



# Ethnobotanical and Nutritional Evaluation of Some Edible Fruit Plants of Southern Odisha, India

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## Abstract

The present paper reports the ethnobotanical use of 110 edible fruit plant species under 83 genera and 47 families, of which 103 species belong to dicots, 6 species to monocots and one species to gymnosperm. Out of these species, 100 species were wild, 10 species that were wild as well as cultivated. The edible fruit plants constitute 15 herbs, 42 shrubs, 3 climbers and 50 tree species. It also reports the nutrient value of edible fruits of 22 plants of Southern Odisha, India. Most of these fruits of these plants are used by the tribal/rural people at the time of food scarcity. Analysis of nutritive values such as crude protein, total sugar, total lipid, vitamin B<sub>1</sub> and vitamin C content of the selected fruits revealed that fruits of *Semecarpus anacardium* showed highest crude protein (3.2%) and vitamin B<sub>1</sub> content (0.0024 mg g<sup>-1</sup>) while fruits of *Phoenix sylvestris* showed the highest total sugar content (33.9%). Fruits of *Flacourtia indica* showed the highest total lipid content (0.075 mg g<sup>-1</sup>) while fruits of *Phyllanthus emblica* exhibited the highest vitamin C content (5.16 mg g<sup>-1</sup>). Some of these fruits may be useful as food and medicine that are required in small quantities to cure some of the diseases the tribal and rural poor suffer from.

**Keywords:** Edible fruit plants, ethnobotany, nutritive value, southern Odisha, tribal people.

## 1. Introduction

Wild food plants are categorised as underutilized or neglected crops that occurring in wild or are grown in local scale whose economic potential have been poorly addressed, confining it into mostly traditional and local use only. A considerable proportion of tribal population is still under-nourished and the people living in remote areas cannot produce enough food grains to meet the yearly requirement. Therefore, a large share of such population meets its food requirement through non-conventional means by consuming various wild plants and animal resources especially in periods of food scarcity (FAO, 2004; Balemie & Kebebew, 2006). Collection,



consumption and trading of forest food products is thus a skill for a group of people for coping and adapting to poverty, growing food demand and seasonal food scarcity. The indigenous forest foods are of great cultural significance to rural/tribal population in developing countries including India (Maikhuri *et al.*, 2004; Kala, 2007; Misra *et al.*, 2008; Rana *et al.*, 2012).

Wild food plants serve as alternative to staple food during periods of food deficit and are the valuable supplements for a nutritional balanced diet; one of the primary alternative source of income for many resource poor communities, and the source of species for domestication (Shrestha & Dhillon, 2006). Wild fruits are important for the potential resources which could be utilized at the time of scarcity or during normal days or cultivated as a source of food material for an ever increasing population (Rashid *et al.*, 2008). Although the use of wild fruits has recently decreased, many people in rural areas still use them extensively as a supplement to their basic food requirement, some are preserved for use during periods of scarcity, they are sometime sold in the urban market and are then in competition with exotic fruits (Manyafu, 1971).

Use of non-cultivated foods, of which wild fruits form a part, as a diet supplement in times of plenty, as a component of local responses to increasing food insecurity and as one of the major coping mechanisms at times of food shortage and famine is widely documented (Abbink, 1993; Guinand & Dechassa, 2000; Getachew *et al.*, 2005; Redzic, 2007; Fentahun & Hager, 2009). Wild food contributes to diet diversity and hereby constituting an essential part of nutritionally poor diet (Bell, 1995; FAO, 2005). Wild fruits provide vitamins, flavourings and compounds of nutritional, gastronomic and social important such as alkaloids, essential oils and phenolics derived from secondary metabolism (FAO, 1999).

Much work has been done on ethnobotany of wild edible plants world over (Ali-shtayeh *et al.*, 2008; Turner *et al.*, 2011; Abubakar *et al.*, 2012; Ju *et al.*, 2013; Kang *et al.*, 2014). In India, much work has been carried out on ethnobotany of wild edible plants (Maheswari & Singh, 1984; Sundriyal *et al.*, 1998; Getachew *et al.*, 2005; Sankaram *et al.*, 2006; Rashid *et al.*, 2008; Hebbar *et al.*, 2010; Deshmukh & Waghmode, 2011; Valvi *et al.*, 2011; Ajesh *et al.*, 2012; Shukla & Chakravarty, 2012; Pegu *et al.*, 2013; Suresh *et al.*, 2014). There are some reports on ethnobotany and traditional use of wild edible plants of Odisha (Girach *et al.*, 1988; Girach & Aminuddin, 1992; Girach *et al.*, 1992; Das & Das, 2009; Mishra & Chaudhury, 2011; Sahoo & Goel, 2012).

Attempts have been made by researchers worldwide on compositional evaluation and functional properties of various types of wild edible fruit plants (Bello *et al.*, 2008; Mohan & Kalidass, 2010; Abdulrahman *et al.*, 2011; Olujobi, 2012; Deshmukh & Rathod, 2013; Deshmukh, S. & Rathod, 2013). In India, nutritional evaluation of various types of edible fruit plants have been reported by various authors (Dahot, 1993; Nazarudeen, 2010; Deshmukh & Waghmode, 2011; Gupta *et al.*, 2011; Vishwakarma & Dubey, 2011; Jain & Tiwari, 2012; Mahapatra *et al.*, 2012; Seal, 2012; Rathi *et al.*, 2012; Anjum & Tripathi, 2013). Work on wild edible fruit plants and their nutritional evaluation of Southern Odisha is meagre. In this study, an attempt has been made to collect ethnobotanical information on wild edible fruit plants and their nutritional analysis in south Odisha, India.



## 2. Methods

### 2.1 Study area

Odisha state, in the eastern part of India, consists of 30 districts. Of these seven districts, viz., Ganjam, Gajapati, Rayagada, Koraput, Nawrangpur, Malkangiri and Kandhamal are in the southern part (collectively called as southern Odisha) with a diversified geographical status extending from coast to interior mountainous areas (Figure 1). This region constitutes a part of the Eastern Ghats of India. All these districts are covered with forest and inhabited by different ethnic groups, viz., Kondha, Koya, Paraja, Saura, Langia Saura, Bonda, Paika, Bhumia, Bhatra, Gond, Munda, Didayi, Gadaba, Juang and Kutia Kandha. Tribal and rural poor people collect wild plant products free from the environment especially from the forest and consume them. Many of the wild forest products are consumed in normal time and some products during times of food scarcity.

### 2.2 Field survey and data collection

For the survey, different places of southern Odisha were visited in different seasons during 2010-2014 and some of the elderly tribal and non-tribal men and women were identified and were interviewed to collect information on edible fruit plants. A questionnaire was developed to collect information on Odia name of the plant, parts used, method of collection of plant parts, its availability and mode of food preparation. The data collected in this study is based on first-hand information. The referred plant specimens were collected in the company of at least one elderly man to make sure that the correct plant has been collected. The collected plant specimens were dried and herbarium specimens were prepared and deposited in the Herbarium of the P.G. Department of Botany, Berhampur University (BOTB), Berhampur.

The specimens were identified with the help of the local floras (Saxena and Brahmam 1994-1996; Misra *et al.* 2009). The plants are enumerated alphabetically as per their botanical name along with family, Odia name (O), habit, ethno-botanical uses, consumption pattern, locality and fruiting period.

### 2.3 Sample preparation

Out of 110 wild edible fruit plants, 23 plant specimens were selected for nutritional analysis of edible parts. The selected plants are *Carissa carandas*, *Casearia graveolens*, *Corchorus aestuans*, *Coccinia grandis*, *Diospyros melanoxylon*, *Ficus benghalensis*, *F. racemosa*, *F. hispida*, *Flacourtia indica*, *Lantana camara* var. *aculeata*, *Limonia acidissima*, *Mangifera indica*, *Melothria heterophylla*, *Ocimum canum*, *Phoenix sylvestris*, *Pithecellobium dulce*, *Phyllanthus emblica*, *Semecarpus anacardium* (Thalamus), *Syzygium cumini*, *Tamarindus indicus*, *Ziziphus mauritiana* (ripe and unripe fruit) and *Z. oenopolia*. About one gram of fresh fruit sample (edible parts) was taken for each determination.



## 2.4 Chemical analysis

Moisture content of the selected edible fruit sample was determined by keeping the sample in a hot air oven at 70 °C for a constant weight. Crude protein content of the fresh fruit samples was determined by following Bradford method (Sawhney & Singh, 2006). For extraction of total sugar Anthrone-Suphuric acid reagent test was applied (Sawhney & Singh, 2006). For extraction of total lipid, Chloroform: Methanol mixture (2:1 vol) test was applied (Sawhney & Singh, 2006). Visual titration method based on reduction of 2, 6-dichlorophenol indophenols dye was adopted for estimation of ascorbic acid (vitamin C) content (Sawhney & Singh, 2006). Spectrofluorometric method using oxidising agent potassium ferricyanide was adopted for quantitative determination of thiamine (vitamin B<sub>1</sub>) content of selected fresh fruit (edible part) sample (Sawhney & Singh, 2006).

