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Underutilized Fruits: Lost Nutritional Treasure

Swati Shukla[1-2] and Shashi Jain[2]
[1]Department of Food Technology and Nutrition, Lovely Professional University, Phagwara, Punjab- 14411
[2]Department of Food Science and Nutrition, College of Home Science, MPUA&T, Udaipur, Rajasthan
Corresponding author:
email: swatishukla.shukla9@gmail.com

Abstract:

The consumption of underutilized plants for medicinal as well as nutritional use is being reported long back. Majorly the consumers of these plants are tribal sects of the society because they are the keepers of traditional knowledge on different uses of plant genetic sources. Even in today's time underutilized plants are still utilized during the famine and similar situations as they provide sufficient nutrition. Although, these underutilized plants can play a significance role in food and nutrition security, but maximum are unexplored and/or they are not cultivated. Hence present article throws a light on the nutritional potential of underutilized fruits.

Introduction:

Micronutrient deficiency is constant challenge that human race is facing from decades. Among the world's population one third of it is suffering from severe micronutrient deficiencies and the problem has been reported long back. Particularly the problem of malnutrition exists in the form of hidden hunger(Tontisirin et al. 2002). Micronutrients are needed in very small quantities but are essentially required for the vital activities of the body and are the major components in combating or preventing any disease. There are more than 30 micronutrients which are needed by the dietary sources as they are not synthesized by the body. Severe complications have been observed during the deficiencies of micronutrients as they are directly or indirectly involved in catalyzing different chemical reactions performed by the body (Shergill-bonner, 2017).

There are several sects of the society which belongs to the complicated socio-economic stature or belongs to food insecure households are majorly deficient in micronutrients. The major reason reported behind these deficiencies ishabitually low consumption or utilization of fruits and vegetables. But the basicunderlying cause behind and

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which needs to be immediately addressed is the availability of fruits and vegetables at higher prices and limited options or limited variety; as people are majorly focusing on the commercially available options. Therefore, thereneed to explore regionally available and less expensive though nutritionally rich options.

There are thousands of varieties of edible fruits and vegetable are available which have the potential to combat above stated issues and are easily available, less expensive but are unexplored therefore, underutilized. These underutilized species have potential to provide high content of micronutrient such as minerals, vitamins and several bioactive compounds. Thus, the present article focuses a light on different nutritionally rich yet underutilized fruits of India.

Consumption and uses of underutilized fruits

As far as consumption is concerned the use of underutilized fruits have been documented long back. they were and still are being used by the tribal sects of the society for the medicinal and traditional purposes. As evidence bhil tribe of dhar district of Madhya Pradesh, at times of crises depends upon several underutilized plants. They use leaves,fruits and seeds of various underutilized plants which can be eaten either raw or cooked. It has been observed that they ate the‘kasha’ either as fruit or as vegetables. ‘Sandeshra’ is another common fruit which satisfies both hunger and thirst and other fruits are ‘Tammer’ and ‘Tamra’. Leaves of ‘Goinda’, ‘Rajara’, ‘Keria’, ‘Sagara’, ‘Phangs’ and so on are also eaten in large quantity (Quamra et al. 2001). Furthermore,edible plants are the important constituent of traditional diets of Himalayan region of northern India. There are 190 species which have been screened as edible species, 27 plant species out of which 22 were edible for their fruit and five for leaves/shoots (Sundriyal and Sundriyal, 2004).

Several species of unexplored fruit bearing plants are found in Aravalli hills of Mewar region of Rajasthan. The main fruits which were found to be used as medicine are *Aegele maemelos* (L) Correa, *Emblica officinali, Helicteres isora, Pedalium murex, Solanum incanum* L., *Tamarindus indica* Linn., *Tribulus terrestris, Ziziphus mauritiana* Lam. These fruits are highly rich in different bioactive compounds and are used by the tribal people residing in that region (Katewa et al.2004).

