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Ethnomedicinal plants used by *Dongaria Kondha* tribe of Rayagada district, Odisha

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Studies were conducted to document ethnomedicinal plants used by *Dongaria Kondha* tribe in Kashipur block of Rayagada district, Odisha, India. Tribal belief/faith systems used to address health-related issues are recorded and evaluated. Information on traditional knowledge (TK) on medicine and resources was documented through personal interview, questionnaires and observation methods from 134 informants in the age group 21-70, including three medicine men. Community believes that the medicine men gain knowledge of herbal medicine through devotion and animal sacrifice. It is not inherited. Ethnomedicinal practices play a pivotal role in their health care system. However, the younger generations have limited interest in ethnomedicine. Eighty-one plant species belonging to 79 genera and 55 families are documented which are utilized by the tribe in Rayagada. Plant species of Fabaceae, Cucurbitaceae, Euphorbiaceae and Lamiaceae are predominantly used. Most of the species grow wild. The traditional healer frequently uses roots (56 out of 189) followed by stem bark (36), leaf (32), whole plant and fruit (19 each). Paste is the most common method of drug preparation and application (104 out of 189) followed by juice (35 applications) and powder (22 applications). The traditional healers with long and practical experience perceive the usefulness of plants or plants parts for ethnomedicine formulations to enhance the efficacy of the drug in treating the ailments.

Keywords: Belief system, *Dongaria Kondha*, Ethnomedicinal plants, Medicine man, Traditional knowledge, Tribe

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The link between the indigenous people (aboriginals) and their environment is very intricate. An aborigine, the *Kondha* tribe of Odisha mostly inhabits the forest covered hills of central region (Boudh and Kandhamal districts), Rayagada and south western parts of Eastern Ghats region[1]. These indigenous people depend on their environment for food, shelter, clothes and medicine[2-5]. In the tribal culture, knowledge of environment is transmitted from generation to generation by traditions and is called as Indigenous/Traditional Environmental Knowledge (IEK/TEK)[6]. Health care of these societies are based on acquired TEK- the traditional system based on the use of different plants and animal extracts[5,7-9] and is called 'Traditional Medicine (TM)' or 'Ethnomedicine'. Ethnomedicine is culture specific and differs from one indigenous society/culture to the other. Every culture has its own healing practices[9-11]. Domestic animals[5] are also treated following TEK. According to the World Health Organization[12], TM is defined as the sum total of the knowledge, skill and practices based on the theories, beliefs, and experiences indigenous to different cultures, whether explicable or not, used in the maintenance of health as well as in the prevention, diagnosis, improvement or treatment of physical and mental illness. TM is often used as the most accessible and affordable means of treatment for ailments among the marginalised people in developing countries while complementary and alternative medicine (CAM), mostly plant and animal extracts, are becoming popular even in developed countries[8]. A majority of the population in developing countries, including nearly 65% of the Indian population, relies mostly on TM for their primary health care needs[13]. Nearly 80% of the people in the world use the traditional healing practices while in India, nearly 63% of the people, living in the rural areas and forest environment, depend on TM because TM are cost –effective, safe and affordable[14]. Globally, nearly 85% of the TM used in primary healthcare is derived from plant species[15].

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Therefore, the objective of the present study is to document the ethnomedicinal plants and the indigenous knowledge used for preparation of TM by *Dongaria Kondha* tribe of Odisha. The detailed objectives of the study are:

To examine the ethnomedicinal practices followed by the tribe;

To document the ethnomedicinal plants in the study area, parts used, mode of preparation and application; and

To study the various belief systems in the community and how they are used for healing health problems.

Methodology

Study area and the people

The present study on ethnomedicinal practices of *Dongaria Kondha* tribe, has been carried out in four villages of Sankarada Gram Panchayat of the Kashipur block of the Rayagada district of Odisha, India (Fig. 1) (19°10′N 83°25′E to 19.17°N 83.42°E). *Kondha* tribe in Odisha is the most populous tribe amongst the 62 different tribal groups which inhabit the state while *Kondha* population in Rayagada district is maximum compared to other districts of the state[16]. Studies on the ethnomedicinal aspects of the tribe are very rare. Some studies focus on the ethnomedicinal practices of Kalahandi[2,4-5,9,17], Kandhamal[18-20], Ganjam[21,22] and Koraput disticts[23-26]. However, study on ethnomedicinal practices of *Kondha* tribe in Rayagada district, accommodating maximum *Kondha* population, is absent. Further, Rayagada district houses one of the primitive tribal groups (PTG) of *Kondha* tribe, the *Dongaria Kondha*[27]. The future of *Dongoria Kondha* was threatened by Vedanta Resources, a UK based mining company, which tried to mine bauxite from the Niyamagiri Hills, the home for *Dongoria Kondha*[28]. Yet, the ethnomedicinal practice of this threatened PTG is not known. Therefore, understanding the TEK, particularly ethnomedicinal practices of this tribal group is essential. This study while investigating on ethnomedicinal practices also throws some light on various issues like belief systems, superstitions, notions and attitudes of the tribe towards healthcare. The *Dongaria Kondhas* have a great knowledge on TM[29]. Hence the present study, which aims at investigating the ethnomedicinal practices along with other issues of health care system of the PTG in one of the inaccessible and most populous districts of *Kondha* tribe in Odisha, Rayagada, assumes importance.