## 3. Results

### 3.1 Enumeration of plants

**Alangium salvifolium** (L.f.) Wangerin (Alangiaceae) O: *Ankula*

Small bushy tree. Sweet ripe fruits are eaten as raw. Common in waste ground, waysides and mixed forest. March - July.

**Allophylus serratus** (Hiern) Kurz (Sapindaceae) O: *Khandakoli*

Branched shrub. Ripe fruits are eaten as raw. Common in scrub forests. July - October.

**Ampelocissus latifolia** (Roxb.) Planch (Vitaceae) O: *Kanjinoi*

Large shrub. Blackish purple berries are sweet sour in taste; eaten by tribal people. Frequent in open forests and scrub forest. June - October.

**Antidesma acidum** Retz. (Euphorbiaceae) O: *Nunnunia, Jamula*

Large shrub or small tree. Ripe fruits are eaten as raw. Common in forest. June - December.

**Antidesma ghaesembilla** Gaertn. (Euphorbiaceae) O: *Katha murmuri*

Shrub or small tree. Fruits are acidic with acid taste and are eaten as raw. Common in forest. April - October.

**Aporosa octandra** (Buch.-Ham. ex D. Don) Vickery (Euphorbiaceae) O: *Masania*

Small tree. Ripe fruits are eaten as raw. Common near streams. February - May.

**Ardisia solanacea** (Poir.) Roxb. (Myrsinaceae) O: *Tinkoli*

Small tree or large shrub. Juice of ripe fruit is a favorite drink of tribal people. Common in forest, close to streams. March - January.

**Argemone maxicana** L. (Papaveraceae) O: *Kanta kusuma, Udisamari*

Herb. Seed oil is used for cooking and edible purpose by the tribal people during emergency. Common weed. Most part of the year.

**Argyreia cymosa** Wight (Convolvulaceae)

Herb. Ripe fruits are sweet in taste, eaten as raw. Common in jungle. November - February.



**Bambusa bambos** (L) Voss (Poaceae) O: *Kantabanso*.

Large shrub. Cake prepared out of seed flour. Common in moist valley. Young shoots (culms) emerge during rainy season.

**Bauhinia vahlii** Wight & Aran. (Caesalpiniaceae) O: *Siali, Sialipatra*

Woody climber. Cotyledons are eaten. Roasted seeds are an important diet of tribal people. Common in mixed sal forest. December - March.

**Bombax ceiba** L. (Bombacaceae) O: *Simuli*

Tree with prickly trunk. Unripe green fruits are fried and eaten. Seed made into edible flour and cake. Common throughout the area. January - May.

**Bridelia montana** (Roxb.) Willd. (Euphorbiaceae) O: *Marda*

Large shrub or small tree. Ripe fruits and seeds are eaten as raw. Common in semi-evergreen forest, especially in valleys. August - December.

**Bridelia retusa** (L.)A. Juss. (Euphorbiaceae) O: *Kasi, Panikasi*

Small or moderate sized tree. Ripe fruits are eaten as raw. Common in forest, especially in valleys. August - January.

**Buchanania cochinchinensis** (Lour.) M. R. Almeida (Syn. *Buchanania lanzan* Spreng.)  
(Anacardiaceae) O: *Charakoli*

Small tree. Ripe fruits and seeds are eaten as raw. Common in dry deciduous forest. April - May.

**Cajanus scarabaeoides** (L.) Thouars. (Syn. *Atylosia scarabaeoides* (L.) Benth.) (Fabaceae) O: *Kulthia, Ban-Kulthia*

Shrub. Seed are eaten as raw. Fairly common in open forest. August - January.

**Calamus guruba** Buch.-Ham. (Arecaceae) O: *Kanta beta*

Large climber. Pulp of ripe fruit is eaten. Along the streams in the hills. March - December.

**Calamus viminalis** Willd. (Arecaceae) O: *Beta, Panibeta*

Shrub. Ripe fruits are eaten as raw. Common in damp forest. September - April.

**Capparis brevispina** DC. (Capparaceae) O: *Lepura, Niphura*

Erect shrub. Unripe green fruits are fried and eaten; ripe fruits are eaten as raw. Common in scrub forest. January - June.

**Capparis zeylanica** L. (Capparaceae) O: *Asadhua*

Climbing shrub. Fruits are made into pickle. Ripe fruits with white pulp are occasionally eaten by tribal people. Common in scrub forest, thickets, hedges. February - October.

**Careya arborea** Roxb. (Lecythidaceae) O: *Kumbhi*

Small or medium-sized tree. Ripe fruits are aromatic, often cooked and eaten. Common in forest, especially in valleys. April - August.

**Carissa carandas** L. (Apocynaceae) O: *Ankukoli* (Figure 2a)



Large shrub or small tree. Ripe fruits are consumed as raw and unripe fruits are made into pickle. Occasional, in dry forest. June - October.

**Carissa spinarum** L. (Apocynaceae) O: *Ankhukoli, Sana Karenda*

Shrub. Ripe fruits are consumed as raw and unripe fruits are made into pickle. Fairly common, especially in scrubs and open forests. March - December.

**Cipadessa baccifera** (Roth) Mig. (Meliaceae) O: *Pittamari* (Figure 2b)

Shrub or small tree, common, especially in scrubs and open mixed forest. Ripe fruits are eaten as raw. March - November.

**Coccinia grandis** (L.) Voigt. (Cucurbitaceae) O: *Bana torada* (Figure 2c)

Climbing herb. Green fruits are cooked and eaten. Common in hedges and thickets. Improved varieties are also cultivated. Most part of the year.

**Combretum album** Pers. (Combretaceae) O: *Atundi, Koralkundia*

Under shrub. Roasted seeds are eaten by tribal people. Common along waysides in sal forest, often in burnt forest. November - June.

**Combretum nanum** Buch.-Ham. ex D. Don (Combretaceae)

Under shrub. Seeds roasted with salt and eaten. Common along waysides in sal forest, often in burnt forest. March - April.

**Corchorus aestuans** L. (Tiliaceae) O: *Banakadali* (Figure 2d)

Herb. Unripe fruits are cooked and eaten. Common weed. July - December.

**Cordia dichotoma** G. Forst. (*Cordia obliqua* Willd.) (Boraginaceae) O: *Ambota, Goohalo*

Small tree. Ripe fruits are eaten as raw. Frequent in mixed forest. March - September.

**Crateva religiosa** G. Forst. (Syn. *Crateva magna* (Lour.) DC.) (Capparaceae) O: *Baruna*

Tree. Unripe green fruits are fried and eaten. Ripe fruits are eaten as raw. Common in scrub forest. May - March.

**Cycas circinalis** L. var. *orixensis* Haines (Cycadaceae) O: *Oruna, Rengua*

Tree. Pulp of ripe dried fruit is made into cake with rice and are consumed. Fairly frequent in forest. May - October.

**Dillenia pentagyna** Roxb. (Dilleniaceae) O: *Rai, Kirmilla*

Moderate sized tree. Ripe fruits are consumed as raw. Common in the hilly regions. March - May.

**Diospyros chloroxylon** Roxb. (Ebenaceae) O: *Gaurakasa*

Shrub or small tree. Ripe fruits are sweet and consumed as raw. Frequent in the hills and scrub forest. June - December.

**Diospyros malabarica** (Desr.) Kostel (Ebenaceae) O: *Kendu*

Tree with spreading branch. Ripe fruits are sweet and consumed as raw. Common in valleys along streams. March - April.

**Diospyros melanoxylon** Roxb. (Ebenaceae) O: *Kendu*

Large tree. Ripe fruits are eaten as raw. Common in dry mixed deciduous forest. March - April.



**Ehretia laevis** Roxb. (Boraginaceae) O: *Masania*

Small or medium sized tree. Ripe fruits are eaten as raw. Frequent in forest. March - May.

**Ficus auriculata** Lour. (Moraceae) O: *Rajadimiri*

Tree. Ripe fruits are sweet and consumed as raw. Common near stream. October -December.

**Ficus benghalensis** L. (Moraceae) O: *Bara*

Large Tree. Ripe fruits are sweet and consumed as raw. Fairly common both wild and sometime planted. Available round the year but ripening during April - February.

