reported to drop down to 7 °C. The average annual rainfall is reported to be 1910.1 mm. The Baitarani is the principal river of the district. The soil is red throughout the district with patches of black cotton soil towards south. The district is the home of as many as 55 different tribal communities including Juangs. 'Gonasika' is located in Bansapal block of Keonjhar district of Odisha (Fig.1). It is a sacred place of pilgrimage for the shrine of Lord Brahmeswar Shiva. Gonasika dominates the mountainous landscape for kilometers around, and is the source of innumerable mountain streams including the Baitarani, the Machkaadan and the Kanjhari. The Baitarani takes its rise from the southern face of the hill at a height of about 3,100 feet and flows for a short distance as a petty rivulet. The villages Gonasika, Guptaganga and Baitarani are named after the sacred spots in the course of river Baitarani. The topography of Gonasika and its surrounding areas consists of undulating surface of high hills and flat river valley.

Methodology

An ethnobotanical exploration was conducted during 2019-2020 in order to collect and document the therapeutically potential plant resources of the Gonasika hill range and its adjoining forest areas with special reference to their uses by the native Juang tribe. The data on medicinal uses of plants were collected using semi-structured questionnaire, field-observation, personal interview and group discussion with 130 (60 men and 70 women) pre-identified local tribal informants, among which 13 male and 2 female were local healers. Some knowledgeable people comprising of tribes and non-tribes in the study area were approached to reveal and locate the plants in the forest used for medicinal purposes to cure human and animal diseases. The mode of use of each plant species was documented and recorded by closely interacting with local medicine men, women and tribal healers of the Juang and other hill communities in different places of the study site. Additional information regarding doses, form in which a plant is used, whether solely used or used with other ingredients etc. were also collected. The plants with potential therapeutic claim were critically studied for their taxonomic characters and identified by using the Flora of Orissa and other available standard literatures [35-37]. Some of the frequently used medicinal plants among the tribal people of the study area are enumerated in Table-1, which are arranged with the binomials of the plants mentioned alphabetically along with their accession number, family, local names and the mode of application. The voucher specimens were preserved in the Centre of Excellence in Studies on Tribal and Marginalized Communities, Post Graduate Department of Anthropology, Utkal University, Vani Vihar, Bhubaneswar for future reference.

Results and Discussion

The results of the present study revealed 77 ethnomedicinal plant species distributed in 67 genera belonging to 43 different families that are used for the treatment of various ailments of human being as well as domestic animals. The fast-hand information on the ethnomedicinal plants used by

the major ethnic group (Juangs), were enumerated by scientific name, and followed by local name along with mode of applications (Table 1). Traditional healers are using these plants to treat diseases related to stomach disorders, rheumatism, indigestion, dysentery, diarrhoea, vomiting, diabetes, asthma, epilepsy, jaundice, gynaecological problems, nasal bleeding, skin disease including scabies, eczema, pimples, boils, whitlow & ring worm, migraine, snake bites, fever, cold & cough, toothache, wounds, burn injuries, worm infestation in children, bleeding piles, prostrate problems, stone in kidney & gall bladder, insomnia and hypertension. Herbs (43% species) were found to be the most frequently used plant forms followed by trees (31% species), climbers (13% species), liana (7% species) and shrubs (6% species) in descending order (Fig. 2). The fact that the most ethnomedicinal plants were herbs could be because the locations of the study sites are in high elevation ranges where the plant diversity especially herbs is higher than that of trees, shrubs and climbers.

In this study, members of the family Asteraceae (with 7 species) were observed to be the most commonly used plants for the treatment of various diseases, while other dominant families were Fabaceae (with 6 species), Amaranthaceae and Moraceae with 5 species each (Fig. 3). Different parts of the plants were used as medicine by the local traditional healers. Among the different plant parts, the leaves (38%) were most frequently used for the treatment of diseases followed by root (20%), bark (14%), seed (6%), rhizome (6%), flower (5%), fruit (5%), stem (5%) and tuber (1%) (Fig. 4). Considering the form of preparation, paste, powders, decoction, juices and mixtures were much recommended over infusions. Both external applications (mostly for skin diseases and wounds) and oral consumption of the preparations were prescribed in the treatment of various diseases.