Fig. 1 — Study Area showing the Kashipur block in Rayagada district of Odisha, India (upper left shows Odisha map with Rayagada district)

Dongaria Kondha tribe lives in hamlets at the foothills of small mountains (*Dongor*). Several visits were made to hamlets, namely S. Dongasil, Tala Sipili, Upor Sipili and Konsariguda during 9-20th February, 2015. The villages are within a radius of 7 km of the Sankarada Gram Panchayat office. The geography of the study area comprises of small rocky hills, small streams, bushy and dense forest. The average temperature of the district varies from a minimum of 14.9°C during December to a maximum of 36.7°C in May with an annual average temperature of 26.5°C and an average annual rainfall of 1312 mm. The climate of the district is a typical tropical type and the district has a rich biodiversity. Health care facilities provided by government are absent in the studied villages except the visits of Multipurpose Health Workers (MPHW) and Auxiliary Nurse Midwife (ANM) workers.

Data collection methods

From a total population of 268, information from 134 people in the age group 21-70 and above was collected by following various methods such as observation, census survey, sample survey, interview and case study. The sample survey method includes medicine men, chief of local communities, priests and household heads. People were interviewed in their local language with the help of an interpreter. The information obtained on different medicinal plants, their uses and methods of preparation were verified

with the help of medicine men and some experienced people of the community. Taxonomic identification of the medicinal plants was made with flora books of the state[30,31]. The taxonomic information on medicinal plants were reconfirmed by two experts from the Department of Botany, Berhampur University, Odisha and following the book on "*Udvida Sangraha*"[32]. Observation method was used to visualize the practices adapted by the medicine-man during the preparation of TM and its application procedure while different notions and beliefs among the people and the medicine-man about ethnomedicine were collected though the interview technique.

Results and Discussion

Socio-demographic data

The four studied villages have 70 households of the *Dongaria Kondha* tribe only with a total population of 268, out of which 141 are males and 127 are females. The tribals mostly speak in their own dialect called as *'Kuvi'* or *'Kui'*, known as *'Desia Bhasa'* while some of them also speak in Odia. *Kondhas* comprise 17% of the total tribal population of Odisha and their decadal growth rate (2001-2011) is 16.61%. However, *Kondha* tribe of Rayagada district comprises of 23.68% of the total *Kondha* population of the state and their decadal growth rate (2001-2011) in the district is 17%. The tribe has a very low literacy rate (6.39%), male literacy rate little higher than the female literacy rate[16]. Out of the 134 indigenous informants including the three medicine men, 113 are illiterate and only 21 are literate. Their literacy level is up to secondary school level.

Traditional health care and belief system

The medicine-men (*Disari*) do not have faith in the modern medicine. They only believe in the traditional healing practices. The medicine-man uses different plants or plant parts for treating various diseases free of cost. Neither the traditional healers have interest to pass on their traditional knowledge (TK) to the younger generation nor do the younger generations show interest in TM. *Disari* believes that God has chosen him/her for practicing the medicines and the knowledge is transferred through dreams. However, a study[33] on the use of antimalarial plants by the ethnic group indicated patrilineal culture of kinship in the study area where the TK is transferred through male lineage. The TK of medicine men in *Kondha* tribe is not inherited by their sons or daughters. Anybody who desires to be a medicine man/woman should worship the God following their traditional practice. Perpetual transfer of TM knowledge to younger generation is difficult as they show very little interest in TM because of their education, exposure to a modern lifestyle and urbanization[34,35]. The medicine-men also treat persons attacked by evil spirits and ghosts following magical practices and also provide TM.