**Ficus heterophylla** L.f. (Moraceae) O: *Bhui dumur, Ganthi sahada*

Shrub. Receptacle are cooked and then eaten. Common in wet and watery places. January - May.

**Ficus hispida** L.f. (Moraceae) O: *Dimiri, Baidimiri*

Small tree. Unripe fruit and receptacle are cooked as curry. Ripe fruits are edible made into jam. Common in forests and waste places. November - July.

**Ficus racemosa** L. (Moraceae) O: *Dimiri* (Figure 3a)

Large or moderate sized tree. Ripe fruits are eaten as raw. Fairly common in valleys and village surrounding. March - June.

**Ficus semicordata** Buch. - Ham. ex J. E. Sm. (Moraceae) O: *Bhui dimri, Kuji dimri*

Small or moderate sized tree. Cooked receptacles are eaten. Common near streams and in cool, damp places. November - June.

**Flacourtia indica** (Burm.f.) Merr (Flacourtiaceae) O: *Kanteikoli* (Figure 3b)

Deciduous or evergreen shrub or small tree. Ripe fruits are eaten raw. Common, both in plain and hill areas. March - May.

**Flacourtia jangomas** (Lour.) Raeusch (Flacourtiaceae) O: *Bainchakoli*

Small deciduous tree. Sweet and tasty ripe berries are eaten raw in summer. Common in forest, cool valleys. October - January.

**Garcinia xanthochymus** Hook.f. ex T. Anders. (Cluciaceae) O: *Sitambu, Chiuri*

Small or moderate sized tree. Ripe fruits are eaten raw. Fairly common in evergreen forest, near streams. Sometimes planted. April - May.

**Gardenia gummifera** L. f. (Rubiaceae) O: *Bhurana koli*

Shrub. Fleshy pulps of the fruits are consumed by tribal people. Seed roasted with salt and eaten. Common in dry hills or open forest. March - August.

**Gardenia latifolia** Aiton. (Rubiaceae) O: *Dimaru, Papra*

Small tree. Fleshy pulp of the fruits is consumed by tribal people. Common in open forest, rocky hills. March - June.

**Garuga pinnata** Roxb. (Burseraceae) O: *Sarupatri*

Tree. Fruits and seeds are eaten raw, cooked or pickled. Common in mixed forest along streams. February - August.



**Glycosmis pentaphylla** (Retz.) DC. (Rutaceae) O: *Chauladhua*

Shrub. Ripe fruits and berries are pulpy, eaten as raw. Common in scrub forest, open forest. October - April.

**Grewia carpinifolia** Juss. (Tiliaceae)

Large climbing shrub. Ripe fruits are eaten as raw. Occasional in scrub forest. July - November.

**Grewia hirsuta** Vahl (Tiliaceae) O: *Sunaranga*

Shrub. Ripe fruits are eaten as raw. Common in open forest. July - December.

**Grewia rothii** DC. (Tiliaceae) O: *Phulari*

Shrub. Ripe fruits are eaten as raw. Common in the forests especially in the hills. April - October.

**Grewia sepida** Roxb. ex DC. (Tiliaceae) O: *Burso*

Undershrub. Ripe fruits are eaten as raw. Frequent in open places, near forest and grasslands. February - May.

**Holoptelea integrifolia** (Roxb.) Planch. (Ulmaceae) O: *Charla*

Large or small tree. Ripe fruits are eaten as raw. Occasional in deciduous forest. March - June.

**Indigofera astragalina** DC. (Fabaceae)

Erect herb. Seed pounded with rice and eaten as cake. Frequent in waste ground. May - December.

**Kavalama urens** (Roxb.) Raf. (Syn. *Sterculia urens* Roxb.) (Sterculiaceae) O: *Genduli, Kavili*

Moderate sized tree. Seeds roasted and eaten. Common in deciduous forest. December - August.

**Lannea coromandelica** (Houtt.) Merr. (Anacardiaceae) O: *Mahi*

Small or moderate sized tree. Ripe fruits are eaten as raw. Fairly common in forest throughout the area. March - May.

**Lantana camara** L. var. **aculeata** (L.) Mold. (Verbenaceae) O: *Nagairi, Jaikoli*

Aromatic shrub. Ripe fruit consumed as raw. In wasteland, roadside, open forest area and scrub jungle. Throughout the year.

**Lepisanthes rubiginosa** (Roxb.) Leenth. (Sapindaceae) O: *Nanga*

Small tree. Ripe fruit consumed as raw. Common in damp forest. Throughout the year.

**Limonia acidissima** Groff (Syn. *Feronia limonia* (L.) Swingle) (Rutaceae) O: *Kaitha*

Tree with axillary spine. Pulp of unripe fruit is made into pickle. Ripe fruit pulp is eaten. Frequent in open forest and around villages. November - April.

**Madhuca longifolia** var. **latifolia** (Roxb.) A. Chev. (Syn. *Madhuca indica* Gmel.) (Sapotaceae) O: *Mahula, Mahua*

Large or moderate sized tree. Oil obtained from the seeds is used for cooking purpose by the local tribes. Common in forests and village sides. February - July.

**Mangifera indica** L. (Anacardiaceae) O: *Amba* (Figure 4a)

Large tree. Ripe fruit eaten as raw and unripe fruit made into pickle and chutney. Wild in valleys along the bank of streams, also cultivated. April - July.





**Manilkara hexandra** (Roxb.) Dubard. (Sapotaceae) O: *Khirikoli*

Small tree. Ripe fruits are consumed as raw. Abundant in open forest. March - June.

**Meyna spinosa** Roxb. ex Link var. **pubescens** Robyns (Rubiaceae) O: *Manta kanta, Solora*

Small tree or large shrub. Seeds roasted and eaten. Common in forest. May - April.

**Miliusa tomentosa** (Roxb.) J. Sinclair (Annonaceae) O: *Gandha palasa*

Small or moderate sized tree. Fleshy Ripe fruits are consumed as raw. Common in forest. May - July.

**Momordica charantia** L. (Cucurbitaceae) O: *Tusikalara* (Figure 4b)

Climbing herb. Fruit is used as vegetable. Common in hedges and thickets or on waste grounds. Improved varieties are cultivated. June - February.

**Mucuna pruriens** (L.) DC. (Fabaceae) O: *Baidanka*

Annual twinner. Young fruits and seeds after cooking are eaten by tribal people. Common in forest hedge and thickets. January - April.

**Mukia maderaspatana** (L.) M. Roem. (Cucurbitaceae) O: *Pahari kakharu*

Climbing herb. Ripe berries are eaten by children. Common in hedges, thickets and often climbing over bushes in open forests. September - December.

**Naringi crenulata** (Roxb.) Nicolson. (Rutaceae) O: *Benta*

Small tree with axillary spine. Fleshy ripe fruits are consumed as raw. Common in scrub forest. April - December.

**Nelumbo nucifera** Gaertn. (Nymphaeaceae) O: *Padma, Ranga/ Dhala Padma*

Aquatic herb. Immature seeds are eaten as raw. Common in ponds and lakes. April - January.

**Nymphaea pubescens** Willd. (Nymphaeaceae) O: *Dhala kain.*

Aquatic herb. Seeds roasted with salt and eaten. Common in lakes and ponds. Most part of the year.

**Ocimum americanum** L. (Syn. *Ocimum canum* Sims.) (Lamiaceae) O: *Bana tulasi*

Erect branched herb. Seeds are eaten as raw. Common weed especially in cultivated land. June - March.

**Phoenix acaulis** Roxb. (Arecaceae) O: *Bana khajuri* (Figure 4c)

Small palm. Flesh ripe fruits are consumed. Common in dry forest and in open grassy field. April - June.

**Phoenix loureiroi** Kunth (Arecaceae) O: *Bukhajuro, Kojiri*

Small palm. Ripe fruits are consumed. Common in hilly areas. March- June.

**Phoenix sylvestris** (Linn.) Roxb. (Arecaceae) O: *Khajuri*

Tall palm, densely covered with petiole-bases. Ripe fruits are sweet and eaten as raw. The plant is abundant in wasteland and roadsides. April - June.

**Phyllanthus emblica** L. (Euphorbiaceae) O: *Amla*

Small or moderate- sized tree. Matured fruits eaten as raw; made into pickle. Common in forests. May - April.

**Physalis angulata** L. (Syn. *Physalis minima* L.) (Solanaceae) O: *Tipai*

Erect herb. Sweet mature fruits are eaten. Fairly common weed. August - January.



**Pithecellobium dulce** (Roxb.) Benth. (Mimosaceae) O: *Simakoina*

Tree with small stipular spines. Sweet mature seeds are eaten as raw. Cultivated and self sown, often found in hedges. April - June.

