



Medicinal uses of few edible tuber crops by “Dongria Kandha” tribes of Kandhamal district of Odisha, India

S Parida*[†] & M Sarangi

Department of Botany, School of Applied Sciences, Centurion University of Technology and Management, Odisha, India

E-mail: [†]sagarika.parida@cutm.ac.in

Received 26 September 2019; revised 22 October 2020

This paper describes the systematic study of root and tuber crops consumed by “Dongria Kandha” tribes of two blocks of “Kandhamal” district of Odisha. Periodic surveys were conducted in 25 villages of these two blocks regarding the methods of uses of different wild and cultivated edible tuber crops. Total seven types of edible tuber crops were consumed by this tribe. As no specific reports are available on the tuber crops consumed as food and medicine by this tribe, therefore documentation of tuber crops relating to the methods of uses, along with the morphological parameters were recorded. During survey 10 species of *Dioscorea* genus were found to be consumed as food as well as medicine to cure various ailments. Among them two species were found to be bitter in taste and unpalatable when consumed raw. Various methods were applied by the tribes to make the tubers palatable. The methods of consumption of ten species of *Dioscorea* along with the medicinal uses to treat various diseases were described in this article. Therefore these crops are valued for food security and also play a vital role towards diminishing rural poverty as well as have significant contribution towards curing of various diseases.

Keywords: *Dioscorea*, Dongria Kandha, Edible tuber crops, Morphological parameters, Unpalatable

IPC Code: Int. Cl.²¹: A61K 36/8945, A01D 82/02, G01N 30/52, A61K 9/00

Root and tuber crops play an important role as the staple foods to meet the demand of these poor tribal people and are valued for food security and also play a key role towards diminishing rural poverty. These crops occupy about 50 million ha worldwide and annual production exceeds 550 million tonnes, about two thirds of which is harvested in the developing world¹. These crops occupy the second position after cereals and are the major sources of carbohydrates. In the world’s food supply these crops play an important role and also act as the valuable source of processed products for human consumption. The edible starch is stored in the underground part of the plants like roots, stem rhizomes corm and tubers. These tuber crops are sourced from diversified plant sources. Depending upon the demand of energy required in different types of populations the demand for root and tuber crops varies with the country. Annually the universal production of root and tuber crops is approximately 836 million tonnes. Asian continent is contributing 33% of root and tuber crops of the total global production.

Diversity of wild endemic as well as cultivated species of *Dioscorea* spp. is high in the dry western area in Menabe central, Morondava of Madagascar. A comparative study in between the dry western area and humid area of eastern slopes of Brickaville of Madagascar was studied for the differences in diversity of *Dioscorea* spp. in relation with bioclimatic areas, local knowledge, sustainable utilization and traditions related to yams². Nutritional value and variation in taste (hedonic value) of yam tubers were also analyzed in this study. *Dioscorea* species comprises a genus of about 613 tuberous climbers³ especially *D. alata* L., *D. caryennensis* lam sub sp. *caryennensis* and *D. caryennensis* lam subsp. *rotudanta* (Poir.) J. Miegé are of foremost important staple crop in Western Africa^{4,5}. Data revealed that about 50 species are eaten as wild staple food in scarcity of food and retains importance for global food security⁵. *Dioscorea* species have been used in traditional medicines and also as a source of steroidal precursors⁶⁻⁹. Tubers of *Dioscorea* are rich source of steroidal C saponins¹⁰. About 15 species of *Dioscorea* are used as a source of diosgenin with estimated market value of \$500 million¹¹. Diosgenin is used as the starting material for the synthesis of pregnenolone

*Corresponding author

derived steroids⁵. About 2 to 3% diosbulbin B (DIOB) is isolated from the root tubers of *D. bulbifera* L. The rhizome is traditionally used to treat breast lumps, carbuncles, sore throat and tumor in China and other Asian countries. *Dioscorea* species is used in traditional medicines documented since 2000 BC¹². *D. dumetorum* and *D. hispida* Dennst. are poisonous due to the presence of polar alkaloids. *Dioscorea bulbifera* L. is pharmacologically studied for antitumor, anti HIV, anti-inflammatory, diuretic, gastroprotective, antioxidant, antimicrobial, cardioprotective and antihyperthyroid activities¹³. It is well known that rice is the staple food of the Kandha people; but besides rice, they also take ragi, mandia, kandul, maize, mushrooms and various kinds of roots and tubers, leafy vegetables and vegetables, and wild edible fruits and berries and also bamboo sprouting¹⁴ (kardi). They generally preserve mango stones, tamarind seeds, jackfruit seeds and some of the root and tuber crops to eat in the off season. *Gundelia* species is also used as traditional food and medicine in Tunceli, Turkey¹⁵. Literature data revealed the use of 85 wild plants belonging to 38 families with their local names, parts of the plant used and the method of preparation for the treatment of various diseases like cold, shortness of breath, heart and gastrointestinal problems by the local people of Ballakayati district of North Iraq¹⁶. *Ziziphora* taxa was also reported as the potential source to be consumed as spice and herbal tea; in pharmaceutical, cosmetics because of presence of essential oil and also used in beverage industry¹⁷.