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Likewise, there are fourty six types of fruits which are edible and are popular among the tribal community of Orissa, but not used by the other communities of the region. Among these, Badru (*Olax scandens* Roxb.), Bankundri *(Melothria heterophylla)*,Lawa (*Ficus glomerata* R.Br.),Karmata (*Dillenia aurea* Sm.), Korkotta (*Dillenia indica* Linn), Kongat Pinder (*Dregea sp*.), Oserwa (*Capparis Zeylanica* Linn) and Pakare (*Ficus Lucescens* Blume) are cooked and eaten as vegetable, while others are eaten ripe (Sinha and Lakra, 2005). These underutilized and indigenous fruits extremely popular among the tribal communities, despite of popularity people are still not adopting these fruit species for farming purposes which can help in getting income as well as nutritious option to the society (Mahaptra and Panda 2012).

Kumar *et al.* (2013) conducted an ethnobotanical inventory in the rural areas of Kannauj districts, Uttar Pradesh. In this survey documentation of underexploited, non-conventional, traditional and indigenous wild vegetables was done. Results of the study revealed that twenty-fiveunexplored plant species belonging to 18 families are used as vegetables by the rural community of Kannauj district. Leaves and young stem are used in majority of the cases (68%) followed by fruits (18%), flowers and tubers (7%).

As far as the consumption of underutilized plant species is concerned it has been reported that tribal communities belonging to Parambikulam wildlife sanctuary, Kerala consume eighty three species of edible underutilized plants, out of which thirty one species are used as fruits. Among the wild fruits, consumption of jackfruit is common in all the tribes (Yesodharan and Sujana 2007).

Ethano botanical studies have reported that desert region is endowed with valuable natural resources with special mention of arid fruits and vegetables. According to the study arid foods are largely used by the native people of north-west India as a prime source of food with their own traditional wisdom with less effort for value addition. However, processing is one of concern while consuming these arid foods; so that more useful and convenient product can improve livelihood security of the people residing in the desert regions. During the study ten arid plant species belonging to seven families were identified. fruits like *Ziziphus nummularia* (Burm.f.) Wight & Arn., *Cucumis callosus, capparis deciduas* Edges, *Citrullus lanatus* (Thumb.) were found to be commonly used by the people (Goyal and Sharma 2009).

Jhalod and Dahod district of Gujrat are filled with nutritious treasure as investigation done by Maru and Patel (2012) revealed that there are angiosperm herbs, shrubs and trees

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species which belongs to different families *Bombax ceiba* L., *Aegle marmelos* (L.), *Ailanthus Excesla* Robx., *Azadirachta Indica* A. Juss., *Melia azedarach* L., *Maytenus emarginata*(Willd.) D. Hou, *Mangifera Indica* L., *Butea Monosperma* (Lam) Taub., *Dalbergia sissoo* Roxb, *Sterculia urens* Roxb., *Pithecellobium Dulce* (Roxb) Bth., *Prosopis cineraria* (L.) Druce., *Terminalia arjuna* (Roxb). W.&A., *Terminalia bellirica* (Gaerth.) Roxb, *Eucalyptus globules* Labill., *Holoptelea intergrifolia* (Roxb.) Konth, *Diospyros melanoxylon* Roxb., *Holarhena antidysenterica* (L.) Wall ex G. Don. , *Wrightia tinctoria* R. Br., *Calotropis procera* (Ait.) R. Br., *Datura metel* L., *Tectona grandis* L. f., *Holoptelea Integrifolia* (Roxb.) Planch., *Ficus arnottiana* Miq., *Ficus benghalensis* L., *Ficus religiosa* L., *Ficus racemosa* L., *Agave Americana* L., *Phoenix sylvestris* (L.) Roxb. and *Dendrocalamus strictus* Nees are popular among the tribal districts.

Among the underutilized species Madhuca Lonigfolia (Sapotaceae) is also one of the plants of nutritional importance. It is widely known as 'Butter nut tree' and commonly known as Mahua. Mahua flower are used as a food as well as used as an exchanger in tribal and rural areas. Mahua seeds are rich in edible fats so they have economic importance. Mahua fruits are used as vegetable and widely consumed by the tribes of western Odisha. Madhuca longifolia is also considered as medicinal herbs and is useful for external application in treating skin diseases, rheumatism, headache, chronic constipation, piles, hemorrhoids and sometimes used as an emetic and galactagogue. Mahua oil is used for manufacturer of laundry soaps and detergent, and also used as cooking oil in various tribal region of India. Madhuca longifolia is reported by various scientist that it contains sapogenins, triterpenoids, steroids, saponins, flavonoids and glycosides. The tree is considered a boon by the tribals who are forest dwellers and keenly conserve this tree. The tribes consider the mahua tree and the mahua drink as part of their cultural heritage. So it is very much necessary to create awareness among the people to conserve the wild forest (Patel 2008, Mishra and Pradhan 2013, Pinakin et al. 2018).