**Polyalthia suberosa** (Roxb.) Thwaites. (Annonaceae) O: *Karadia, Lohania mossu*

Small tree or shrub. Ripe fruits are consumed as raw. Common in shady forests, generally near streams. April - November.

**Protium serratum** (Wall. ex Colebr.) Engl. (Burseraceae) O: *Rajamahi*

Tree. Ripe fruits are acidic; eaten raw or made into pickle. Common in mixed forests along streams. March - June.

**Psyrax dicoccos** Gaertn. (Syn. *Canthium dicoccum* (Gaertn.) Teijsm & Binnend) (Rubiaceae) O: *Dalasinga*

Large shrub or small tree. Tribal people eat both ripe and raw fruit. Fairly common near streams. February - May.

**Rubus ellipticus** Sm. (Rosaceae) O: *Machdim, Mach koli*

Shrub. Ripe fruits are consumed as raw. Occasional in cool valleys in partially open places. January - June.

**Schleichera oleosa** (Lour.) Oken (Sapindaceae) O: *Kusum, Swad kusum*

Tree. Ripe fruits are consumed as raw or pickle. Frequent in forests, especially in the valley. Often near villages. February - August.

**Semecarpus anacardium** Linn.f. (Anacardiaceae) O: *Kalabhalia* (Figure 4d)

Small deciduous tree. Ripe peduncles are eaten raw or as pickle. Kernels (seed) are roasted and eaten. Common in dry deciduous forest. April - May.

**Senna hirsuta** (L.) H. S. Irwin & Barneby (Syn. *Cassia hirsuta* L.) (Caesalpiniaceae) O: *Bado chakunda*

Erect shrub. Seeds roasted with salt and eaten. Common along wayside in forest, on rocky ground. October - December.

**Shorea robusta** Gaertn.f. (Dipterocarpaceae) O: *Sal*

Tree. Oil obtained from seeds is used for cooking purpose by the local tribe. Common in forest. March - June.

**Smilax zeylanica** L. (Smilacaceae) O: *Mutri, Rajdanti* (Figure 5a)

Climbing shrub. Ripe fruits are consumed as raw. Seeds are roasted then eaten. Common in forest. April - January.

**Solanum americanum** Mill. (Syn. *Solanum nigrum* L.) (Solanaceae) O: *Nunununia*

Branched herb. Sweet ripe fruits are consumed. Fairly common weed. Most part of the year.

**Solanum rudepannum** Dunal (Syn. *Solanum torvum* Sw.) (Solanaceae) O: *Kantua, Dengabheji*

Shrub. Ripe fruits are consumed as raw. Fairly common, in moist waste places in forests, especially near streams. Available during most part of the year.



**Solena amplexicaulis** (Lam.) Gandhi in Saldanha & Nicolson (Syn. *Melothria heterophylla* (Lour.) Coen.) (Cucurbitaceae) O: *Mataka, Banakunduri* (Figure 5b)

Climbing herb. Unripe fruits are cooked as vegetable. Common in hedges, thickets and also in forest. April - November.

**Spondias pinnata** (L.f.) Kurz (Anacardiaceae) O: *Ambada, Amta*

Large or medium-sized tree. Ripe fruits consumed as raw and unripe fruits are cooked as vegetable. Occasional, near rivers; and often planted near villages. February - January.

**Streblus asper** Lour. (Moraceae) O: *Sahada*

Branched shrub or small tree. Ripe fruits are eaten as raw. Common in open forest, scrub forest, wastelands. March - June.

**Streblus taxoides** (Heyne ex Roth) Kurz. (Moraceae) O: *Jhumpuri, Phutkuli*

Small evergreen tree or shrub. Fruits are eaten as vegetable. Frequent in scrub forests and also in damp forest. March - June.

**Strychnos potatorum** L.f. (Strychnaceae) O: *Nirmali*

Small tree. Seeds roasted and eaten. Common in forest. May - December.

**Syzygium cumini** (L.) Skeels (Myrtaceae) O: *Jamukoli*

Large glabrous tree. Ripe fruits consumed as raw. Fairly common in forest. June - August.

**Tamarindus indicus** L. (Caesalpiniaceae) O: *Tentuli*

Large tree. Fruits are eaten both ripe and raw. Pulp used as food (spice). Wild in forests and planted or self-sown. December - March.

**Tamilnadia uliginosa** (Retz.) Tirveng. & Sastre (Rubiaceae) O: *Telkur*

Small thorny tree or shrub. The ripe fruits are eaten as such or after boiling, roasted or made into curry. Frequent in the forest. April - January.

**Terminalia bellirica** (Gaertn.) Roxb. (Combretaceae) O: *Bahada*

Tree. Seeds are eaten after roasting. Common in sal and mixed forests. March - December.

**Toddalia asiatica** (L.) Lam. (Rutaceae) O: *Tundapora*

Prickly shrub. Ripe fruit consumed as raw or as pickle. Common, especially in the scrub forests and also in the hills. August - April.

**Trapa natan** L. (Trapaceae) O: *Pani Singara*

Free floating aquatic herb. The kernel of the fruit consumed as raw or after boiling. Seeds are eaten raw when tender or after cooking, roasting. Rare, in tanks. August - January.

**Trichosanthes cucumerina** L. (Cucurbitaceae) O: *Ban potol*

Climbing herb. Unripe fruits are cooked as vegetable and ripe fruits are consumed as raw. Common, in hedges and thickets. August - January.

**Uvaria hamiltonii** Hook. f. & Thomson (Annonaceae) O: *Lakun koli*

Shrub. Ripe fruit consumed as raw. Common in hill forests. May - September.



**Woodfordia fruticosa** (L.) Kurz (Lythraceae) O: *Dhatuki*

Large spreading shrub. Ripe fruits consumed as raw. Common, especially in the hills. November - May.

**Xylocarpus xylocarpa** (Roxb.) Taub. (Mimosaceae) O: *Dhamani*

Small tree. Seeds are roasted and eaten. Frequent in forest and commonly associated with Sal. April - March.

**Ziziphus mauritiana** Lam. (Rhamnaceae) O: *Barkoli* (Figure 5c)

Branched, thorny moderate tree. Ripe fruits are eaten raw or as pickle. Abundant in sandy river banks, scrub forests and along road sides. November - February.

**Ziziphus nummularia** (Burm.f.) Wt. & Arn. (Rhamnaceae) O: *Jangalikoli*

Small shrub. Ripe fruit consumed as raw. Frequent in scrub forests. October - February.

**Ziziphus oenopolia** (L.) Mill. (Rhamnaceae) O: *Kanteikoli* (Figure 5d)

Thorny shrub. Ripe fruits are sweet acidic in taste and consumed by children in villages. Common in scrub forest, wasteland, hedges, village thicket and dry degraded forest. October - January.

**Ziziphus rugosa** Lam. (Rhamnaceae) O: *Tinkoli, Simukoli*

Large shrub or small tree. Sweet ripe fruits are consumed as raw. Fairly common, in open forests, near ravines. March - July.

**Ziziphus xylocarpa** (Retz.) Willd. (Rhamnaceae) O: *Kanta baula, Ghat*

Small tree. Ripe fruits are eaten as raw. Fairly common in open forests, scrub forests. March - January.

### 3.2 Taxonomic diversity

The study provides information on 110 edible fruit plant species under 83 genera and 47 families. Of these, 103 species are dicotyledons under 79 genera and 43 families; 6 species are monocotyledons under 3 genera and 3 families. One gymnosperm species was recorded. The edible fruit plants include 100 wild species, 10 species that are wild as well as cultivated.

### 3.3 Growth form

The growth form of the wild edible fruit plants as observed in the study includes herb, shrub, under-shrub, climber and tree species. Out of 110 species recorded; are 15 herbs, 42 shrubs, 3 climber/twiner and 50 tree species (Figure 6).

### 3.4 Preparation technique

The edible parts consumed as vegetable are unripe and ripe fruit. Based on local use, the fruit plants are consumed in different ways using different preparation methods. Three methods such as eating raw, roasted/fried with salt, cooked as curry were observed (Table 1). Fruit plants of 80 species are eaten as raw. Unripe fruit of 14 plants are roasted/fried with salt. Fruits of 3 plant species are cooked as curry along with vegetables. Fruits of 17 plant species are mainly used for cooking and edible purpose by the tribal people. Fruit plant of 13 species are



used as medicinal plants because of their assumed health benefits, thus can be called as food-cum- medicinal plants (Table 1).

### 3.5 Use category

Analysis of data on use category showed that the identified fruit plant species provide 8 major edible use categories based on local practices such as food supplement, flour and cake, food flavourings (spice and condiments), pulp, pickle, chutney, Jam or jellies and medicine.