The tuber crops are important for their storage capacity in the ground for a longer period and also requirement of low labour¹⁸. Among these tuber crops, sweet potato [*Ipomea batatas* (L.) LAM.] and potato (*Solanum tuberosum* L.) are well known as popular tuber crops, but several other crops are also utilized by “Dongria Kandha” tribes as these crops are readily available naturally and also cultivated by these people in order to supplement their consumption. Amongst these crops Cassava (*Manihot esculenta* Crantz.), elephant foot yam (*Amorphophallus*), *Colocasia*, yam (*Dioscorea*) and arrowroot (*Maranta arundinacea* L.) are widely used.

Few lesser known tuber crops have received attention since for the last 10 years because of their ability to withstand to marginal conditions¹⁹. A number of wild crops remain unexplored and some of them have excellent medicinal and nutritional properties. An attempt has been made to document the

tuber crop species consumed by ‘Dongria Kandha’ tribe with a special emphasis on *Dioscorea* species which was used maximum. This would be helpful for researchers for utilization of these species in drug discovery and also to set up food preservation and processing industries to restore and conservation of these species.

Materials and Methods

The present work is based on review of literature and fast hand information gathered through field studies conducted among the ‘Dongria Kandha’ tribe inhabited in Kandhamal district of Odisha through the information gathered from the local people regarding the use of the available tubers as food and medicine.

Study area

Odisha, is a state on the eastern coast of India, known for its biodiversity with an area of 155.7 thousand kilometers and occupy 9th area rank in the country. The state is divided into 30 administrative geographical sections called districts²⁰⁻²² with 118 tribal blocks. In Odisha, out of 62 scheduled tribes constituting 22.43% of total population of the state, the ‘Kandha’ tribe is the most populous tribe with a population of 17.1 of total ST population according to Orissa population 2011-2018, census data. District wise distribution of the individual ST showed that the Kandha have the highest proportion in Kandhamal district with 93.3% and hence selected as the study area. Kandha are categorized into three categories such as Desia Kandha, Dongria Kandha and Kutia Kandha. Out of these three categories ‘Dongria Kandha’ is one of the primitive tribe out of 13 primitive tribes’ houses in Odisha and the primitive tribes are now re-designated as Particularly Vulnerable Tribal Group (PTVGs) by Government of India for the purpose of receiving special attention for their overall development. Dongria Kandha (Dongria Khond) is the 7th PTVGs. The district is rich with waterfalls, springs and hill stations with full of flora and fauna and is well known for its organic cultivated turmeric called as ‘Kandhamal Haldi’. Apart from rice the major crops cultivated area are tuber crops like turmeric, arrowroot, cassava and other vegetables (Fig. 1). The district lies between 83.30° E to 84.48° E longitude and 19.34°E to 20.54°E latitude; 300-1100 m altitude with area of 8,021 square km²³. The study was conducted to explore and document different wild edible root and tuber crops widely used