Diversity of ethnomedicinal plants used

Table 1 presents the list of plant species used for preparation of ethnomedicine with details of scientific name of the plants, family name, local name, plant parts used with mode of their utilization, treatment of different ailments including magico-religious use and mode of preparation and administration. Eighty-one plants species (64 in the 1st column and 17 in the 4th column of Table 1) belonging to 79 genera and 55 families are documented. Fabaceae, Cucurbitaceae, Euphorbiaceae and Lamiaceae are the most dominant families (four species each) followed by Apocynaceae, Moraceae, Mimosaceae and Poaceae (three species each). Dominant uses of Fabaceae, Moraceae and Euphorbiaceae for ethnomedicine by the indigenous communities living in Hafizabad district, Punjab-Pakistan[34] have been reported. Two species documented here viz., *Careya arborea* Roxb and *Helicteres isora* L. are in the IUCN red list[9] and hence there is an imminent need to conserve and preserve the TK and the resources. The diversity of plant use for ethnomedicinal purposes by *Dongaria Kondha* tribe, as reported here, is very high as compared to the same tribe in other districts of Odisha[4,9]. Further, the ethnomedicinal plants reported here are mostly growing wild in the forest area.

Plant part(s) used, mode of preparation and application

Figure 2 depicts the most commonly used plant parts and modes of preparation of ethnomedicine. Roots more frequently used (56 out of 189 applications) followed by stem bark (36), leaf (32), whole plant and fruit (19 each), stem/branch (10), seed (9), flower (8) and rhizome (6). Our results agree with Dwivedi *et al*.[33], which reported root as the most commonly used plant part for preparation of ethnomedicine. Roots and bark as such can be preserved for a longer time and are easily traded in the herbal market and hence are preferred over leaves by the tribal communities, who do not have any means of preservation except sun drying.

Table 1 — List of plants used for treatment of ailments by the *Dongoria Kondha* tribe of Rayagada district, Odisha along with plant part(s) used, mode of utilisation and administration

Sl. No	Plant Name, family name/ (local name)	Plant Part(s) used/mode of utilisation	Treatment of ailments	Mode of preparation of Ethno-medicines and their administration
1	*Abrus precatorius* L., Fabaceae/(Kaincha)	Root/paste Seed/juice	Baldness	Root paste mixed with water is sprinkled on head and unripe seed juice is rubbed on scalp once daily for about 1-2 months.
2	*Acacia torta* (Roxb.) Craib Mimosaceae/(Chil)	Whole plant/ Paste	Headache	Paste of the plant and castor oil (*Ricinus communis* L.*)* is applied on the forehead once daily.
3	*Achyranthes aspera* L., Amaranthaceae/ (Bonmundi, Apamaranga)	Whole Plant/Paste	Acidity, Gastric or swelling of belly	Whole plant along with whole plants of *Dendrocalamus strictus* (Roxb.) Nees and *Cyperus rotundus* (L.) Pers. are grinded and given to the patient once/ twice daily.
4	*Aegel marmelos* L., Rutaceae/(Belo)	Leaf/fresh leaf juice Fruit/unripe & ripe fruit	Stomach disorder, indigestion, Dysentery, constipation	Leaves are chewed in the morning before breakfast for stomach disorder and indigestion, unripe fruit for dysentery while ripe fruit to cure constipation and fever.
5	*Aegiceras corniculatus* (L.) Blanco, Myrsinaceae/ (Kirti, Telakuni)	Bark/paste	Delayed menstruation	Bark of the plant and root of *Woodfordia fruticosa* (L.) Kurz. are grinded with water and is given to the patient.
6	*Ailanthus excels* Roxb., Simaroubaceae/ (Mahala)	Root/paste	Body pain	Roots of the plant and *Casearia graveolens* Dalz. are grinded with water and the paste is applied on the body to relieve pain.
7	*Albizia lebbeck* (L.) Benth., Mimosaceae/ (Penga plant, Sirsha, Sipo)	Root/Paste Bark/paste	Muscle pain in legs, Wound of rat bite	Roots of the plant and *Fagopyrum esculentum* Moench. and bark of *Flacourtia indica* (Burm.f.) Merr.are grinded with water and the paste is applied once/twice to relieve muscle pain in legs. Bark paste is applied around the wound of rat bite.
8	*Aloe vera* (L.) Burm., Liliaceae/(Hichu ossa)	Leaf/Juice	Headache	Fresh leaves of the plant are rubbed on the forehead once/twice.
9	*Andrographis paniculata* (Burm.f.) Wall. ex. Nees, Acanthaceae/(Bhuinlimbo)	Leaf/paste Leaf/juice Leaf/ powder Stem/ powder Stem/decoction	Intestinal worms, fever(malaria), constipation, Fever, mouth and foot disease of animals	Fresh leaf paste, two spoonsful, with turmeric powder is taken orally, once daily for about a week, to cure intestinal worms. Leaf powder with honey is taken orally, once daily for 3-4 days, to cure fever. Leaf juice is taken orally, once daily for about 3-4 days to cure constipation. Stem powder mixed with jaggery and rock salt are applied against foot and mouth disease while stem decoction is given orally for fever for about 2-3 days.
10	*Anisomeles indica* (L.) Kuntz., Lamiaceae/ (Bhutamari)	Root/paste	Possession of wild spirit	The root is grinded with water and the paste is given twice daily for two days.
11	*Antiaria toxicaria* Lesch., Moraceae/(Bhramarmari)	Whole Plant	Prevention against black magic	Branches of the plant are kept under the roof as prevention.
12	*Argemone mexicana* L. , Papaveraceae/ (Sondho, Agara)	Leaf	Infliction of spirit	Leaves of the plant and leaves *of Sansevieria roxburghiana* Sch. & Schulf. f. and root of *Asparagus racemosus* Willd. tied on the upper arm of the person to get rid of spirit.
13	*Argyreia nervosa* (Burm.f.) Boj. Convolvulaceae/ (Brudhajaraka)	Root/ powder Root/paste	Wound due to mad-dog-bite	Root powder and root pastes are applied locally at the wound.