Srivastava (2013) conducted a study on underutilized fruits utilized by rural people of north-eastern terai region of Uttar Pradesh.Twenty-seven varieties of underutilized edible fruits were identified and most of the varieties of fruits are eaten raw when ripe.

Bael *(Aegle marmelos* L.), Garna *(Carissa spinarum* L.*);* Lasura *(Cordia dichotoma* var. *wallichii),* Fakura *(Ficus palmata* Forsk.), *Rumbal (Ficus roxburghii)*; Kakoa *(Flacourtia indica), Bahera (Terminaliabelerica* Gaertn. Roxb) are underutilized though potentially

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nutritious plant species which are found in regions of Jammu and Kashmir. These tree species have been reported to have different uses as food, fodder, fuel, fencing, medicinal and in ethno-veterinary. Stem, bark, leaves; roots as well as fruits have been reported to have important traditional uses. Diverse medicinal properties of these tree species to overcome different problems/diseases like sun stroke, dysentery, pneumonia, cough, chest complaints, sour throat, toothache, mouth ulcers, inflammations, healing, anemia, curing urinary problems, and leucoderma have also been reported. Foliage of some identified under-utilized trees is used as vegetable and fruits and roots for making pickle. These are also used for the treatment of intestinal disorders (Slathia et al. 2017 and Tewari et al. 2018).

Nutritional potential of tribal fruits

Forests have provided food and shelter to man since ages. About twenty percent of the plants occurring in the forests are reported to have direct utility to mankind. Around 600 plant species in Indian forests are enumerated to have food value. However, they are often undervalued and underutilized as more exotic fruits become accessible. Also, most of these are not cultivated and there is only scant and dispersed knowledge about them. Their production and consumption provide a dietary supplement as well as commercial opportunity.

Macro and micro nutrients in fruits

Twenty three fruits viz. *Alangium Salvifolia, Anacardium Occidentale, Annona reticulate, Artocarpus interifolia, Canthium parviflorum, Carcia papaya, Cordia Myza, Cordia Oblique, Diosphros Melanoxylon, Eugenia Jambolana, Feroxia elephant, Ficus Glomerata, Gardenia Turgide, Mangifera indica, Manilkara hexandra, Murraya Paniculata, Phoneix humilis, phoenix sylvestris, phyllanthus emblica, Polyalthia cerasoides, Semecarpus anacardium and Zizyphus jujube* were analyzed for total carotenoids (TC) and β-carotene (BC) contents using High Performance Liquid Chromatography (HPLC). Among them, *Canthium parviflorum* contained very high TC i.e. 9.51 mg% and BCwas 6.10mg % and the edible orange color fresh rind portion analyzed had the highest 6.8mg % and BC 0.004 to 0.49 mg%. The edible pulp portion of the fruit Diosphros melanoxylon contained no BC and the rind portion analyzed fresh and dried had BC 0.79 and 2.17 mg%, respectively (Rajyalakshmi *et al.* 2003).

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Bael an underutilized fruit has the been reported to have 2.9 percent fibre condent along with 31.8 percent carbohydrates and the mineral content is reported to be 1.7 percent. Its mineral contents include phosphorus, calcium and iron whereas vitamin present are carotene, thiamine, riboflavin, niacin and vitamin C (Hasan 2010).

The underutilized fruits found in Arid zone of Rajasthan are of high nutrient quality. The major fruits species found in the zone are *Capparis decidua* (Ker), *Cordia dichotoma* (lasora), *Ziziphus mauritiana* (ber), *Ziziphus nummularia* (Bordi), *Salvadora oleoides* (Jal), *Balanites aegyptiaca* (Hingota), *Prosopiscineraria* (Khejri) etc. These species which play an significant role in the nutrition of children in rural areas. Most of these fruits are rich sources of protein and energy for example; Ker is a rich source of fibre, vitamin A and vitamin C, Ber is nutritionally rich in comparison with the apple as it has higher content of protein, phosphorous, calcium, carotene and vitamin C (Rathore 2010).