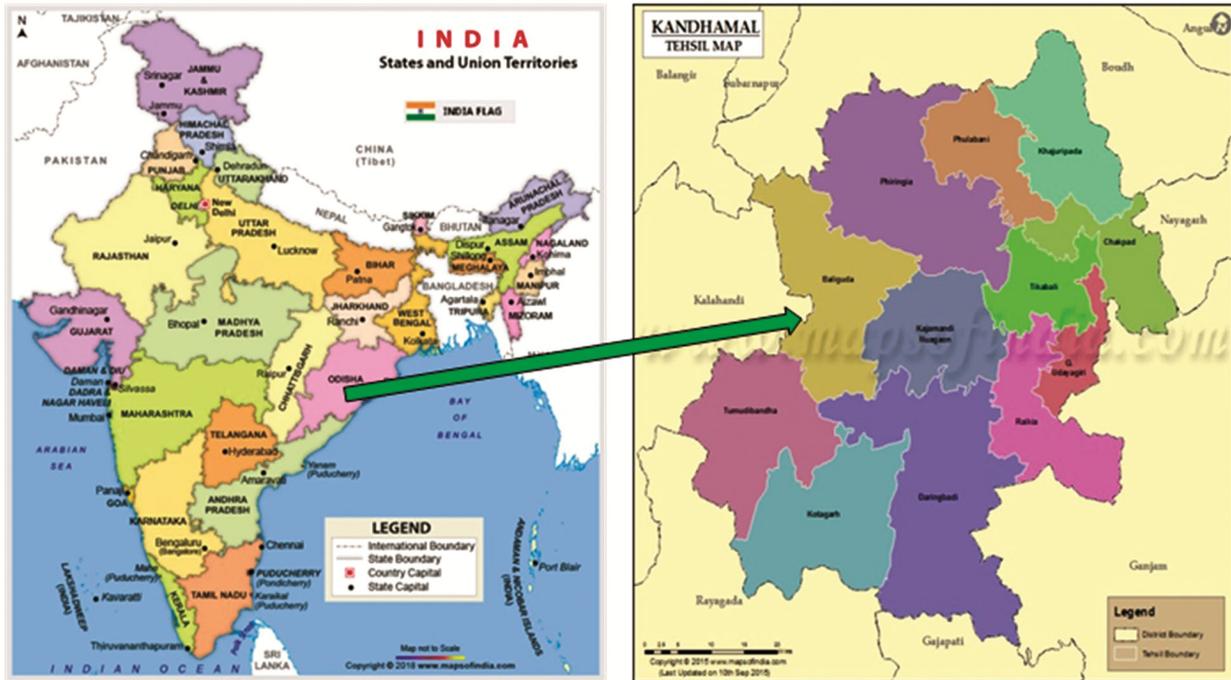


Fig. 1 — Kandhamal District Map of Odisha, India

by Dongria Kandha tribe in Kandhamal district of Odisha.

Site selection and survey

The food and medicinal habits of this tribal community are not fully explored even today. For these, Raikia and G. Udayagiri blocks of Kandhamal district were sufficiently covered for comprehensive listing of root and tuber crops, 25 villages as the ethnic zones were randomly selected (Table 1 & Table 2).

These selected villages are inhabited by Dongria Kandha tribes and the data were collected from these villages through the application of participatory research appraisal tools and techniques such as direct observation, group discussions, individual interviews and field visits during district visit programme from the year 2018 to 2019 organized by Kalinga Institute of Social Sciences University (KISS University), Bhubaneswar, which becomes the first exclusive tribal university in the world and is known as a preferred learning center for the poor indigenous children with an aim on sustainable livelihood. The tribal students of KIIS studying from these areas helped to access these remote villages and also in group discussion. Interviews were conducted by taking the help of KISS students as language translator. Generally ‘Dongria Kandha’ people do not

Table 1 — Village areas of Raikia block surveyed

District	Block	No. of villages	Selected Villages
Kandhamal	Raikia	11	Adunaju Bieripanga Budepanga Budiapanga Dadingi Dalbadi Gudruguda Masedikia Musumaha Pajimaha Piserama

Table 2 — Village areas of G. Udayagiri block surveyed

District	Block	No. of villages	Selected Villages
Kandhamal	G. Udayagiri	14	Ajayapada Babinjia Badenaju Gamuli Gundabaju Kamaraju Kanbagiri Kumbarkupa Kurmingia Malikapadi Mukingia Retudi Sirki Sujeli

share their knowledge to any outsiders. Apart from that the survey areas were also visited whenever necessary during this study. Different cultivated root and tuber crop fields were accessed. The indigenous farmers were requested to bring the samples of the tuber crops. Then the farmers were asked to encase the vernacular name and display different types of root and tuber crops consumed in their village. Through discussion, some key information like method of consumption, medicinal properties of each of the species and their vernacular name in ‘Kui’ language was recorded. The data were collected at random from the ‘Dongria Kandha’ tribes using personal interview schedule based on the prepared questionnaire (Fig. 2) with the co-operation and help taken from ‘Dongria Kandha’ students studying in KISS University. Data were analyzed through descriptive statistics to generate tables and summaries at different villages. The data were also collected regarding farmers perception towards irrigation,

major constraints in production, resilience of tuber crops. Other secondary data were collected from reports, articles and webpage.

Plant identification

The tuber crops were studied in the field for ascertaining their identity. The characters of the plant specimens were collected separately for thorough study, noted down and after critical study the specimens were identified following “The Botany of Bihar and Orissa”²⁴ and “The Flora of Orissa”²⁵ and a host of recent monographs and reviews. The unknown ones were identified by Dr. Nabin Kumar Dhal, Principal Scientist, IMMT (CSIR, Govt. of India), Bhubaneswar, Odisha. All the plant specimens were preserved in the repository of Centurion University after proper authentication by Dr N K Dhal at IMMT, CSIR, Bhubaneswar. The specimens viz., *Dioscorea alata* L., *D. bulbifera* L., *D. glabra* Roxb, *D. hamiltonii* Hook. f., *D. hispida* Dennst., *D. pubera*

Questionnaire for Collecting Ethno-Botanical data during Ethno-botanical Study

Informant’s consent for the participation in the study:

I..... hereby give my full consent and conscious to participate in this study and declare that to the best of my knowledge the information I have provided are true, accurate and complete.