**Table 1.** Wild edible fruit plants associated to different usage categories.

Mode of use	Species
Eaten as raw	<i>Alangium salvifolium</i> , <i>Allophylus serratus</i> , <i>Ampelocissus latifolia</i> , <i>Antidesma acidum</i> , <i>A. ghaesembilla</i> , <i>Aporusa octandra</i> , <i>Ardisia solanacea</i> , <i>Argyreia cymosa</i> , <i>Bridelia retusa</i> , <i>B. montana</i> , <i>Buchanania cochinchinensis</i> , <i>Cajanus scarabaeoides</i> , <i>Calamus viminalis</i> , <i>Capparis brevispina</i> , <i>Carissa carandas</i> , <i>C. spinarum</i> , <i>Cipadessa baccifera</i> , <i>Cordia dichotoma</i> , <i>Crateva religiosa</i> , <i>Dillenia pentagyna</i> , <i>Diospyros chloroxylon</i> , <i>D. malabarica</i> , <i>D. melanoxylon</i> , <i>Ehretia laevis</i> , <i>Ficus auriculata</i> , <i>F. benghalensis</i> , <i>F. racemosa</i> , <i>Flacourtia indica</i> , <i>F. jangomas</i> , <i>Garcinia xanthochymus</i> , <i>Gardenia gummifera</i> , <i>G. latifolia</i> , <i>Garuga pinnata</i> , <i>Glycosmis pentaphylla</i> , <i>Grewia carpinifolia</i> , <i>G. hirsuta</i> , <i>G. rothii</i> , <i>G. sapida</i> , <i>Holoptelea integrifolia</i> , <i>Lanea coromandelica</i> , <i>Lantana camara</i> , <i>Lepisanthes rubiginosa</i> , <i>Limonia acidissima</i> , <i>Mangifera indica</i> , <i>Manilkara hexandra</i> , <i>Miliusa tomentosa</i> , <i>Mukia maderaspatana</i> , <i>Naringi crenulata</i> , <i>Nelumbo nucifera</i> , <i>Ocimum canum</i> , <i>Phoenix acaulis</i> , <i>P. loureirii</i> , <i>P. sylvestris</i> , <i>Phyllanthus emblica</i> , <i>Physalis angulata</i> , <i>Pithecellobium dulce</i> , <i>Polyalthia suberosa</i> , <i>Protium serratum</i> , <i>Psydrax dicoccos</i> , <i>Rubus ellipticus</i> , <i>Schleichera oleosa</i> , <i>Semecarpus anacardium</i> , <i>Smilax zeylanica</i> , <i>Solanum americanum</i> , <i>S. rudepannum</i> , <i>Spondias pinnata</i> , <i>Streblus asper</i> , <i>Syzygium cumini</i> , <i>Tamarindus indicus</i> , <i>Tamilnadia uliginosa</i> , <i>Toddalia asiatica</i> , <i>Trapa natans</i> , <i>Trichosanthes cucumerina</i> , <i>Uvaria hamiltonii</i> , <i>Woodfordia fruticosa</i> , <i>Ziziphus mauritiana</i> , <i>Z. nummularia</i> , <i>Z. oenopolia</i> , <i>Z. rugosa</i> , <i>Z. Xylocarpa</i>
Roasted/fried with salt	<i>Bauhinia vahlii</i> , <i>Bombax ceiba</i> , <i>Capparis brevispina</i> , <i>Combretum album</i> , <i>C. nanum</i> , <i>Gardenia gummifera</i> , <i>Kavalama urens</i> , <i>Meyna spinosa</i> , <i>Nymphaea pubescens</i> , <i>Senna hirsuta</i> , <i>Smilax zeylanica</i> , <i>Strychnos pototorum</i> , <i>Terminalia bellirica</i> , <i>Xylia xylocarpa</i>
Cooking purposes	<i>Argemone maxicana</i> , <i>Bambusa bambos</i> , <i>Brassica oleracea</i> var. <i>botrytis</i> , <i>Brassica oleracea</i> var. <i>gongylodes</i> , <i>Careya arborea</i> , <i>Coccinia grandis</i> , <i>Ficus semicordata</i> , <i>Garuga pinnata</i> , <i>Madhuca longifolia</i> var. <i>latifolia</i> , <i>Momordica charantia</i> , <i>Mucuna pruriens</i> , <i>Shorea robusta</i> , <i>Solena amplexicaulis</i> , <i>Spondias pinnata</i> , <i>Streblus taxoides</i> , <i>Trapa natans</i> , <i>Trichosanthes cucumerina</i>



Curry	<i>Ficus heterophylla, Ficus hispida, Tamilnadia uliginosa</i>
Flour and cakes	<i>Bambusa bambos</i>
Cake	<i>Cycas circinalis, Indigofera astragalina</i>
Pulp	<i>Calamus guruba, Capparis zeylanica</i>
Pickle	<i>Capparis zeylanica, Carissa carandas, C. spinarum, Garuga pinnata, Limonia acidissima, Mangifera indica, Protium serratum, Schleicheria oleosa, Semecarpus anacardium, Toddalia asiatica, Ziziphus mauritiana</i>
Chutney	<i>Mangifera indica, Phyllanthus emblica</i>
Jam or jellies	<i>Ficus hispida</i>
Spices	<i>Tamarindus indicus</i>
Medicines	<i>Ardisia solanacea, Ficus hispida, F. racemosa, Mucuna pruriens, Phyllanthus emblica, Semecarpus anacardium, Solanum nigrum, S. xanthocarpum, Syzygium cumini, S. jambos, Tamarindus indicus, Xylia xylocarpa, Ziziphus mauritiana</i>

### 3.6 Parts used

In fruit plants, the edible part taken as food by the tribal people of south Odisha are ripe fruit, unripe fruit, berry, receptacle, peduncle, kernel and seed (Table 2). Out of 110 species observed; 77 species constitute ripe fruits, 14 are unripe, 4 are berries, 3 receptacle bearing species, one peduncle bearing species, 2 species constitute kernel and 29 species with edible seeds (Table 2).

**Table 2.** Different forms of edible parts of the fruit plant species used as vegetable in South Odisha.

Edible plant parts used	Species
Fruit (ripe)	<i>Alangium salvifolium, Allophylus serratus, Antidesma acidum, A. ghaesembilla, Aporusa octandra, Ardisia solanacea, Argyreia cymosa, Bridelia retusa, B. montana, Buchanania cochinchinensis, Calamus guruba, C. viminalis, Capparis brevispina, C. zeylanica, Careya arborea, Carissa carandas, C. spinarum, Cipadessa baccifera, Cordia dichotoma, Crateva religiosa, Cucurbita maxima, Cycas circinalis, D. pentagyna, Diospyros chloroxylon, D. malabarica, D. melanoxylon, Ehretia laevis, Ficus auriculata, F. benghalensis, F. hispida, F. racemosa, Flacourtia indica, Garcinia xanthochymus, G. gummifera, G. latifolia, Garuga pinnata, Glycosmis pentaphylla, Grewia carpinifolia, G. hirsuta, G. rothii, G. sapida, Holoptelea integrifolia, Lannea coromandelica, Lantana camara, Lepisanthes rubiginosa, Limonia acidissima, Mangifera indica, Manilkara hexandra, Miliusa tomentosa, Naringi crenulata, Phoenix acaulis, P. loureiroii, P. sylvestris, Phyllanthus emblica, Physalis angulata, Pithecellobium dulce, Polyalthia</i>



	<i>suberosa, Protium serratum, Psydrax dicoccos, Rubus ellipticus, Schleicheria oleosa, Smilax zeylanica, Solanum americanum, Solanum rudepannum, Spondias pinnata, Streblus asper, S. taxoides, Syzygium cumini, Tamarindus indicus, Tamilnadia uliginosa, Trichosanthes cucumerina, Uvaria hamiltonii, Woodfordia fruticosa, Ziziphus mauritiana, Z. nummularia, Z. oenopolia, Z. rugosa, Z. xylocarpa</i>
Fruit (unripe)	<i>Bombax ceiba, Capparis brevispina, Carissa carandas, C. spinarum, Coccinia grandis, Crateva religiosa, Ficus hispida, Limonia acidissima, Mangifera indica, Momordica charantia, Mucuna pruriens, Solena amplexicaulis, Spondias pinnata, Trichosanthes cucumerina</i>
Berry	<i>Ampelocissus latifolia, Flacourtia jangomas, Glycosmis pentaphylla, Mukia maderaspatana</i>
Receptacle (fig)	<i>Ficus heterophylla, Ficus hispida, Ficus semicordata</i>
Peduncle/Thalamus	<i>Semecarpus anacardium</i>
Kernel	<i>Semecarpus anacardium, Trapa natans</i>
Seed	<i>Argemone maxicana, Bambusa bambos, Bauhinia vahlii, Bombax ceiba, Bridelia retusa, B. montana, Buchanania cochinchinensis, Cajanus scarabaeoides, Combretum album, C. nanum, Gardenia gummifera, Garuga pinnata, Indigofera astragalina, Kavalama urens, Madhuca longifolia var. latifolia, Meyna spinosa, Mucuna pruriens, Nelumbo nucifera, Nymphaea pubescens, Ocimum americanum, Senna hirsuta, Semecarpus anacardium, Shorea robusta, Smilax zeylanica, Strychnos pototorum, Tamarindus indicus, Terminalia bellirica, Toddalia asiatica, Xylia xylocarpa</i>

### 3.7 Nutritional evaluation

Plant species (23) selected for nutritional analysis are listed with botanical name, odia name and the estimated value of various nutritional compound observed in 23 edible fruit plant parts are shown in Table 3.