(*contd.*)

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Sl. No	Plant Name, family name/ (local name)	Plant Part(s) used/mode of utilisation	Treatment of ailments	Mode of preparation of Ethno-medicines and their administration
14	*Asparagus racemosus* Willd., Asparagaceae/ (Satabari)	Rhizome/ Paste Root/ powder Root/Juice Root/ extract	Body swelling, lactation, paralysis, epilepsy, tooth ache,	Rhizome of the plant is grinded and is given once daily for three days for body swelling. Root powder with cow milk is given orally to enhance lactation. Root juice mixed with old ghee is applied on the body part having paralysis. Extract of root is taken orally to cure epilepsy. A piece of root is kept on the right/left ear to reduce tooth ache.
15	*Basella alba* L., Basellaceae/(Poi)	Whole Plant/Paste	Head reeling	The plant along with *Dendropthoe falcata* (L.f.) Etting. And *Calotropis gigantia.* R.Br. are grinded and the paste is fed or applied on the head once/twice.
16	*Bixa orellana* L., Bixaceae/(Sindur, Kumkum)	Stem/Juice	Tooth pain	The stem/branches of the plant are chewed and the juice is taken once/ twice.
17	*Brassica campestris* L. var. *dichotama* Wall., Brassicaceae/(Gai sungha, Sorisha)	Whole Plant/paste	Muscular pain/pain in the toes	The plant is grinded with water and the paste is taken orally once/ twice.
18	*Buchanania cochinchinensis* (Lour.) Almeide, Anacardiaceae/(Char)	Bark/juice	Diarrhoea	Juice extracted from the bark is taken orally twice.
19	*Calotropis gigantia* R.Br., Asclepiadaceae/(Kolita, Arakha)	Leaf(latex) /juice Leaf/ powder Bark/paste Flower/ decoction Stem/ powder	Constipation, epilepsy, nasal sore insect bite, , migraine,	Root of the plant along with bark of *Cassia fistula* and *Rauvolfia serpentina* (L.) Benth.ex. Kurz. are grinded and the paste is given once daily for two days for constipation. Leaf juice is dropped into the nostril to cure epilepsy. Paste prepared from root bark is mixed with opium and the mixture is applied externally to cure nasal sore. Powder of dried stem and leaf are mixed with latex of the plant and the mixture is applied locally to cure insect bite. Leaf latex is applied on the forehead for migraine.
20	*Capsicum annum* L. var. *acuminata* Fingh., Solanaceae/ (Lanka maricha)	Whole plant/paste	Wrath of black magic	The plant along with *Coleus amboinicus* Lour. and *Opuntia stricta* Haw., are grinded together and the paste is given orally, once daily for about 10-12 days.
21	*Careya arborea* Roxb., Lecythidaceae/ (Kumbhi)	Bark/extract Fruit/ decoction	Dysentery, rheumatism	Extract of stem bark with stem bark of *Holarrhena pubescens* are pounded with water and the filtered water is taken orally for dysentery. Decoction of unripe fruit is taken thrice daily for about a month for rheumatism.
22	*Casearia graveolens* Dalz., Flacourtiaceae/(Kokri)	Bark/paste Root/paste	Body pain	Bark of the plant and the root of *Ailanthus excelsa* are grinded and the paste is taken orally once.
23	*Cassia fistula* L., Caesalpiniaceae/ (Sunari)	Bark/paste bark/juice leaf/paste	Constipation, healing of wound, dysentery, scabies	Bark of the plant, bark of *Rauvolfia serpentina* and root of *Calotropis gigantia* are grinded and the paste is given once daily for two days for constipation. Bark paste is applied locally for healing wound. Raw juice of fresh bark taken orally for dysentery. Paste prepared from leaf of the plant, seeds of *Raphanus sativus* and leaves of *Syzygium cumini* and garlic are applied externally to treat scabies.