Date:

(Signature/Thumb impression of Informant)

Name:

Gender:

Age:

Address:

Data about the tuber crops:

Local name:

Habit (Tree/Herb/Shrub/Climber etc.):

Uses (Medicinal/ vegetables/ direct consumption/other uses):

Mode of use:

Cultivated/Wild:

If cultivated, cultivated for:

If wild, availability in natural resources (easy/difficult/very difficult):

Methods of Collection and storage:

Remarks:

Plant identified as (Botanical name):

Family:

The information provided by the informants will be used for research purpose only)

(Signature of Researcher)

Fig. 2 — Ethno-botanical questionnaire

Blume, *D. oppositifolia* L., *D. pentaphylla* L., *D. tomentosa* J. Koengi ex Spreng, *D. wallichii* Hook. f., *Amorphophallus paeoniifolius* (Dennst.) Nicolson., *Colocasia esculanta* (L.) Schott., *Ipomoea batatas* (L.) Lam., *Manihot esculenta* Crantz., *Maranta arundinacea* L. were authenticated with the voucher specimen number BOT/SoAS/CUTM/103, BOT/SoAS/CUTM/104, BOT/SoAS/CUTM/106, BOT/SoAS/CUTM/108, BOT/SoAS/CUTM/110, BOT/SoAS/CUTM/112, BOT/SoAS/CUTM/114, BOT/SoAS/CUTM/116, BOT/SoAS/CUTM/105, BOT/SoAS/CUTM/107, BOT/SoAS/CUTM/109, BOT/SoAS/CUTM/111, BOT/SoAS/CUTM/113, BOT/SoAS/CUTM/115, BOT/SoAS/CUTM/117 respectively in the herbarium repository of Centurion University Campus, Bhubaneswar, Odisha. Data also was collected regarding the implementation of Govt. policy towards socio-economic status.

Results and Discussion

The data collected from the tribes of 25 villages of two blocks namely G. Udayagiri and Raikia block of Kandhamal district was categorized and analyzed. Data were collected from 11 villages from Raikia block and 14 villages from G. Udayagiri blocks (Table 1 & Table 2).

Seven species of tuber crops were found to be

consumed by Dongria Kandha tribe. Most of the villagers cultivated three species viz., *C. esculanta* (L.) Schott., *I. batatas* (L.) Lam. and *M. arundinacea* L. Out of these 7 species, 4 species viz., *S. tuberosum* L., *I. batatas* (L.) Lam., *C. esculanta* (L.) Schott. and *M. arundinacea* L. were found to be cultivated and other two species namely *M. esculenta* Crantz. and *A. paeoniifolius* (Dennst.) Nicolson were cultivated as well as found from wild sources whereas *Dioscorea* genus was collected from wild sources and occasionally a few species from *Dioscorea* genus were also cultivated (Table 3).

Results of morphological character

The morphological characteristics namely shape of the tubers, colour of the skin and flesh were presented in Table 4. It was revealed that two varieties of *I. batatas* L. with both purple and white skinned were cultivated. Amongst these tuber crops, tubers of different species of *Dioscorea* were shown to have maximum use among these people.

Dioscorea spp. is popularly known as yam and Ban aalu in Odisha, Ten species of *Dioscorea* were consumed by the tribal people (Table 5). Out of these 10 species, three species viz., *D. bulbifera* L., *D. hispida* Dennst. and *D. pubera* Blume are known to be bitter in taste and cannot be taken raw because

Table 3 — Tuber crops consumed by Dongria Kandha

Odia Name	Common name	Name by Dongria Kandha	Botanical name	Family	Status
Alu	Potatoes	Aalwa	<i>S. tuberosum</i> L.	Solanaceae	Cultivated
Saru	Taro	Hapa	<i>C. esculanta</i> (L.) Schott	Araceae	Cultivated/ wild
Olua	Elephant foot yam	—	<i>A. paeoniifolius</i> (Dennst) Nicolson	Araceae	Cultivated/Wild
Matialu/Khambaaalu	Yam	Naapa	<i>Dioscorea</i> spp.	Dioscoreaceae	Wild sometimes cultivated
Kandamula	Sweet potatoes	Ningilikuna	<i>I. batatas</i> (L.) Lam.	Convolvulaceae	Cultivated
Katha kanda	Cassava	—	<i>M. esculenta</i> Crantz.	Euphorbiaceae	Wild
Palua	Arrow root	—	<i>M. arundinacea</i> L.	Marantaceae	Cultivated