Some of the widely used ethnomedicinal plants of the area under survey are *Acorus calamus*, *Aegle marmelos*, *Alternanthera paronychioides*, *Amaranthus spinosus*, *Andrographis paniculata*, *Bauhinia vahlii*, *Chenopodium album*, *Cyperus brevifolius*, *C. rotundus*, *Eclipta prostrata*, *Emilia sonchifolia*, *Heliotropium strigosum*, *Hemidesmus indicus*, *Justicia adhatoda*, *Marsilea minuta*, *Piper longum*, *Rauvolfia sepentina*, *Saraca asoca*, *Sonchus asper* and *Syzygium cumini*. Preference for the use of these plants may be related to their ready availability and efficacy. The newly reported some of the commonly used medicinal plants revealed by this study indicate that the medical ethnobotany of the Gonasika hill range is incompletely explored.

It was observed that the ethnic communities collected these medicinal plants in wild forms thereby showing that the area had poor cultivation of economically valuable medicinal plants. This situation could, in the long term, lead to the depletion of plant resources or even extinction from natural habitat if the plant specimens are used in huge amounts for medicinal and other purposes.

This study indicated that even though the accessibility of Western medicine for simple and complicated diseases is available, many people in the Gonasika region continue to depend on medicinal plants, at least for the treatment of some simple diseases like cold, cough, fever, headache, diarrhoea, dysentery, gastritis, menstrual disorders, skin infections, dental carries and worm infestation in children. Unfortunately, due to lack of interest among the younger generation as well as their tendency to migrate to urban areas for lucrative jobs, there is a possibility of losing this wealth of knowledge in the near future. Hence, it becomes necessary to acquire and preserve this valuable traditional system of medicine by proper documentation and identification of plant specimens.

Although some of the plants reported from this study area are scientifically proven for their efficacy, others have no supporting data which needs for phytochemical as well as pharmacological evaluation and confirmation. Many of the earlier literatures regarding herbal cure does not meet scientific standards, still a large number of research reports about medicinal plants does exist [38-40]. It is pertinent that some of the frequently used less known medicinal plants in the study area require further investigation for chemical analysis and identification of bioactive molecules, which may lead to the discovery of new drugs.

Table 1: List of Medicinal plants of Gonasika hill range and its adjoining area used by Juang tribe

Scientific Name, Accession No. & Family	Local Name	Ethnic Uses
Abrus precatorius L. (UU-225) [Fabaceae]	Dhala Kaincha (O) Hapamara (T)	White seeds (one) is kept in raw cow milk overnight and given to women in morning to eat at the end of menstruation cycle to prevent conception.
Abutilon indicum (L.) Sweet (UU-195) [Malvaceae]	Pedpedika (O) Taramira (T)	Stem decoction (2-3 ml) along with 1-2 g of black pepper is taken for 8 days against jaundice.
Acacia penninervis Sieber ex DC. (UU-138) [Fabaceae]	Acasia (O) Seoha (T)	Bark of *Acacia* tree is grinded and filtered with net to obtain the juice. This is taken to cure the diarrhoea.
Achyranthes aspera L. (UU-201) [Amaranthaceae]	Apamaranga (O) Toria (T)	Paste of the root is taken to cure fever. Stem juice is applied on the teeth to stop bleeding from the gum. About 20 ml of leaf juice is administered orally to the pregnant woman for easy delivery. The leaves and inflorescence are boiled and the decoction is taken twice daily to cure fever. Root or leaf paste is applied to cure boils in their early stage.
Acmella calva (DC.) Jansen (UU-116) [Asteraceae]	Biribiri (O) Morai (T)	Decoction (5 ml) of its inflorescence is taken for 7-8 days along with little with salt against toothache.
Acmella radicans (Jacq.) Jansen (UU-186) [Asteraceae]	Biribiri (O) Mullangi (T)	Whole plant is boiled in water and filtered and the filtrate is taken orally for 7 days against dysentery.
Acorus calamus L. (UU-089) [Araceae]	Bacha (O) Nipura (T)	Paste of the root is applied on forehead to cure headache. About a half teaspoonful of powder prepared from dried rhizome is