The physiochemical composition of Bambangan (Mangifera pajang Kosterm) fruit pulp and fruit juice powder were studied by Ibrahim *et al.* (2010). Investigation revealed that the chemical composition of M. pajang juice powder (MPJP) was rich in protein, CHO, ascorbic acid, and ash. MP pulp was rich in fiber, energy and β- carotene content.

Rao *et al.* (2011) reported that wood apple *(Feronia Limonia L.)* Seed protein concentrate (WSPC) was prepared and its properties were compared with the wood apple seed meal (WSM). The kernel and hull portions in wood apple whole seed were 60.6 and 39.4g/100g respectively. Proximate composition also determined and it was found that the protein content ranges 77g/100g (WSPC) t 33.8g/100g (WSM). Similarly, the carbohydrate accounted for 19.74 of WSM and 9 g/100g of WSP on sample basis. The energy values were calculated to be 487 and 340 kcal/100g for the wood apple seed meal and wood apple seed protein concentrate respectively. WSPC was good source of essential amino acids leucine, phenyl alanine, valine, iso-leucine ant threonine. Protein extractability of WSPC showed optimum WSPC to water ratio 0f 1:50(w/v), over 60 min.

Manila tamarind (*Pithecellobium dulce*) a highly nutrient dense underutilized fruit. Vitamin C content of this fruit is high i.e. 138 mg/100 g pulp which possess a significant value (Nandal and Bhardwaj 2014). Reddy (2016) assessed the nutritive value of anola and reported that calorific value of aonla as 59 cal/100g with 0.03 mg/100g Vitamin B, 0.2 mg/100g nicotinic acid and 700 mg/100g vitamin C.

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Dessert Date commonly known as Hingot *(Balanites aegyptiaca)* is a underutilized plant of Rajasthan; consists of Protein (4.9%), carbohydrate (69.9%), sugar (34.9%), fat (0.1%), fibre (3.5%), vitamin B2 (0.07mg/100g), vitamin C (46mg/100g), phosphorous (58mg/100g), calcium (147mg/100g), iron (4mg/100g) and energy (300.1Kcal/100g). Its ripe fruits are eaten raw/sun-dried and stored like dates, made into sweetmeats or fruit juice (mixed with water) and mixed with cereals, or fermented to alcoholic beverages. Study also reported that Lasora (*Cordia myxa*); a widely distributed small to moderate-sized deciduous fruiting plant. Its fruits consist of Protein (2%), carbohydrates (92%), fat (2%), fibre (2%), phosphorous (275mg/100g), calcium (55mg/100g), iron (6mg/100g), zinc (2mg/100g), manganese (2mg/100g) and energy (394Kcal/100g) (Tewari 2016).

Antioxidant activity in fruits

Lotus seed extract possess hepatoprotective, free radical scavenging properties and anti-fertility properties (Sohn *et al.* 2003). The total phenolic content of lotus seed is reported to be 7.61 per cent, which possess a strong free radical scavenging activity (Rai et al.2006).

Maridass *et al*, (2008) studied 29 *Diospvros* species for extractive values and qualitative identification of phytochemicals constituents. Species-wise percentages of methanol extract yields in decreasing order were as follows: *Diospvrosmalabarica* (5.61 per cent), *Diospvrosovalifolia* (4.39 per cent), and *Diospvros Montana* (4.87 percent), 1)iospyrus ovalifolia (4.39 per cent), and *Diospvros* melanoxylon (4.36 petcent) and minimum percentage was noted of *Diospvros foliosa* (1.25 percent).