Table 4 — Morphological parameters of priority species

Number of priority species	Voucher number	Tuber parameters		
		Shape	Colour of the skin	Flesh color
<i>C. esculanta</i> (L.) Schott.	BOT/SoAS/CUTM/114	Spherical	Brownish	White/Off white
<i>A. paeoniifolius</i> (Dennst.) Nicolson.	BOT/SoAS/CUTM/113	Oblong	Brownish	Off white
<i>D. alata</i> L.	BOT/SoAS/CUTM/103	Ovate	Brownish	White
<i>I. batatas</i> (L.) Lam.	BOT/SoAS/CUTM/115	Elongated to nearly globular, tuberous	Purple and white	Off white
<i>M. esculenta</i> Crantz.	BOT/SoAS/CUTM/116	Tuberous, elongated sometimes fusiform	Brownish	White
<i>M. arundinacea</i> L.	BOT/SoAS/CUTM/117	Fusiform	Off white	White

Table 5 — *Dioscorea* spp. consumed as priority species by Dongria Kandha tribe

Common name	Odia name	Name by Dongria Kandha	Botanical name	Voucher number	Occurrence	Uses
Purple Yam/ Greater yam/ Winged yam/ water yam	Khambaaalu/ Paanikanda	Naapa	<i>Dioscorea alata</i> L.	BOT/SoAS/CUTM/103	Frequent	Edible
Air yam/ bitter yam	Pita aalu	Naapa	<i>D. bulbifera</i> L.	BOT/SoAS/CUTM/104	Frequent	Edible
Wild yam	Vanaalu	Kirpa/ Saragaakanda	<i>D. glabra</i> Roxb.	BOT/SoAS/CUTM/105	Abundant	Edible
Yam	Banaalu	Latarikanda	<i>D. hamiltonii</i> Hook.f.	BOT/SoAS/CUTM/106	Frequent	Edible
Intoxicating yam	Matialu	Jalka	<i>D. hispida</i> Dennst.	BOT/SoAS/CUTM/107	Rare	Edible/ medicinal
Chinese yam/ Cinnamome vine	Kantaaalu/ Paaniaalu	Pit Kanda	<i>D. oppositifolia</i> L.	BOT/SoAS/CUTM/108	Frequent	Edible
Five leaf yam	Panchapatriaalu	Mitnikanda	<i>D. pentaphylla</i> L.	BOT/SoAS/CUTM/109	Rare	Edible
—	Ban alu	Kasha kanda	<i>D. pubera</i> Blume	BOT/SoAS/CUTM/110	Rare	Edible/ medicinal
—	—	Cherengakanda	<i>D. wallichii</i> Hook. f.	BOT/SoAS/CUTM/111	Frequent	Edible
—	—	Laharikanda	<i>D. tomentosa</i> J. Koengi Spreng ex	BOT/SoAS/CUTM/112	Frequent	Edible/ medicinal

of unpalatable nature. The tribal people use these tuber crops as food supplement by making them edible by different traditional methods. Apart from the nutritional importance, these tubers crops possess some antinutritional factors and secondary metabolites, which make them bitter in taste and thereby reduce the palatability. The major toxic content is an alkaloid i.e., dioscorine present in most of species of *Dioscorea*²⁶. Dioscorine triggers fatal paralysis of nervous system²⁷. Histamin was reported to be the principal allergen present, responsible for inflammation and itching²⁸.

Other compounds reported in *Dioscorea* are furanoid-norditerpene, saponin, oxalate, tannin and phytic acid. Furanoidn or diterpenes have been identified from *D. bubifera* L. by several researchers²⁹. Therefore different methods like boiling, steaming and direct baking over coals after cleaning and peeling of the tubers are implemented to reduce the bitterness by the tribe. After processing these tubers are used as a source of food during extreme climatic conditions like drought or in the shortfall period. The unpalatable tuber crops are generally made in to pieces and left overnight in stream. Then these tubers are subjected to successive boiling to remove the bitterness^{30,31}. The other reason might be that some toxic substances might be removed from these tubers and some useful elements might enter into these tubers by keeping them overnight in stream. However this cannot be accepted unless experimentally substantiated. The uses of ten species of *Dioscorea* were described below.

1. *D. alata* L.