		taken twice daily for 7 days against asthma. Half teaspoonful of rhizome powder is taken in empty stomach once in morning to increase appetite. Freshly crushed rhizome is chewed for the treatment of dysentery.
Aegle marmelos (L.) Corr. (UU-125) [Rutaceae]	Bela (O) Sikuar (T)	Two or three fresh leaves are chewed daily in empty stomach to cure severe gastritis and to reduce blood sugar level. About one teaspoonful of dried leaf powder prepared from the leaves of *Aegle marmelos* and *Azadirachta indica* in equal proportion is given to reduce blood sugar level. Leaf paste is applied in the affected part to cure injuries due to burn.
Aerva lanata (L.) Juss. (UU-168) [Amaranthaceae]	Paunsia (O) Sikhini (T)	Decoction of the leaf powder mixed with decoction of leaf of *Tinospora cordifolia* given against fever caused due to dysentery.
Aganosma caryophyllata G.Don. (UU-205) [Apocynaceae]	Malati (O) Nalatiga (T)	Decoction of the root mixed with decoction of *Lygodium palmatum* in equal portion (5 ml each) is given for 7 days as a tonic against long standing fever.
Ageratum conyzoides L. (UU-289) [Asteraceae]	Vishamusthi (O) Semandulu (T)	10 g of leaf extract is given along with 5-7 leaves of *Peristrophe paniculata* to cattle against digestive disorders.
Ailanthus excelsa Roxb. (UU-137) [Simaroubaceae]	Mahala (O) Muriapachha (T)	Bark paste (50 g) mixed with 1 cup of water and kept for 15 minutes. This is strained through a clean cloth and 1 cup is taken every morning for 3 days against jaundice.
Alectra sessiliflora (Vahl) Kuntz. (UU-155) [Orobanchaceae]	Pittadanti (O) Katmouli (T)	1 teaspoon bark powder along with ½ cup of curd is taken twice a day on empty stomach (morning and evening) for 7 days against piles.
Alocasia fornicata (Kunth) Schott (UU-198) [Araceae]	Pahadi-manasaru(O) Kotal (T)	Paste of 10 g of inflorescence is tied on the affected part of the cattle to treat glandular swelling.
Alstonia scholaris (L.) R.Br. (UU-174) [Apocynaceae]	Chhatian (O) Singa (T)	1 cup of bark is crushed and boiled in 4 cups of water till it is reduced to 1 cup. This decoction is then strained, cooled and given to cattle in the morning for 3 days against intestinal worm infestation.
Alternanthera ficoidea (L.) Beauv. (UU-014) [Amaranthaceae]	Sana madaranga (O) Laba (T)	Leachate of the leaves is used in mouth wash for toothache and tender gums.
Alternanthera paronychioides St. Hill (UU-154) [Amaranthaceae]	Badi madaranga (O) Mulgia (T)	Leaf juice (10 ml) mixed with 5 drops of honey is given for kidney stone. Decoction whole plant (10 ml) is taken along with one black pepper against dysentery.
Amaranthus spinosus L. (UU-220) [Amaranthaceae]	Kanta-leutia (O) Srena (T)	Leaf juice mixed with honey is applied all over the body against skin allergy caused due to abscesses and eczema.
Amorphophallus paeoniifolius (Dennst.) Nicolson (UU-059) [Araceae]	Olua (O) Parika (T)	Rhizome extract is used to treat swellings around finger nails due to microbial infection.
Anacardium occidentale L. (UU-163) [Anacardiaceae]	Lanka-amba (O) Tarwar (T)	½ cup decoction of bark is taken once a day for 4 days against bleeding from nostril.
Andrographis paniculata (Burm.f.) Wall. ex Nees (UU-185) [Acanthaceae]	Bhuininimba (O) Kiratatikta (T)	Leaves boiled in water and the infusion is used to wash wound for fast healing. Powder of leaf is given with hot water against thread worm infestation in children. Fresh leaf paste is applied on skin to treat skin infection.
Annona squamosa L. (UU-173) [Annonaceae]	Atta (O) Katal (T)	Leaf paste mixed with mustard oil is heated and applied on knee to treat rheumatism. Leaf juice is applied on forehead to treat headache. Leaf extract is applied on the affected part of the body for treatment of eczema.
Argemone mexicana L. (UU-215) [Papaveraceae]	Kantakusuma (O) Kuhumkata (T)	Powder of the seed is cooked and applied on the body to cure scabies and eczema. Leaf extract is applied on wounds for healing.
Argyreia nervosa (Burm.f.) Boj. (UU-035) [Convolvulaceae]	Munda-nai (O) Goguli (T)	Juice obtained from the stem is used to remove pimples and boils.
Aristolochia indica L. (UU-156) [Aristolochiaceae]	Hansalata (O) Sapsan (T)	Leaf juice is used against boils and piles.
Artocarpus heterophyllus Lam. (UU-184) [Moraceae]	Panasa (O, T) Kanjira (T)	50 g of bark is crushed and kept in one cup of water for 10 minutes and the infusion is taken once in the morning against abdominal pain and vomiting.