(*contd.*)

Table 1 — List of plants used for treatment of ailments by the *Dongoria Kondha* tribe of Rayagada district, Odisha along with plant part(s) used, mode of utilisation and administration (*contd.*)

Sl. No	Plant Name, family name/ (local name)	Plant Part(s) used/mode of utilisation	Treatment of ailments	Mode of preparation of Ethno-medicines and their administration
24	*Citrullus colocynthis* Schrad., Cucurbitaceae/ (Sampboda)	Root/paste	Skin disease, worm & piles	Root paste is applied over infected parts for skin disease. The paste is also given orally to cure worm and piles.
25	*Coccinia grandis* (L.)Voigt, Cucurbitaceae/ (Kainchi)	Bark/paste	Scabies	Bark of the plant with bark of *Pedilanthus tithymaloides* (L.) Poitare grinded together and the paste is applied on the white patch area.
26	*Cocos nucifera* L., Arecaceae/(Poida)	Liquid endosperm, endocarp /extract	Ring worm and scabies	Endosperm is covered with a metal pot and is burnt through flame from below. An oily and black coloured substance smeared on the inner wall of the pot is applied on the areas of ring worm and scabies.
27	*Commelina benghalensis* L., Commelinaceae/ (Kena)	Rhizome/powder	Skin infection in cows	The rhizome of the plant is powdered and is mixed with food of the cattle and is given to the cattle.
28	*Cordia oblique* Willd., Boraginaceae/ (Dhuachera)	Whole Plant/paste	Poisonous Snake bite	The plant and *Rauvolfia serpentina* are grinded together and the paste is applied as soon as possible on the wound.
29	*Cryptolepis buchananii* Roem & Sch., Periplocaceae/ (Gopakanu)	Root/paste	Irregular menstruation	Root paste along with milk is given for two to three days.
30	*Cyperus rotundus* L., Cyperaceae/ (Deb motha)	Root/paste	Acidity, gastric, body swelling and thorn prick	Root of the plant and the roots of *Trichosanthes tricuspidata* Lour., Dendrocalamus *strictus* (Roxb.) Neesand *Rupuni* (local name) are grinded and the paste is taken orally once daily for 1-2 days. Root paste of the plant is applied locally at the place of thorn prick.
31	*Delonixregia* (Boj.ex Hook.) Raf., Caesalpiniaceae/ (Bhalu junugo, Krushnachuda)	Bark/paste	Injuries caused by wild Bear	The bark of the plant is grinded and the paste is applied on the wound.
32	*Dendrophthoe falcata* (L.f.) Etting, Loranthaceae/ (Modang)	Juice	Ear pain	The plant is pasted and the juice extracted from it is dropped into the ear drop by drop once/twice.
33	*Dillenia indica* L., Dilleniaceae/ (Doter Ou)	Bark/paste	Knee joint pain	Bark of the plant is grinded and the paste is mixed with water or alcohol and is given orally.
34	*Ervatamia divericata* (L.) Burkill. Apocynaceae/ (Kukurafari, Tagar)	Bark/juice	Anaemia	The bark of the plant is chewed and the juice is swallowed twice or thrice daily for about three days.
35	*Fagopyrum esculentum* Moench., Polygonaceae/ (Kutugiri)	Rhizome/ paste	Muscle pain in legs	Rhizome of the plant and bark of *Flacourtia indica* and root of *Albizia lebbeck* are ground and the paste is orally taken once/twice.
36	*Ficus benghalensis* L., Moraceae/(Bot gach, Bara gacha)	Root/paste Root/ decoction Root/ powder	Bone fracture, , pain due to broken limbs, piles	Root paste mixed with sugar is tied for about fifteen days for bone fracture. Root of the plant is boiled with tea and the decoction is orally taken two to three times in a day for three days to relieve pain due to broken limbs. Root powder mixed with molasses is taken orally thrice a day for about a month for piles.
37	*Ficus religiosa* L., Moraceae/(Palks Osa, Osta, Pipal)	Stem/juiceBark/paste	Tooth ache, Constipation of cattle	The branch of the plant is chewed once or twice and the juice is taken to cure tooth ache. Bark paste is given to the cattle to cure constipation.