Raw tubers: Used to treat leprosy, blood pressure and skin diseases. Boiled tuber: used as vegetable

2. *D. bulbifera* L.

Raw tubers: Grounded and taken as antihelminthetic and also used to treat cough, cold, asthma, sore throat, constipation, indigestion and contraceptive. Roasted tubers: Consumed as vegetable and also used as fodder.

3. *D. glabra* Roxb.

Boiled tubers: Boiled tuber is edible³²

4. *D. hamiltonii* Hook.f.

Raw tubers: Stomach ache, appetite booster, diarrhoea, reduce body heat during summer Boiled tubers: Cooked tuber is edible

5. *D. hispida* Dennst.

Raw tuber: Used to cure indigestion, vomiting, antihelminthes.

Roasted tubers: Roasted, pounded and applied on injuries. The tuber is used as famine food or poverty food to nourish people in time of hunger and starvation during economic depression, natural disasters or by war or genocide. This tuber is toxic because of high content of dioscorine but was consumed at the time of severe food shortage by the tribe after keeping the tubers overnight in water followed by repeated washing for several times for detoxification. It was made into small pieces and washed off in running water and boiled for longer period in salt water. This is also used in making alcohol and as cooling agent to reduce body heat during summer.

6. *D. pubera* Blume

Bulbils: edible after boiling to treat colic pain³³

Raw Tuber: unpalatable because of bitter taste. Using different traditional practices it was made edible, used for birth control and relieving from skin infections. Tubers were boiled and mixed with rice, salt and eaten a famine food.

7. *D. oppositifolia* L.

Raw Tuber: boost appetite

Boiled tubers: reduce body heat during summer
Roasted tubers: eaten with salt to reduce cough, used against dysentery, bronchial cough, good for intestinal colic, acidity, rheumatoid arthritis, and asthma and used in relieving pain of child birth.

8. *D. pentaphylla* L.

Raw tubers: Edible after boiling in scarcity of rice, enhances body immunity, used to get rid of boils, relieves joint swelling, stomach pain, Tuber powder is given orally in abdominal pain after delivery.

9. *D. tomentosa* J. Koengi ex Spreng

Raw tubers: This tuber is used as oral contraceptives, also used to cure rheumatism

10. *D. wallichii* Hook. f.

Raw tubers: Edible after boiling and peeling off the skin, used in stomach pain

Roasted tubers: It is used to reduce bloating of stomach

Discussion

The above ten species of *Dioscorea* are edible and also used to treat different ailments. The curative properties of these crops are due to presence of certain bioactive compounds present in them. The bioactive compounds present in most of the *Dioscorea* species are in the phenolic group of compounds³⁴⁻³⁶. Uses of these tuber crops have been documented for their therapeutic properties for curing various elements as well as for culinary properties. It was revealed that the tubers of *D. bulbifera* L. were made palatable by implying few above described methods and are used as a source of food during extreme climatic conditions when there is scarcity of rice⁵. In some places detoxifications is done with lime or sand and then slow roasting and repeated boiling with wood ashes followed by steeping sliced pieces in running water.

Most of the farmers cultivate tuber crops like cassava, elephant foot yam, sweet potato, colocasia and arrowroot. Out of these 7 species three species were found to be cultivated in the fields and other 5 species were available in wild (Fig. 3, 4 & Fig. 5). The high dominance of wild species indicates that in

many villages life is still traditional and local people remain dependent on nature. Regular harvesting from wild sources might be the cause for decrease in the



Fig. 3 — Harvested *Cassava*



Fig. 4 — Harvested *Colocasia*



Fig. 5 — Digging out of *Dioscorea* spp. by the tribal people

production rate which was reported in South America and the production rate was decreased with 20.1, 1.2, 1.3% for tuber crops like cassava, sweet potato and yam respectively because of weather condition, disease and pest infestation^{37,38}. Out of these species consumed by these tribes proportion of wild and cultivated species were also variable. This result establishes the truth that the tribal community depends on these tuber crops not only in the household nutrition but also as the supplementary food against paddy when the paddy production is low in variable climatic conditions. Maximum number of species was found to be consumed by the same tribe in different villages of these two blocks.

Need for conservation and promotion to cultivate the tuber crops

This investigation revealed that the ‘Dongria Kandha’ tribes generally practicing intercropping and crop rotation in order to consume as supplementary food in decreased paddy production because of extreme climatic conditions. The villagers were also reported that a variation in climate change has also an

important role on growth and on production of paddy. Because of the low profitability in cultivation of paddy, there is a shifting of paddy land to other crops especially tuber crops to be used as staple food and other cash crops to enhance economy and sustainability. Most of the farmers reported that intercropping of tuber crops with brinjal, amaranthus and maize and fruit crop like banana. Crop rotation was also practiced by this tribe with vegetables like pumpkins, chilly, watermelons and corn. This crop rotation pattern was also implemented by them in their field. The farmers reported that both the crop rotation and intercropping is proved to be highly profitable and also this will enhance the soil productivity.