Asparagus racemosus Willd. (UU-160) [Liliaceae]	Satabari (O) Satomuli (T)	Root powder (10 g) mixed with a cup of milk is taken for 7 days against Gynaecological disorders.
Azadirachta indica A.Juss. (UU-078) [Meliaceae]	Limba (O, T) Yepa (T)	Bark paste, leaf leachate and seed oil are used to cure skin diseases including scabies, eczema and rashes.
Bauhinia vahlii Wt. & Arn. (UU-171) [Caesalpiniaceae]	Siali (O) Fulbari (T)	Seed decoction (10 ml) is taken twice daily in empty stomach for 10-15 days to reduce sugar content in blood and urine. About 5 g of dried seed powder is taken orally along with a glass of cold water to cure diarrhoea. Leaf paste is applied externally to cure pimples on the face.
Bauhinia variegata L. (UU-213) [Caesalpiniaceae]	Kanchana (O) Kotora (T)	Bark extract is taken once for 2 days to kill worm in alimentary canal in children. 20 ml of root extract from 20 g root taken twice in a day for 7 days to treat enlargement of liver. 100 ml of leaf extract is taken three times in a day for 3 days to cure jaundice. Decoction of flowers (10 ml) is taken twice a day for 3 days against bleeding piles.
Benincasa hispida L. (UU-180) [Cucurbitaceae]	Panikakharu (O) Tangkhul (T)	Prepared curry (without any spices) is taken regularly to cure piles. Curry prepared with the fruit of this plant is to be taken regularly to retain pregnancy and prevent miscarriage.
Blumea lacera (Burm.f.) DC. (UU-142) [Asteraceae]	Pokasungha (O) Kakronda (T)	Leaf paste (50 g) is given to hasten the expulsion of placenta of cow after calving.
Bombax ceiba L. (UU-158) [Bombacaceae]	Simili (O) Himolu (T)	Fresh roots are grinded with water and applied on the affected parts to get relief from pain due to boils. Paste prepared from fresh root along with sugar candy is taken by females to restore fertility.
Chenopodium album L. (UU-193) [Chenopodiaceae]	Bathua (O) Jilmil (T)	Leaves are used as vegetable to improve appetite and also to treat abdominal pains.
Clitoria ternatea L. (UU-212) [Fabaceae]	Aparajita (O) Dintena (T)	Root decoction is helpful against filariasis in human beings as well as in cattles.
Curcuma longa L. (UU-092) [Zingiberaceae]	Haladi (O, T) Manjal (T)	Rhizome powder (10 g) mixed with milk is prescribed against helminthic infestation in children.
Cyperus brevifolius (Rottb.) Hassk. (UU-208) [Cyperaceae]	Haritmutha (O) Nelatangedu (T)	Tuber powder (5 g) along with 5 drops of honey is given against flatulence, dysentery and nasal bleeding.
Cyperus rotundus var. *tuberosus* (Rottb.) Kuek. (UU-070) [Cyperaceae]	Golamutha (O) Kondatangedu (T)	Root powder mixed with equal quantity of sugar candy is used in dysentery and vomiting.
Cyperus rotundus L. var. *rotundus* Kern. (UU-153) [Cyperaceae]	Ardhagolamutha(O) Mutha (T)	Root powder mixed with 5 drops of honey is given to treat epilepsy.
Datura stramonium L. (UU-147) [Solanaceae]	Dudura (O) Dhatura (T)	Leaf powder is inhaled to cure chronic cough. Leaf extract is boiled with sesame oil is massaged to get rid of aching of body parts. Leaves are fried in mustard oil to extract the juice in the oil, which is massaged on joints to lessen rheumatic pain and inflammation.
Dendrocalamus strictus (Roxb.) Nees (UU-211) [Poaceae]	Salia baunsa (O) Kalmunji (T)	Wounds and cuts are treated with powder prepared from leaves and outer layer of the stem.
Diospyros melanoxylon Roxb. (UU-178) [Ebenaceae]	Kendu (O, T) Tendu (T)	Bark paste is used in dysentery.
Eclipta prostrata (L.) L. (UU-097) [Asteraceae]	Kesuta (O) Kantaraj (T)	Leaf paste mixed with sesame oil is used as anthelmintic as well as to treat whitlow and wounds.
Emilia sonchifolia (L.)DC. (UU-133) [Asteraceae]	Sarkara (O) Phurki (T)	Leaf paste mixed with pinch of common salt is used externally against ring worm infection.
Eryngium foetidum L. (UU-161) [Apiaceae]	Banadhania (O) Mandhania (T)	Leaf paste (5 g) along with the 2 black pepper powder given against indigestion and vomiting.
Erythrina variegata L. (UU-114) [Fabaceae]	Paladhua (O) Maidal (T)	Inhaling of well crushed leaves by nostrils relieves headache.
Ficus benghalensis L. (UU-084) [Moraceae]	Baragachha (O) Bara (T)	Prop root paste (5 g) mixed with fermented rice water (20 ml) is given against acidity and stomach disorders.
Ficus racemosa L. (UU-179) [Moraceae]	Airi-dimiri (O) Rumondo (T)	Fresh fruit paste is prescribed for prostrate problems.
Ficus religiosa L. (UU-101) [Moraceae]	Aswastha (O, T)	Leaf paste is useful for blood coagulation.
Gymnema sylvestre (Retz.) R.Br.	Gudamari (O) Vishani	Seven fresh leaves are chewed daily in the morning in empty