(*contd.*)

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Sl. No	Plant Name, family name/ (local name)	Plant Part(s) used/mode of utilisation	Treatment of ailments	Mode of preparation of Ethno-medicines and their administration
38	*Flacourtia indica* (Burm. f.) Merr., Flacourtiaceae (Kontakuli, Konteikoli)	Bark/paste	Muscle pain in legs	Bark of the plant, and root of *Albizia lebbeck* (L.) Benth. are grinded and the paste is orally taken once/twice.
39	*Helicteres isora* L., Sterculiaceae/ (Kukurbicha)	Root/paste Fruit/ decoction Fruit/ paste	Big cut by axe, Pain of infants/ladies after delivery, growth of infants	Root paste of the plant is applied immediately after the cut to check bleeding and again after one/two days. Decoction of the fruit is prepared by boiling in til/sesame oil and the oil is messaged on the body of the infants to relieve pain. Ladies also take decoction of the fruit orally to relieve waist pain immediately after child birth. Fruit paste with three seeds of black pepper is taken orally for growth of infants.
40	*Holarrhena pubescens* (Buch.-Ham.) Wall. exG. Don., Apocynaceae/(Kacheri)	Root/paste	Bone fracture	Roots of the plant and *Ficus benghalensis* L. are grinded and the paste is taken orally for about 3-4 days.
41	*Leucas aspera* (Willd.) Link, Lamiaceae/ (Uspus, Gubi)	Root/paste Leaf/juice Leaf/paste	Fever, ear pain, itching, scorpion sting	Roots of the plant, *merka (local name)* and *Argemone mexicana* L. are grinded with water or country liquor and is taken once daily for two days for very high fever with headache and vomiting. Leaf juice is poured into the ear to relieve ear pain. Leaves are rubbed on the skin to get relief from itching due to contact of caterpillars. Warm leaf paste is applied locally to treat scorpion sting.
42	*Madhuca indica* J. F. Gmel., Sapotaceae/ (Mohul, Mohua)	Root/paste Bark/paste Seed/ extract Flower/ extract Root/paste Plant parasite	Muscular cramp and sprain, indigestion, skin infection due to spider urination, health of infants, snake bite	Parasite of the plant (*Madanga*) is grinded with water and the paste is taken orally once to relieve muscular pain/cramp. Barks of the plant along with *Asparagus racemosus* Willd, *Careya arborea* Roxb. and *Pterocarpus marsupium* Roxb. are grinded and is given orally once to cure indigestion. Oil extracted from the seed is used locally to cure skin infection due to spider urination. Country liquor prepared from its flower is touched on the tongue of the infant for its better health. Root paste is applied externally to treat snake bite.
43	*Mallotus philippensis* (Lam.) Muell.- Arg., Euphorbiaceae/(Sinduri, Kamala gundi)	Stem/juice Fruit/ extract	Toothache	The branches of the plant are chewed once or twice and the juice is taken to cure toothache.
44	*Martynia annua* L., Pedaliaceae/ (Baghnokhi)	Seed/ decoction	Eczema	The seed of the plant along with wood of *Dalbergia sisso* and node of *Bambusa vulgaris* and endocarp of *Cocos nucifera* are kept in an earthen pot covered with an earthen plate. Holes are made on the back of the pot and the entire pot is kept over another earthen pot, which is heated from below. The extract/ decoction collected in the lower pot is used to cure eczema.
45	*Melia azedarach* L., Meliaceae/ (Moha Limbo)	Leaf/juice	Worms in intestines	Juice of fresh leaf is taken orally by chewing once daily for 2-3 days.

(contd.)