The State government should give prior emphasis to create motivation towards cultivation and proper storage of these crops, so that this would fulfill the demand of consumption of the inhabiting people. The geographical location and the climatic factors play important roles, therefore the local tribal people should be motivated for intercropping and crop

rotation through government agencies like Krishi Vigyan Kendra (KVK) and other associated NGO's in order to minimize rural poverty. The tuber crops would definitely give promising results towards food security and thereby in diminishing rural poverty.

Conclusion

The present study documented different types of tuber crops used as food and medicine by Dongria Kandha tribe of Kandhamal district of Odisha. Vernacular names of these tuber crops were documented. There is need for conservation and enhancement in production of the edible tuber crops which would be beneficial in diminishing rural poverty as well as ensure food security. This study will contribute for pharmacological research to discover new drug sources.

Acknowledgement

The authors are thankful to the tribal communities of the villages of G Udayagiri and Raikia block of Kandhamal district and the students of KISS University of these two blocks who had involved for their support as translator for describing the uses and importance of these species. Prior informed consent was taken from the knowledge providers as per the NBA/CBD guidelines. The photographs of practices were also taken after taking the permission from the concerned persons. The authors are thankful to Dr Nabin Kumar Dhal, Principal Scientist, IMMT (CSIR) and Bhubaneswar for identification and authentication of the collected species. The research work was not funded by any funding agency and the work was carried out by the student for M. Phil. dissertation.

Conflict of Interest

'Authors have no conflict of interest'

Author Contributions

SP conceived the idea, supervised this work and wrote the manuscript. MS investigated the findings of this work. Both the two authors discussed the results and contributed to the manuscript.

References

- 1 Wheatley C, Scott G J, Best B & Wiersema S, Adding value to root and tuber crops. A manual on product development, *International Centre for Tropical Agriculture Publication* No. 247 (1995) Columbia.
- 2 Jeannoda V, Razanamparany J L, Rajaonah M T, Monneuse M O, Hladik A, *et al.*, The yams (*Dioscorea* spp.) of Madagascar, wild endemic and cultivated species; diversity, perception, nutritional value and sustainable management, *Reveu d Ecologie*, 62 (2-3) (2007) 191-207.
- 3 Govaerts R, Wilkin P & Saundera R M K, World checklist of Dioscoreales: Yams and their Allies (Kew Publishing, 2007). Available at: <http://apps.kew.org/wcsp/home.do>.
- 4 Mignouna H D, Abang M M & Asiedu R, Harnessing modern biotechnology for tropical tuber crop improvement: yam (*Dioscorea* spp.) molecular breeding. *Afr J Biotechnol*, 2 (2003) 478-485
- 5 Martin F W & Degras L, Tropical yams and their potential: part 6. Minor cultivated *Dioscorea* species. *Agricultura handbook* Number 538 (Science and Education Administration, United States Department of Agriculture in cooperation with agency for International Development (1978). <http://naldc.nal.usda.gov/naldc/download.xhtml?id=CAT87209435&content=PDF>.
- 6 Shah N C, My experiences with herbal plants and drugs as I knew Part XVI: *Dioscorea* and *Costus* Herb, *Tech, Ind*, (2010) 21-30.
- 7 Coursey D G The civilizations of the yam: interrelationships of man and yams in Africa and the Indo-Pacific region. *APAO*, 7 (1972) 215-233.
- 8 Ramawat K G Das S & Mathur M, *In Herbal Drugs: Ethnomedicine to modern Medicine* edited by K G Ramawat, Ch. 2 (2009) 7-32.
- 9 Crabbe P, Some aspects of steroid research based on natural products from plant origin, *Bull Des Soc Chim, Belges*, 88 (2009) 345-358
- 10 Heftmann E, Bennett R D, Bonner J, Biosynthesis of diosgenin in *Dioscorea* tubers, *Arch Biochem Biophys*, 2 (1962) 13-16.
- 11 Martin F W, The species of *Dioscorea* containing sapogenin, *Econ Bot*, 23 (1969) 373-379
- 12 Singh KN, Kaushal R C, omprehensive notes on commercial utilization, characerestics and status of steroid yielding plants in India, *Ethnobot. Leafl.*, 11 (2007) 45-51
- 13 Galani V J, Patel Divyeshkumar M A, Comprehensiv Phytopharmacological Review of *Dioscorea* bulbifera Linn, *Int J Env Sci Nat Res*, 4 (5) (2017) 177-187.
- 14 Parida S, Rout K K & Mishra S K, Method of identification and standardisation of "Vamsalochana" (Bamboo Manna), *Indian Drugs*, 51 (01) (2014) 55-58
- 15 Çakılcıoğlu U, An ethnobotanical field study; Traditional foods production and medicinal utilization of *Gundelia* L. species in Tunceli (Turkey), *Indian J Tradit Know*, 19 (4) (2020) 714-818.
- 16 Kawarty A M A Behçet L & Cakilcioğlu U, An ethnobotanical survey of medicinal plants in Ballakayati (Erbil, North Iraq), *Turk. J. Bot*, 44 (2020) 345-357.
- 17 Satil F & Selvi S Ethnobotanical Features of *Ziziphora* L. (Lamiaceae) Taxa in, *Turkey, Int J Nat Life Sci*, 4 (2020) 56-65.
- 18 FAO, Traditional Food Plants, *Food and Nutrition Paper* 42, *Food and Agri Orga of the United Nations*, Rome 1988
- 19 Plucknett D L, Tropical root crops in the eighties. In: *proceeding of the 6th Symposium of the International Society for Tropical Root Crops, International Potato Center*, Lima, 1983, pp 6-8
- 20 Anonymous a, 2012, "List of Districts". Retrieved 13 January