Fruits of Manila tamarind *(Pithecellobium dulce)* are known for their high antioxidant and antimicrobial activity specially against skin related problems. Antioxidant content of manila Tamarind has been reported as (91.79 mg/g ± 1.71 and the DPPH activity of Pithecellobium dulce was above 526 µg/ml(IC_{50} Value), whereas the superoxide value of *Pithecellobium dulce was found* 410µg/ml (IC_{50} Value) that shows maximum inhibition or scavenging ability (Chanda and Baravalia 2010). In this category another fruit which has the highes antioxidant activity is *Mangifera pajang* Kosterm. The fruit possess highest free radical scavenging activities by 1,1-diphenyl-2-picrylhydrazyl (DPPH) and ferric reducing antioxidant power (FRAP) methods (Ibrahim et al.2010). Ponmozhi et al. (2011) investigated the anthocyanin extracted from *Pithecellobium Dulce* fruit pericarp and its evaluation for antioxidant activity. The percent of inhibited value of *Pithecellobium Dulce* fruit pericarp extract ranging from 40% to 66% in different methods of extraction.

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Apart from the fruit pulp of Manila Tamarind (*Pithecellobium dulce*) its peel also possess a great antioxidant and antibacterial activity. The aqueous, ethyl acetate and methanolic extracts of the fruit peel in a study showed higher levels of total phenolic contents than the petroleum ether extract i.e. 47.50 µg/ml (+ 1.45) , 45.00 µg/ml (+ 1.35), 45.00 µg/ml (+ 1.35), and 5.20 µg/ml (+ 0.15) respectively. Whereas, DPPH activity or percent(%) inhibition of *Pithecellobium dulce* Benth. fruit peel orthe was recorded 96.49 % (+ 2.90) in methanolic extracts, 88.29 % (+ 2.65) in ethyl acetate extracts, 87.39 % (+ 2.60) in aqueous and 0.98 % (+ 0.03) in petroleum ether extracts respectively Sukantha *et al.* (2011).

High phenolic activity has been recorded major underutilized fruits of Manipur, namely *Rhus semialata, Garcinia xanthochymus, Docynia indica, , Garcinia pedunculata and Averrhoea carambola*(Sharma et al. 2013).

Among all the fruits *Rhus semialata* was found to have higher polyphenol content followed by *Docynia indica* and *Averrhoea carambola*. Whereas, *Garcinia xanthochymus* showed higher flavonoid contents among all the fruits.

Bhati and Jain (2016) studied the vitamin C and antioxidant content of fruits commonly grown in tribal region of Udaipur, Rajasthan and reported marked variation among all the analysed uncultivated fruits were recorded. Ascorbic acid was observed highest in *Citrusmedica* (123.01 ± 0.61 mg/100g) and nil in *Holopteleaintegrifolia*. The highest DPPH inhibition observed in *Citrus medica* (86.96 per cent) followed by *Diospyros melanoxylon* (82.03 per cent) and *Manilkarahexandra* (81.19 per cent). Minimum DPPH inhibition was found in *Holoptelea integrifolia* followed by *Feronia limonia*, *Pithecellobium dulce* and *Ficus recemosa*.

Conclusion:

In the present socioeconomic scenario, when our country is facing the challenge severe malnutrition, hidden hunger, because of nutrient and micronutrient deficiencies, poverty and unemployment; there is a need to explore alternatives for better nutrition so for maintaining demand and supply chain of nutritious food items specially the horticultural crops. In terms of nutritional alternatives, the best way is to explore the unexplored species of underutilized horticultural crops. These crops are the best sources of different nutrient such as

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dietary fibre, micronutrients, macronutrients and many phytochemicals and possess therapeutic properties. Despite these nutritional properties they are easily available and are less expensive in comparison with the commonly available commercial species.

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TABLES

Table 1: Nutrient content of some important forest fruits from arid zone of Rajasthan (values are given per 100 gm)

Species	**Protein (%)**	**CHO (%)**	**Fat (%)**	**Fibre (%)**	**Vit. A (mg)**	**Vit. B2 (mg)**	**Vit. C (mg)**	**Ca (mg)**	**P (mg)**	**Fe (mg)**
Balanites aegyptiaca	4.9	69.9	0.1	3.5	-	-	46	147	58	4
Capparis decidua	8.6	1.8	-	12.3	-	-	7.81	55	57	-
Cordia dichotoma	2.0	92.0	2.0	2.0	-	-		55.0	275	6.0
Prosopis cineraria	23.2	56.0	2.0	20	-	-	523.0	414	400	19.0
Salvadora oleoides	6.0	76.0	2.0	2.0	-	-		6.0	76.0	8.0
Ziziphus mauritiana	0.8	17.0	0.3	-	0.02	0.02	76.0	4.0	9.0	1.8
Aegle marmelos	1.8	31.8	0.3	2.9	0.055	1.2		85.0	31.8	0.6