#### 3.7.1 Moisture content

From the experimental result, it is observed that all the selected fresh edible fruit plants exhibited high moisture content. Fruit of *Syzygium cumini* registered top value (84.3%) in moisture content whereas *Ficus hispida* had the minimum value (63.3%) (Table 3).

#### 3.7.2 Crude protein content

All the selected fruits showed high amount of crude protein. Frut plant of *Semecarpus anacardium* (32.20 mg g<sup>-1</sup>) exhibited the highest crude protein while *Ziziphus mauritiana*, unripe (5.17 mg g<sup>-1</sup>) had the lowest value (Table 3).



### 3.7.3 Total sugar content

Out of 23 different fruits studied, fruits of *Phoenix sylvestris* (339.17 mg g<sup>-1</sup>, 33.9%) showed the highest total sugar content and the lowest value was exhibited by fruits of *Carissa carandas* (29.0 mg g<sup>-1</sup>) (Table 3).

### 3.7.4 Total lipid content

Among the 23 edible fruits studied, fruits of *Flacourtia indica* contained the highest lipid content (0.075 mg g<sup>-1</sup>) followed by fruit of *Carissa carandas* (0.029 mg g<sup>-1</sup>). Lowest fat content has shown by fruits of *Diospyros melanoxylon*, *Ziziphus mauritiana* (ripe) and (Table 3).

### 3.7.5 Vitamin content

The result of vitamin analysis of fruits showed that fruits of *Semecarpus anacardium* (0.0024 mg g<sup>-1</sup>) showed the highest vitamin B<sub>1</sub> content and the lowest value was shown by fruits of *Phyllanthus emblica*, *Syzygium cumini* (each 0.0003 mg g<sup>-1</sup>). The result of vitamin C analysis showed that fruits of *Phyllanthus emblica* (5.16 mg g<sup>-1</sup>) exhibited the highest vitamin C content and the lowest value was shown by fruits of *Diospyros melanoxylon* (0.02 mg g<sup>-1</sup>) (Table 3).

**Table 3.** Crude protein, total sugar, lipid and vitamin B<sub>1</sub> and C content of some of the edible fruit plants of south Odisha ( $\pm$  standard deviation).

Fruit and Seed Plant	Odia name	Moisture content (%)	Crude protein (mg g <sup>-1</sup> )	Total sugar (mg g <sup>-1</sup> )	Total lipid (mg g <sup>-1</sup> )	Vitamin B <sub>1</sub> (mg g <sup>-1</sup> )	Vitamin C (mg g <sup>-1</sup> )
<i>Carissa carandas</i>	<i>Karanda- koli</i>	82.3 $\pm$ 17.6	11.77 $\pm$ 0.93	29.00 $\pm$ 0.20	0.029 $\pm$ 0.001	Nil	Nil
<i>Casearia graveolens</i>	<i>Giridi</i>	83.0 $\pm$ 17.0	30.06 $\pm$ 0.60	31.50 $\pm$ 1.5	0.006 $\pm$ 0.002	Nil	0.27 $\pm$ 0.01
<i>Corchorus aestuans</i>	<i>Bana kadali</i>	75.0 $\pm$ 25.0	27.23 $\pm$ 0.94	101.17 $\pm$ 0.76	0.009 $\pm$ 0.002	Nil	Nil
<i>Coccinia grandis</i>	<i>Toroda, Kunduri</i>	68.0 $\pm$ 32.0	29.43 $\pm$ 1.11	82.17 $\pm$ 1.26	0.007 $\pm$ 0.002	0.0006 $\pm$ 0.0001	0.14 $\pm$ 0.02
<i>Diospyros melanoxylon</i>	<i>Kendu</i>	69.6 $\pm$ 30.3	8.64 $\pm$ 1.18	266.00 $\pm$ 1.73	0.002 $\pm$ 0.001	0.0004 $\pm$ 0.0002	0.02 $\pm$ 0.01
<i>Ficus benghalensis</i>	<i>Bara</i>	74.6 $\pm$ 25.6	16.17 $\pm$ 0.76	119.17 $\pm$ 1.04	0.018 $\pm$ 0.002	Nil	Nil
<i>Ficus racemosa</i>	<i>Dimiri</i>	66.6 $\pm$ 33.3	8.17 $\pm$ 1.04	76.50 $\pm$ 1.32	0.007 $\pm$ 0.003	Nil	0.05 $\pm$ 0.01
<i>Ficus hispida</i>	<i>Aswatha</i>	63.3 $\pm$ 36.6	26.47 $\pm$ 1.05	148.50 $\pm$ 1.50	0.017 $\pm$ 0.002	Nil	Nil
<i>Flacourtia indica</i>	<i>Kanteikoli, tutudikoli</i>	68.6 $\pm$ 31.3	17.33 $\pm$ 1.26	226.83 $\pm$ 1.26	0.075 $\pm$ 0.001	Nil	Nil
<i>Lantana camara</i> var.	<i>Jaikoli</i>	66.0	6.00	146.03	0.004	Nil	Nil





<i>aculeata</i>		±34.0	±0.36	±0.84	±0.001		
<i>Limonia acidissima</i>	<i>Kaitha</i>	65.3 ±34.6	11.33 ±1.04	182.37 ±1.20	0.027 ±0.002	0.0006 ±0.0002	0.04 ±0.02
<i>Mangifera indica</i>	<i>Amba</i>	80.3 ±19.6	7.17 ±1.04	167.83 ±1.61	0.016 ±0.001	0.0006 ±0.0002	0.15 ±0.02
<i>Melothria heterophylla</i>	<i>Kainchi kakudi</i>	74.0 ±26.0	8.67 ±1.53	120.50 ±1.50	0.006 ±0.002	Nil	Nil
<i>Ocimum canum</i>	<i>Bana tulasi</i>	71.6 ±28.3	9.32 ±0.85	64.13 ±1.02	0.006 ±0.001	Nil	0.23 ±0.02
<i>Phoenix sylvestris</i>	<i>Khajuri</i>	72.6 ±27.3	28.17 ±1.25	339.17 ±0.76	0.004 ±0.001	Nil	Nil
<i>Pithecellobium dulce</i>	<i>Simakainya</i>	78.6 ±21.3	28.83 ±1.61	161.83 ±1.76	0.006 ±0.001	0.0022 ±0.0002	1.08 ±0.01
<i>Phyllanthus emblica</i>	<i>Amla</i>	79.3 ±20.3	6.17 ±0.76	136.17 ±1.04	0.004 ±0.001	0.0003 ±0.0001	5.16 ±0.76
<i>Semecarpus anacardium</i>	<i>Kalabhalia</i>	83.6 ±16.3	32.20 ±1.11	147.30 ±1.25	0.016 ±0.003	0.0024 ±0.0003	0.35 ±0.02
<i>Syzygium cumini</i>	<i>Jamukoli</i>	84.3 ±15.6	8.17 ±1.04	140.83 ±1.04	0.005 ±0.001	0.0003 ±0.0001	0.19 ±0.01
<i>Tamarindus indicus</i>	<i>Tentuli</i>	67.3 ±32.6	17.40 ±1.01	231.43 ±1.05	0.010 ±0.002	0.0008 ±0.0002	0.12 ±0.02
<i>Ziziphus mauritiana</i> (ripe)	<i>Barakoli</i>	79.6 ±20.3	7.67 ±1.53	165.50 ±0.50	0.002 ±0.001	0.0008 ±0.0002	0.74 ±0.02
<i>Ziziphus mauritiana</i> (unripe)	<i>Barakoli</i>	81.3 ±18.6	5.17 ±1.26	151.33 ±0.76	0.004 ±0.001	0.0008 ±0.0004	0.67 ±0.02
<i>Ziziphus oenopolia</i>	<i>Kanteikoli</i>	79.3 ±20.6	16.67 ±1.53	168.5 0 ±1.30	0.009 ±0.0008	0.0005 ±0.0002	0.56 ±0.01

#### 4. Discussion

During the study period it was recorded that tribal and rural people of south Odisha use 110 edible fruit plant species. The edible parts consumed as vegetables are fruits and/or seeds. The edible plant parts are mostly collected free from the environment, washed properly, boiled or cooked, sliced and then eaten. In India, the tribal and rural people traditionally use about 9500 wild plants for various purposes such as medicine, food, fodder, fuel, fibre, essence, culture and other miscellaneous purposes (Panda & Misra, 2011). Out of these about 3900 wild plants are used as food that is mostly consumed during emergency (Anonymous, 1995). Consumption pattern of wild food plants depends mostly upon their availability in nature. Majority of the wild edible fruit plants are consumed by tribal and non-tribal people due to their poor economic condition. However, it is established that most of the wild food plants are rich in nutrients and vitamins (Anonymous, 1995).