ex Schutt. (UU-231) [Asclepiadaceae]	(T)	stomach for seven days to reduce blood sugar level.
Heliotropium strigosum Willd. (UU-191) [Boraginaceae]	Hatisundhia (O) Hatisura (T)	Plant paste is applied in abscess of joints.
Hemidesmus indicus (L.)R.Br. (UU-172) [Asclepiadaceae]	Anantamula (O) Sugandhi (T)	Root paste is taken in empty stomach for a week to treat leucoderma. About 10 g of root paste is taken with coconut water in empty stomach for seven days to cure jaundice. About 5 g of root powder is taken with lukewarm water thrice daily for about 21 days to cure rheumatic pain.
Justicia adhatoda L. (UU-111) [Acanthaceae]	Basanga (O) Boga bahak (T)	Leaf decoction (about 20 ml) taken with honey twice daily in empty stomach for 7-10 days to cure acute cough and cold. Powder made from leaf is taken with warm water once daily for 20 days to get relief from rheumatic pain.
Madhuca indica Gmelin (UU-214) [Sapotaceae]	Mahula (O) Mohulo (T)	Powder obtained from dried leaves is applied to cure burn injuries. Flower decoction (20 ml) is taken twice daily for about 2 weeks for treatment of asthma.
Marcotyloma unifiorum L. (UU-050) [Fabaceae]	Kolatha (O, T)	Seed is soaked in water over night and the water is taken before food in early morning for 2-3 months to get rid of gall bladder stone.
Marsilea minuta L. (UU-117) [Marsileaceae]	Sunusunia saga (O) Sushni saga (T)	10 ml of decoction of the whole plant is taken along with 5 ml of honey early in the morning in empty stomach for at least one week to cure sleeplessness.
Nyctanthes arbor-tristis L. (UU-055) [Oleaceae]	Singadahara (O) Sinagarahara (T)	Leaf juice mixed with honey or old jaggery is given to treat common cold and any type of fever including malaria.
Ocimum sanctum L. (UU-202) [Lamiaceae]	Tulasi (O, T)	Leaf juice with honey is taken in empty stomach for treatment of cold and cough. 3 to 4 fresh leaves are chewed along with honey daily in the morning in empty stomach to prevent malaria. About 10 ml of leaf juice is taken in empty stomach for 15 days to check excess urination.
Paederia foetida L. (UU-090) [Rubiaceae]	Pasaruni (O) Bhedai lata (T)	Leaf juice is prescribed against stomachic disorders and rheumatism.
Phyllanthus emblica L. (UU-204) [Euphorbiaceae]	Aenla (O) Aonla (T)	Fruits taken raw to cures eye diseases and improve eye sight.
Phyllanthus reticulatus Poir. (UU-144) [Euphorbiaceae]	Jajanga (O) Panjuli (T)	Leaf and young branches are given to treat stomach disorder in cows.
Piper longum L. (UU-079) [Piperaceae]	Pippali (O, T)	Fruit and root powder are given against gynaeic problems.
Pongamia pinnata (L.) Pierre (UU-1108) [Fabaceae]	Karanja (O, T)	Tender twig is used as tooth brush to cure pyorrhoea. Oil extracted from seed is massaged on the body to cure skin disease.
Rauvolfia serpentina (L.) Benth ex Kurz. (UU-226) [Apocynaceae]	Patalagaruda (O) Hadaki (T)	About 10 g of root paste is given as antidote against of snake bite. Bark obtained from root is grinded with water and about 5 g of this paste is taken with cold water to cure stomach ache. About 5 g root paste is taken daily in empty stomach for a week for the treatment of hypertension.
Saraca asoca (Roxb.) de Willd. (UU-086) [Caesalpiniaceae]	Asoka (O, T)	Powder prepared from dried petals of the flower is taken with cold water twice daily in empty stomach to cure dysentery. About 20 ml of bark decoction is taken in empty stomach twice daily for about a month to cure irregular menstruation and excessive bleeding.
Sida acuta Burm.f. (UU-106) [Malvaceae]	Bajramuli (O) Bariara (T)	Fruit, root and leaf are boiled to prepare a decoction and dry ginger powder is added to it. It is taken thrice a day to treat malaria. Root grinded into a paste and is applied on wound to cure it.
Sida cordifolia L. (UU-194) [Malvaceae]	Bisiripi (O) Jhumka (T)	Juice (3-4 ml) of the flower is taken early in the morning in empty stomach for 15 days to cure Jaundice.
Smilax zeylanica L. (UU-088) [Smilacaceae]	Muturi (O) Muturi lai (T)	About 20 ml of root decoction is taken for 15 days to cure rheumatic pain. Root paste is taken for a week to cure venereal diseases. Powder of dried root is applied on chronic ulcers.
Sonchus asper (L.)Hill (UU-119) [Asteraceae]	Pittatruna (O) Pitara (T)	Whole plant is used as a paste to cure burning sensation in skin.
Stephania japonica (Thunb.) Miers (UU-177)	Akanabindi (O) Kharkha (T)	Leaves are uses as poultice against head injury.