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Feronia limonia	7.3	15.5	0.6	5.2	-	0.170	2.0	0.13	0.11	0.6

Source : Rathore (2010)

Table 2: Nutritive value of underutilized fruits of Madhya Pradesh

Fruits	**Energy (Kcal)**	**Moisture (g)**	**Protein (g)**	**Fat (g)**	**Mineral (g)**	**Fibre (g)**	**Carbohy Drate (g)**	**Phospho rus (mg)**	**Calcium (mg)**	**Iron (mg)**
Aonla	58	82	0	0	0	3	14	50	20	1
Bael	137	61	2	0	2	3	32	85	50	1
Pomogranatae	65	78	2	0	1	5	14	10	70	2
Custurd apple	104	70	2	0	1	3	23	17	47	4
Wood apple	134	64	7	4	2	5	18	130	110	0
Ber	74	82	1	0	0	0	17	4	9	0

Source: Nair and Agrawal (2017)

Table 3: Ascorbic acid, β-carotene, total phenolics and antioxidant of *M. pajang* pulp (MPP) and *M. pajang* juice powder (MPJP).

Antioxidants parameters	**Mpp**	**Mpjp**

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Ascorbic acid (mg/100 g)	46.31 ± 5.84	132.14 ± 3.99
β -carotene (mg/100 g)	42.21 ± 1.80	35.59 ± 9.87
Total phenolics (mg GAE/100 g)	26.09 ± 3.20	19.30 ± 5.84
FRAP assay (m*M*/100 g)	26.50 ± 3.81	39.58 ± 2.73
DPPH radical scavenging activity (%)	43.25 ± 1.95	52.61 ± 1.3

Source: Ibrahim *et al.* (2010)

Table 4: Total phenol content (TPC) and total flavonoid content (TFC) of five wild edible fruits grown in Manipur, India

Extracts	**Common name**	**TPC (GAE mg/g ext.)**	**TFC (QE mg/g ext.)**
Garcinia pedunculata	Amalvet	9.44±0.24	0.607±0.027
Garcinia xanthochymus	Mysore Gamboge	31.31±2.0	5.313±0.668
Docynia indica	Mehul	49.26±4.21	0.504±0.074
Rhus semialata	Chinese gall	172.84±15.33	2.775±0.275
Averrhoea carambola	Kamrakh	43.11±2.46	0.379±0.01

Source: Sharma *et al.* 2013

Table 5: Vitamin and antioxidant content of fruits grown in tribal region of Udaipur (per 100g of edible portion)

Botanical Name	**Common Name**	**Vitamin-C (mg/100)**	**Antioxidant**
Citrus medica	Bijoura	123.01 ± 0.61	86.96 ± 1.04

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Cordia gharaf	Gunda	39.52 ± 0.97	76.16 ± 0.41
Diospyros melanoxylon	Tendu	49.01 ± 0.43	82.03 ± 0.24
Feronia limonia	Kaith	9.38 ± 1.50	67.54 ± 0.19
Ficus benghalensis	Bargad	47.47 ± 1.02	77.61 ± 0.51
Ficus recemosa	Goolar	47.78 ± 0.85	70.71 ± 0.15
Holoptelea integrifolia	Chilbil	Nil	58.2 ± 0.4
Pithecellobium dulce	Jungle Jalebi	95.68 ± 0.95	68.12 ±2.12
Manilkara hexandra	Rayan	12.53 ± 0.77	81.19 ± 0.5
Nelumbo nucifera	Kamal Kakri	47.84 ± 0.75	76.16 ± 0.41
Tribulus Terrestris	Gokhru	1.73 ± 0.39	73.31 ±1.8

Source: Bhati and Jain (2016)