- 21 Anonymous b, *Districts of Odisha*, (2012) Archived from the Original on 16 January
- 22 Anonymous, *Districts of Odisha, Official Portal, Bhubaneswar, Govt. of Odisha*, (2013) Retrieved 4 January
- 23 Anonymous, *District Census 2011.co.in.* (2011) Retrieved 2011-09-30
- 24 Haines H, *The Botany of Bihar and Orissa*, 6 parts, London. Calcutta, Botanical Survey of India (1921-1925).
- 25 Saxena H O Brahmam, *The Flora of Orissa*, vol. I-IV, RRL and OFDE Ltd., Bhubaneswar, 1994-1996.
- 26 Lu Y L, Chia C Y, Liu Y W & Hou W, Biological activities and applications of dioscorins, the major tuber storage proteins of yam, *J. Tradit. Complem. Med*, 2 (2012) 41–46
- 27 Reddy D S, Ethnobotanical studies of *Dioscorea hispida* Dennst. In Nallamala forest area AP, *India, Rev, Res*, 4 (2015) 1–4.
- 28 Shim W S & Oh U, Histamine-induced itch & its relationship with pain, *Mol. Pain*, 4 (2008) 29–32.
- 29 Webster J, Beck W & Ternai B, Toxicity and bitterness in Australian *Dioscorea bulbifera* L. and *Dioscorea hispida* Dennst. from Thailand, *J Agric Food Chem* 32 (1984) 1087–1090.
- 30 Kumar S, Parida A K & Jena P K, Ethno-medico-biology of banaalu (*Dioscorea* species): a neglected tuber crops of Odisha, India, *Int J Pharm Life Sci*, 60 (2013) 129-135.
- 31 Misra R C, Sahoo H K, Pani D R & Bhandari D C Genetic resources of wild tuberous food plants traditionally used in Similipal Biosphere Reserve, Odisha, India, *Genet Resour Crop Evol*, 60 (2013) 20-33.
- 32 Elanchezian R, Kumar R S, Beena S J & Suryanarayana M A, Ethnobotany of Shompens-a primitive tribe of Great Nicobar Island, *Indian J Tradit Know*, 6 (2) (2007) 342- 345.
- 33 Pandey A K & Rout S D Ethnobotanical used of Plants of Similipal Biosphere Reserve (Orissa) *Ethnobotany*, 18 (2006) 102-106.
- 34 Liu H, Tim K W, Chou G X, Wang J M Jiand L L, *et al.*, Phenolic compounds from the rhizomes of *Dioscorea bulbifera*, *Chem. Biodivers*, 8 (2011) 2110–2116.
- 35 Saxena S & Raja A S M, *Natural Dyes: Sources, Chemistry, Application and Sustainability Issues*. Singapore: *Springer International Publishing AG*, 2014.
- 36 Van H P, Phenolic compounds of cereals and their antioxidant capacity, *Crit Rev Food Sci Nutr*, 56 (2016) 25–35.
- 37 Lalfakzuala R, Lalramnghinglova H and Kayang H, Ethnobotanical usages of plants in Mizoram, *Indian J Tradit Know*, 6 (3) (2007) 486-493
- 38 FAO, 1985. Available at: <http://www.fao.org/3/T0207E01.GIF>