The result of nutritional analysis of selected fruit plants obtained in this study show a close agreement with those reported by Gopalan *et al.* (1982) in terms of moisture, crude protein, total sugar, total lipid, vitamin



B<sub>1</sub> and vitamin C content. Out of the selected plants, *Ziziphus mauritiana*, *Ziziphus oenopolia* showed a close agreement with the finding of Mahapatra *et al.* (2012) in terms of crude protein, total sugar and vitamin C content. *Ficus benghalensis* and *Ziziphus mauritiana* showed a close agreement with the finding of Vishwakarma & Dubey (2011) in terms of crude protein, total sugar, and total lipid.

The present crude protein content of ripe fruit of *Ziziphus mauritiana* (0.7%) is higher than the earlier value (0.46%) reported by Mahapatra *et al.* (2012) but less than the values (0.8%, 2.6%) reported by Gopalan *et al.* (1982) and Vishwakarma & Dubey (2011). The crude protein content of fruit of *Ziziphus oenopolia* (1.6%) is higher than the earlier report (0.7%) made by Mahapatra *et al.* (2012). The fruits of *Embllica officinalis* (0.6%), *Syzygium cumini* (0.8%), *Pithecellobium dulce* (2.8%), *Mangifera indica* (0.7%) and *Limonia acidissima* (1.1%) have higher crude protein content than the earlier value (0.5%, 0.2%, 2.7%, 0.6%, and 0.7%) made by Gopalan *et al.* (1982). The fruits of *Diospyrous melanoxydon* (0.8%) and *Flacourtia indica* (1.7%) show similar crude protein content with the earlier values (0.8%, 1.7%) reported by Gopalan *et al.* (1982).

The total sugar content of ripe fruit of *Ziziphus mauritiana* (16.5%) is higher than the earlier value (7.2%, 8.4%) reported by Mahapatra *et al.* (2012) and Vishwakarma & Dubey (2011) but less than the values (17.0%) reported by Gopalan *et al.* (1982). The total sugar content of *Ziziphus oenopolia* (16.8%) is higher than the earlier value (6.15%) reported by Mahapatra *et al.* (2012). Fruit plants like *Embllica officinalis* (13.6%), *Flacourtia indica* (22.6%), *Mangifera indica* (16.7%) and *Diospyrous melanoxydon* (26.6%) have less sugar content than the values (13.7%, 22.7%, 16.9% and 26.8%) reported by Gopalan *et al.* (1982). Sugar content of *Syzygium cumini* (14.0%) is similar with the value reported by Gopalan *et al.* (1982).

The total lipid content of *Ziziphus mauritiana* (ripe fruit) (0.002 mg g<sup>-1</sup>) is less than the value (0.003 mg g<sup>-1</sup>) reported by Gopalan *et al.* (1982) but is higher than the value (0.001 mg g<sup>-1</sup>) reported by Vishwakarma & Dubey (2011).

The present vitamin B<sub>1</sub> content *Diospyrous melanoxydon* (0.0004 mg g<sup>-1</sup>), *Limonia acidissima* (0.0006 mg g<sup>-1</sup>) and *Ziziphus mauritiana* (0.0008 mg g<sup>-1</sup>) are higher than the values (0.0001 mg g<sup>-1</sup>, 0.0004 mg g<sup>-1</sup> and 0.0002 mg g<sup>-1</sup>, respectively) reported by Gopalan *et al.* (1982).

Vitamin C content of *Ziziphus mauritiana* (0.74 mg g<sup>-1</sup>) is lower than the value (0.76 mg g<sup>-1</sup>) reported by Gopalan *et al.* (1982) but higher than the value (0.36 mg g<sup>-1</sup>) made by Mahapatra *et al.* (2012). Vitamin C content of *Ziziphus oenopolia* (0.56 mg g<sup>-1</sup>) is less than the value (0.17 mg g<sup>-1</sup>) made by Mahapatra *et al.* (2012).

All the selected fruit plants have high percentage of moisture content. Some of the fruits have relatively higher moisture content, which is typical of fresh fruit at maturity (Umoh, 1998), while some have low moisture content, which are within the acceptable range for a good keeping period. The relatively low moisture content is an indication that these fruit plants will have high self life especially when properly packaged against external conditions (Eka, 1987). All the selected fruit plants in this study showed high amount of crude protein with *Semecarpus anacardium* having the highest value. Proteins are essential component of the diet needed for survival of animals and humans, their basic function in nutrition is to supply adequate amount of required amount of amino acids (Pugalenthi *et al.*, 2004). Among the selected fruit plants, *Phoenix sylvestris* (33.9%)



registered the highest total sugar content. High carbohydrate content of feed is desirable; the deficiency causes depletion of body tissues (Barker, 1996). Most of the selected fruit plants reported have high total lipid values. Lipids are essential because they provide the body with maximum energy; approximately twice that for an equal amount of protein or carbohydrate and facilitate intestinal absorption and transportation of fat-soluble vitamins A, D, E and K (Dreon *et al.*, 1990). Vitamin C (ascorbic acid) is an important water soluble vitamin already implicated in most of the life processes but principally functions as an antioxidant. Among the fruit analyzed, *Phyllanthus emblica* exhibited the highest vitamin C content. The relatively high amount of ascorbic acid in some selected fruits may be due to its acidity arising from the sour taste, since ascorbic acid occur more in acidic medium than at high pH values (Mapson, 1970).

Besides their usage as food item, these edible fruit plants are also exploited for their medicinal properties. Most of these species are utilised against various diseases by the local communities through their indigenous knowledge. For example, the latex of unripe fruit of *Ficus racemosa* is given internally to cure piles (Harish, 1988). The seeds of *Mucuna pruriens* are used in leucorrhoea, spermatorrhoea and also as an aphrodisiac; hairs covering the seeds are considered as vermifuge (Choudhury *et al.*, 1993). *Senna hirsuta* fruits are crushed and the paste is taken to cure constipation (Thakur *et al.*, 1992); seeds are given as animal feed to check epidemic disease among fowls (Aminuddin & Girach, 1991). *Mimusops elengi*, pulp of ripe fruit is useful for curing dysentery (Das, 1995). Oil from the seeds of *Semecarpus anacardium* plant is used externally to relief pain from wound and snake bite (Das, 1995). Fruit of *Tamarindus indicus* is useful for digestion and the testa of the seed is useful for extraction of gum and to cure dysentery (Das, 1995). *Ardisia solanacea* fruit paste is applied on forehead to relief from headache (Das & Misra, 1987). *Bombax ceiba* fruit is smeared on forehead for relief from headache. Fruit and seeds of *Zizyphus mauritiana* are consumed with salt to control vomiting (Shukla & Chakravarty, 2012).

This study highlights the significance of wild fruit species as a source of nutrients for tribal people. The data reported show that the various fruits are rich in nutrients and can serve as potential sources of food nutrient for the tribal rural people of southern Odisha. The analysis of 23 wild edible fruits bring into focus the rich nutritional composition of indigenous fruits and the scope for their use as an alternative source of bio-nutrition.

## 5. Conclusion

The present work brings to light a large number of wild edible fruit plants that are under use in south Odisha, India. The report identified superior/identical nutritional status in terms of crude protein, total sugar, total lipid, vitamins contents of edible fruit plants of south Odisha. The analysis indicates the scope of using wild edible fruits for dietary supplement. The present results indicate the potentiality of some edible fruit plants as source of non-conventional foods. These plants could be used for nutritional purposes due to their demonstrated good nutritional qualities and can help to overcome the nutritional deficiency especially in rural areas. In the light of this investigation, it is evident that, further studies to find new, unconventional underutilized fruits from



the wild is an urgent necessity, which will definitely enrich the fruit basket of the state and it is hoped that popularization of these fruits for the benefit of the rest of the communities will gain momentum.