[Menispermaceae]		
Streblus asper Lour. (UU-115) [Moraceae]	Sahada (O, T)	Regular brushing of teeth by fresh tender twigs cures dental carries and toothache. Leaf paste with castor oil (*Ricinus communis*) is applied externally to cure eczema.
Syzygium cumini (L.) Skeels (UU-189) [Myrtaceae]	Jamu koli (O) Jamun (T)	About 20 ml of fruit juice is taken once daily in empty stomach to cure dysentery. About 10 g of fruit powder is taken in empty stomach for 7-10 days for the treatment of piles.
Terminalia arjuna (Roxb. ex DC.) Wight. (UU-219) [Combretaceae]	Arjuna (O) Arjuna (T)	Bark powder with Luke warm water is given twice to cure blood dysentery. Fresh bark extract (5 g) is given thrice a day for 15 days to treat menstrual disorder.
Terminalia bellirica (Gaertn.) Roxb. (UU-091) [Combretaceae]	Bahada (O, T)	Fruit powder is given to cure stomach disorder. Bark paste is given to women with Luke warm water twice a day to cure leucorrhoea.
Tinospora cordifolia (Willd.) Hook. (UU-157) [Menispermaceae]	Guluchi lata (O) Koilisuta (T)	Stem powder (20 g) along with old jaggery is prescribed against skin diseases in cattle.
Zingiber officinale Rosc. (UU-227) [Zingiberaceae]	Ada (O, T)	Dried rhizome powder is given with Luke warm water against indigestion, cough and cold.
Ziziphus mauritiana Lam. (UU-162) [Rhamnaceae]	Barakoli (O, T)	Paste of bark is taken twice a day after food to treat abdominal pain during pregnancy.