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Sl. No	Plant Name, family name/ (local name)	Plant Part(s) used/mode of utilisation	Treatment of ailments	Mode of preparation of Ethno-medicines and their administration
46	*Mimosa pudica* L., Mimosaceae/ (Lajakuli)	Leaf/paste Root/ decoction	Eczema, insomnia, kidney stone, delivery pain	Leaf paste is applied locally over eczema. Leaf of the plant and rhizome of *Smilax zeylanica* L. are grinded and the paste is taken orally once for insomnia. Decoction prepared from the root of the plant is taken orally once daily for about a week to heal kidney stone and for 2-3 days for delivery pain.
47	*Momordica charantia* L., Cucurbitaceae/ (Karla)	Leaf/Juice Whole plant/ extract	Fever, chicken pox, measles Appetite of animals	Leaf juice (half/one cup) of the plant is taken orally in empty stomach for seven days to cure chicken pox, measles and high fever. Whole plant extract is fed to increase appetite of animals.
48	*Musa sapientum* L., Musaceae/ (Munguni Kadoli)	Flower/ paste	Dog bite	Flower paste of the plant and root powder of *Argyreia nervosa* are mixed and is given thrice daily for three days.
49	*Ocimum tenuiflorum* L., Lamiaceae/(Tulsi)	Leaf/juice	Chest pain	Leaves of the plant, *Aegel marmelos, Rosa indica* and rice grain are chewed and the juice is taken once.
50	*Oryza sativa* L.,	Seed/ extract	Chest pain, Burning sensation during urination	Leaves of *Ocimum tenuiflorum, Aegel marmelos, Rosa indica* and seed grain of the plant are chewed and the juice is taken once to cure chest pain. Some pieces of straw are chewed and the juice is swallowed to cure burning sensation during urination.
51	Poaceae/(Aruachaula, Dhan) *Pedilanthus tithymoloides* (L.) Poit., Euphorbiaceae /(Luhamali)	Stem/juice Whole plant/paste	Local body pain	The whole plant is grinded and the paste is applied locally once to relieve pain.
52	*Piper betle* L., Piperaceae/ (Pana patra)	Rhizome/ paste	Avoiding pregnancy (Birth control)	Rhizome of the plant with coconut water and wood of *Niakhiri* (local name) are grinded and the paste is given to the women once.
53	*Phyllanthus emblica* L., Euphorbiaceae/ (Amla)	Fruit/ decoction	Cold and cough	Fruits of the plant, *Terminalia chebula* Retz. and *Terminalia bellirica* (Gaertn.) Roxb. are grinded to powder and the decoction prepared is taken orally once daily for about 3-4 days.
54	*Pterocarpus marsupium* Roxb., Fabaceae/(Bija)	Bark/paste	Indigestion	Bark of the plant, the plant *Asparagus racemosus* and bark of *Careya arborea* and *Mangifera indica* L. are grinded and is given orally once to cure indigestion and loose motion.
55	*Rauvolfia serpentina* (L.) Benth.ex. Kurz, Apocynaceae/ (Patalgorur)	Root/juice Whole plant/paste	Fever, constipation, stomach ache, acidity,	Roots of the plant, Aristolochia *indica* and *Cissampelos pareira* are grinded with water and the juice extracted is taken orally once to cure fever. Barks of the plant, *Cassia fistula* and rootof *Tephrosia purpurea* are grinded together and the paste is given once daily for two days for constipation. Root piece is chewed and the juice is swallowed to cure stomach ache and acidity.
56	*Ricinus communis* L., Euphorbiaceae/(Jora oil plant)	Seed/ extract	Jaundice, blood in the stool	Root of *Majent* (local name) fried with oil extracted from seed of the plant is taken for jaundice. Root of *Indigofera cassiodes* Rott.ex DC. is fried in the oil of the plant and is given to cure blood in the stool.

(*contd.*)

Table 1 — List of plants used for treatment of ailments by the *Dongoria Kondha* tribe of Rayagada district, Odisha along with plant part(s) used, mode of utilisation and administration (*contd*.)