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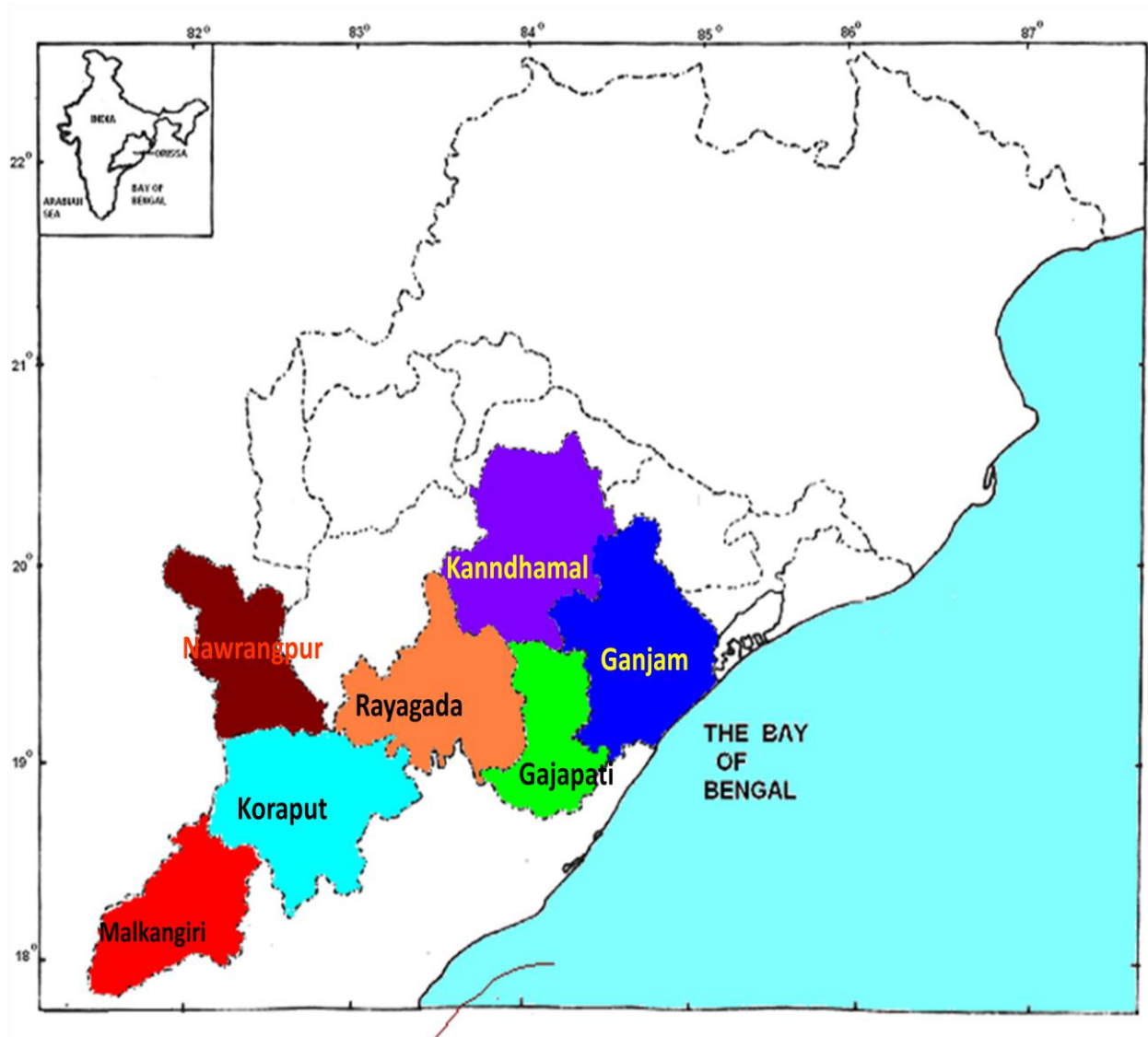
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**Fig. 1.** Map showing the study area, the seven districts of Odisha. Inset is India





**a**



**b**



**c**



**d**

**Figure 2a.** *Carissa carandas* **b.** *Cipadessa baccifera* **c.** *Coccinia grandis* **d.** *Corchorus aestuans*



**a**



**b**

**Figure 3a.** *Ficus racemosa* **b.** *Flacourtia indica*



**a**



**b**



**c**



**d**

**Figure 4a.** *Mangifera indica* **b.** *Momordica charantia* **c.** *Phoenix acaulis* **d.** *Semecarpus anacardium*



a



b

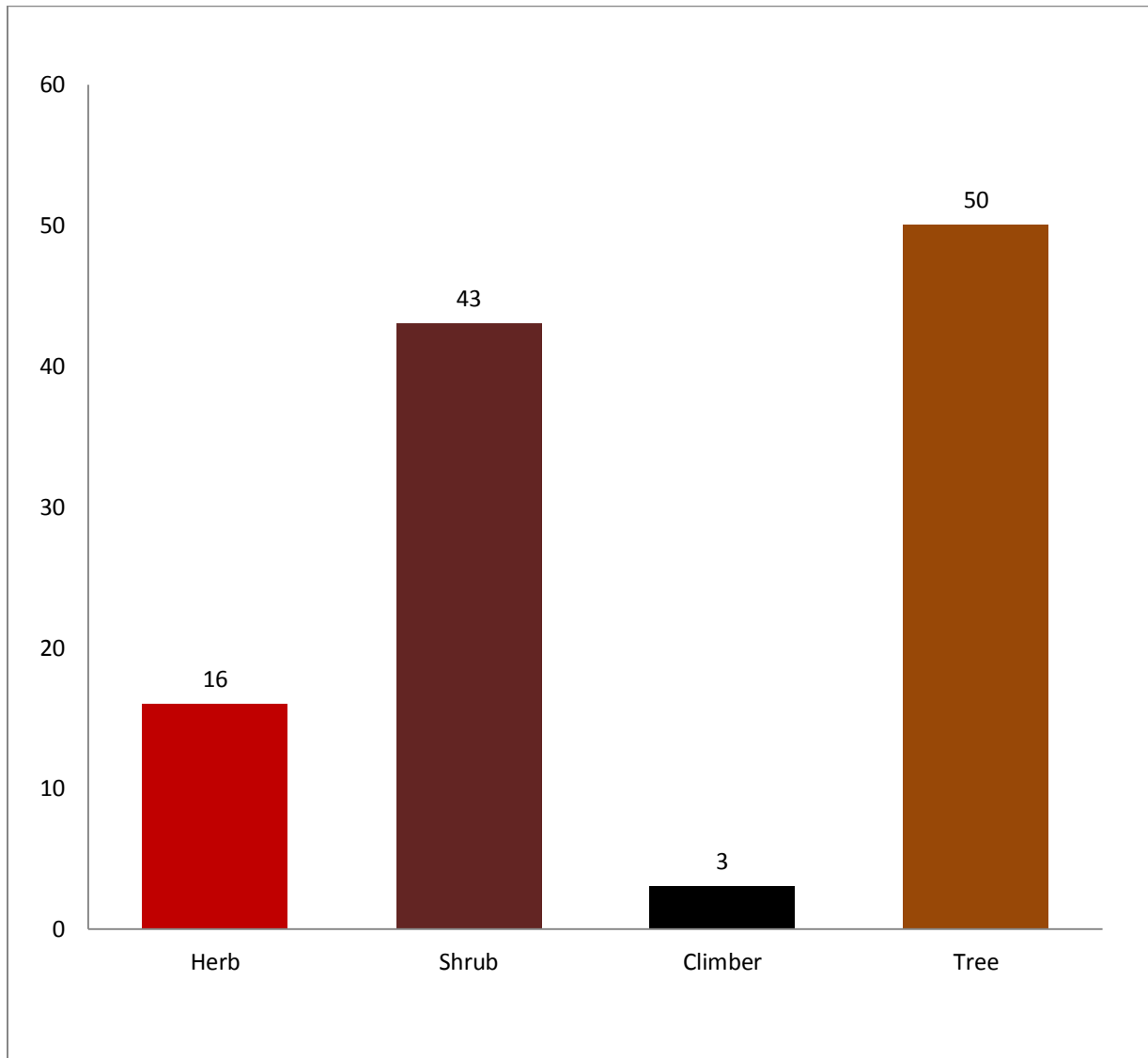


c



d

**Figure 5a.** *Smilax zeylanica* **b.** *Solena amplexicaulis* **c.** *Ziziphus mauritiana* **d.** *Ziziphus oenopolia*



**Figure 6.** Habit wise distribution of edible fruit plants of south Odisha.



## Author's Biography

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