[Abbreviations: UU-Utkal University; O-Odia; T-Tribal]

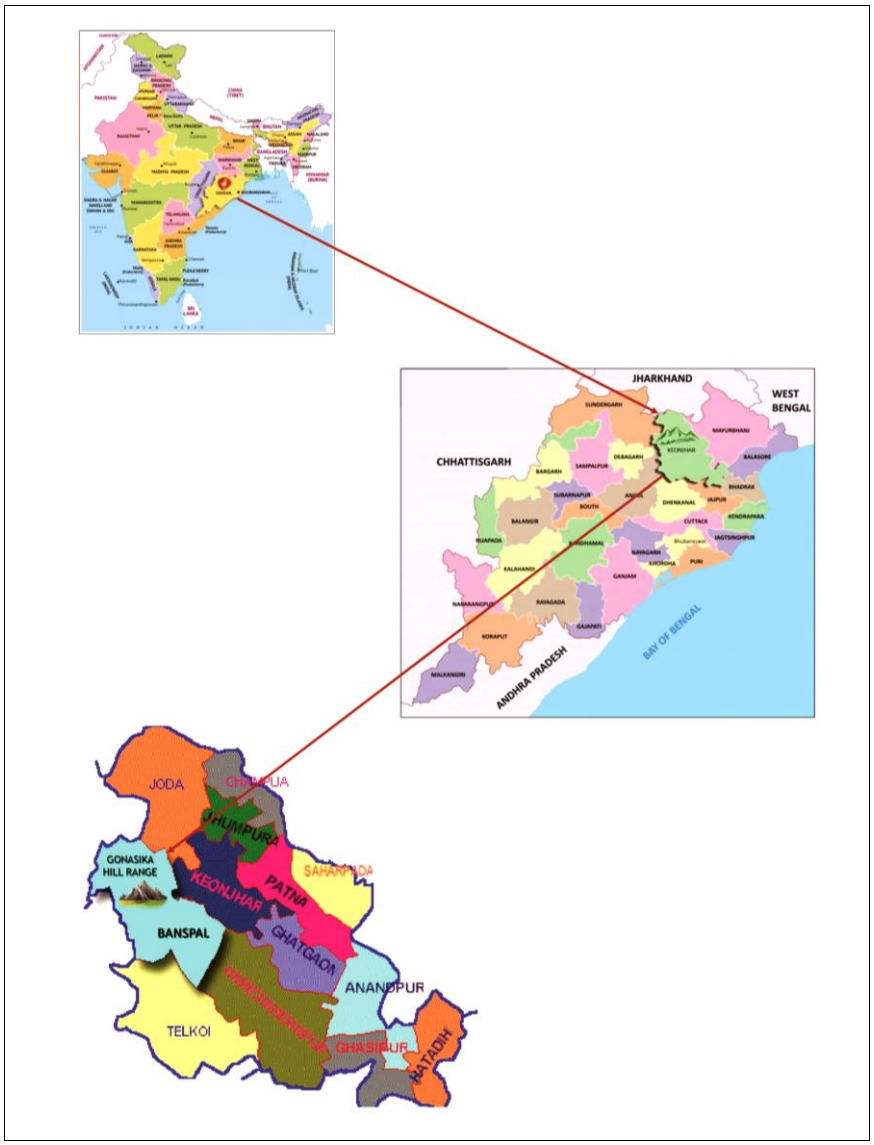

Fig 1: Map of Keonjhar district of Odisha showing the location of study area

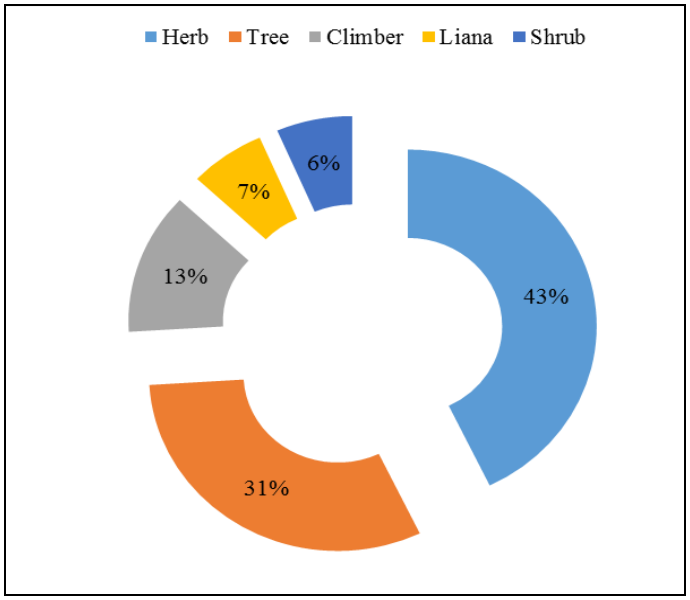

Fig 2: Habit-wise distribution of medicinal plant species of the study area.