Sl. No	Plant Name, family name/ (local name)	Plant Part(s) used/mode of utilisation	Treatment of ailments	Mode of preparation of Ethno-medicines and their administration
57	*Rosa indica* L., Rosaceae/ (Ranga Gulap)	Leaf/ paste	Chest pain	Leaves of the plant, *Aegel marmelos, Ocimum tenuiflorum* and rice grain are chewed and the juice is taken once.
58	*Smilax zeylanica* L., Smilaceae/(Muturi)	Rhizome/ paste Root/powder	Insomnia, dental care, infertility	Rhizome of the plant and leaves of *Mimosa pudica* are grinded and the paste is taken orally once for insomnia. Twig of the plant is used as toothbrush for dental care. Dried roots of the plant along with *Piper longum* and *Piper nigrum* L. are grinded into powder and is taken orally twice daily for infertility.
59	*Tephrosia purpurea* (L.) Pers., Fabaceae/ (Koltia)	Root/paste Root/juice Bark/paste	Tooth ache, constipation	The root of the plant is chewed and kept within the gum for about 15 min to treat toothache. Barks of *Rauvolfia serpentina, Cassia fistula* and root of the plant are grinded and the paste is given once daily for two days for constipation.
60	*Terminalia chebula* Retz., Combretaceae/ (Harida)	Fruit/ decoction	Cold and cough	Fruits of the plant, *Phyllanthus emblica* and *Terminalia bellirica* (Gaertn.) Roxb., are grinded to powder and the decoction prepared from it is taken orally once daily for 3-4 days.
61	*Trichosanthes tricuspidata* Lour., Cucurbitaceae/ (Mahakal)	Leaf/ extract Root/paste	Ear sore, acidity, gastric, swelling of belly, loss of appetite, hair loss	Mustard oil applied on the surface of the leaf of the plant is heated and the extracted juice by squeezing the leaf is dropped into the ear for ear sore. Root of the plant is grinded and the paste is given once daily for one/two days to treat acidity, gastric, swelling of belly and loss of appetite. Root paste mixed with cow urine is used to check hair loss.
62	*Tridax procumbens* L., Asteraceae/ (Bisalyakarani)	Leaf/extract	Wound	Leaf extract of the plant is applied on the wound.
63	*Woodfordia fruticosa* (L.) Kurz., Lythraceae/ (Dhatiki)	Root/paste Flower/ powder Flower/ Paste Bark/paste	Delayed menstruation, cough, wound	Root of the plant and bark of *Aegiceras corniculatus* are grinded and the paste is taken orally for delayed/irregular menstruation. Sun dried flowers are grinded to powder and is taken with honey orally to treat cough. Warmed flower paste is applied locally to heal wound.
64	*Ziziphus mauritiana* Lam., Rhamnaceae/ (Barakoli, Pondka Bori)	Leaf/paste	Redness of eyes, cough	The leaf paste is applied on the outer wall of the eye to cure redness of eyes. Two to three young leaves with leaf bud are chewed thrice daily for about five days to treat cough.

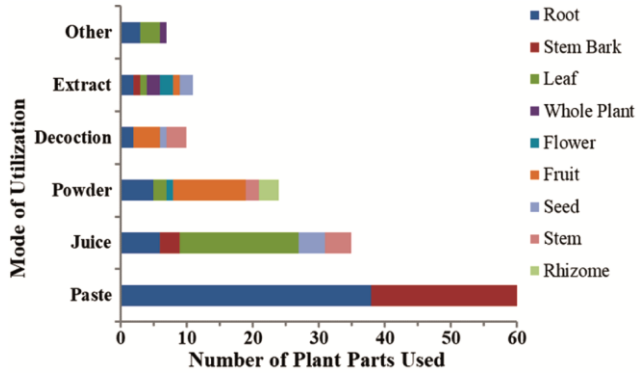

Fig. 2 — Proportional contribution of plant parts in ethnomedicine preparation and their modes of utilization.

Paste is observed as the most common method of drug preparation (104 out of 189 applications) followed by juice (35) and powder (22). Table 1 show that in most of the applications, multiple plants or plant parts are used. As revealed by the medicine man, use of multiple plants or plant parts enhances the efficacy of the drug and hence is most commonly adapted and also agrees with some of the earlier reports[33,36,37] Traditional healers from their long and practical experience well perceived the uses of multiple plants or plant parts for ethnomedicine formulations. Table 1 show that oral administration of recipes is the most preferred mode of treatment followed by local application.

Conclusions

Dongaria Kondha tribe in Rayagada district uses "Traditional Medicine" or Ethnomedicine as the most accessible and affordable method of health care as compared to modern medicine. The built-in belief system and obligation towards TK is evident from the philanthropic philosophy and the selflessness of the medicine man. The future of TM or "Ethnomedicine" is in danger due to lack interest in Ethnomedicine and its practices by the younger generation, poor conservation and promotion of ethnomedicinal practices and over-exploitation and utilization of forest land for development of industry leading to peril of ethnomedicinal plants.

The study documents eighty-one plant species belonging to 79 genera and 55 families out of which 37 plants species were reported earlier[3-5,9] mostly from Kalahandi district, Odisha. However, the uses and mode of utilization for treatment of different ailments are different than what is reported in the present study for the same 37 plants. This study, for the first time, documents ethnomedicinal uses of 44 plants by *Dongaria Kondha* tribe of Rayagada district, Odisha. The study reveals that roots followed by barks are the most commonly utilized plant parts for preparation of ethnomedicine while paste is the most preferred mode of preparation. Combination of different plants or plant parts for preparation of ethnomedicine was well perceived by the traditional healers. The study reaffirms the importance of ethnomedicine for health care of tribal and rural people and suggests its proper documentation.

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Conflict of Interest

Authors declare no conflict of interest.

Authors' Contributions

The paper was conceptualized by MS and BKS. KD visited the field, collected data and prepared the figures. Analysis and drafting of the paper, interpretation and final revision were made by MS.

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