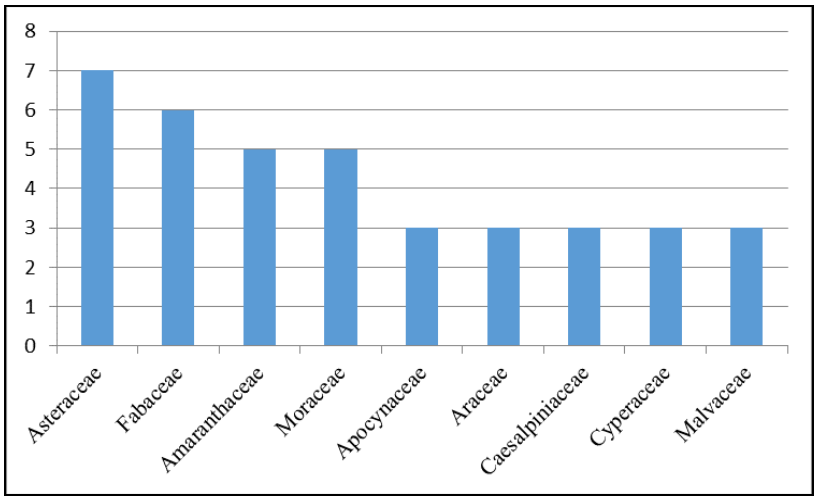

Fig 3: Representation of Medicinally important dominant families of Gonasika hill range

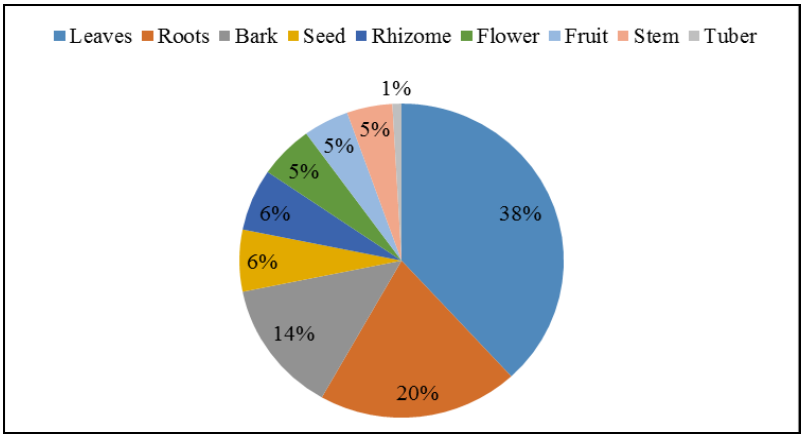

Fig 4: Representation of plant parts used by tribal people in the study area.

Conclusion

The present ethnobotanical exploration resulted in an inventory of 77 medicinal plants species utilized by the indigenous Juang tribe inhabiting in Gonasika hill range and its adjoining forest areas in Keonjhar district in Odisha. Depletion of indigenous knowledge among the people of the study area was serious due to disinterest of young generation to gain the knowledge. Oral based knowledge transfer, unavailability of the species, and influence of modern education can be attributed as important factors for this depletion. The main threat on medicinal plants in the study area arises from agricultural and industrial expansion. Although the hill area is found to be rich in medicinal plant diversity, the effort to conserve the plants and associated

indigenous knowledge was observed to be very poor. Thus, conservation of medicinal plants by local communities and responsible bodies is vital to avoid further loss. Moreover, phytochemical and pharmacological investigation is recommended with due consideration to frequently used medicinal plants. It also becomes very urgent to encourage the local people to participate in the conservation of the forest which is the source of these plants and their preservation for posterity of their cultural heritage.

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