

Wild edible fruit crops- the unexplored gems of Western Ghats

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Seminar report submitted in partial fulfilment of requirement of the course
FSC 591: Master's Seminar (0+1)



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DECLARATION

I, Reshma Ravi P (2018-12-006) hereby declare that the seminar entitled 'Wild edible fruit crops- the unexplored gems of Western Ghats' has been completed by me independently after going through the reference cited herein and I have not copied from any of the fellow students or previous seminar reports.

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CERTIFICATE

This is to certify that the seminar report entitled ‘Wild edible fruit crops- the unexplored gems of Western Ghats’ has been solely prepared by Reshma Ravi P (2018-12-006) under my guidance and has not been copied from fellow students.

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CONTENTS

Sl. No.	Title	Page No.
1.	Introduction	8
1.1	The Western Ghats	8
1.2	Wild edible fruits	10
2.	Wild edible fruits of Western Ghats	10
2.1	State-wise diversity of wild edible fruits	10
2.1.1	Wild edible fruits of Gujarat	11
2.1.2	Wild edible fruits of Maharashtra	12
2.1.3	Wild edible fruits of Karnataka	14
2.1.4	Wild edible fruits of Tamil Nadu	15
2.1.5	Wild edible fruits of Kerala	17
3.	Why wild edible fruits are important?	18
3.1	Wild edible fruits for nutritional security	19
3.2	Nutraceutical properties of wild edible fruits	21
3.2.1	Anticancer activity	22
3.2.2	Antioxidant activity	23
3.2.3	Antidiabetic activity	25
3.2.4	Laxative property	25
3.3	Wild edible fruits as a source of income	26
3.4	Wild edible fruits and climate resilient agriculture	27
4.	Domestication of wild edible fruits	27
5.	Conservation of wild edible fruits	28
6.	Value addition of wild edible fruits	29
7.	Challenges	29
8.	Future thrust areas	30
9.	Conclusion	30
10.	Discussion	30
11.	Reference	31
12.	Abstract	33

LIST OF TABLES

Table no.	Title	Page no.
1.	Wild edible fruit species of Gujarat	12
2.	Wild edible fruit species of Maharashtra	13
3.	Wild edible fruit species of Karnataka	14
4.	Wild edible fruit species of Tamil Nadu	16
5.	Wild edible fruit species of Kerala	17
6.	Ascorbic acid content in wild edible fruits	21
7.	Wild edible fruits used in traditional medicine	21
8.	Anthocyanin, ascorbic acid, phenolic and flavonoid contents in wild edible fruits	24
9.	Wild relative of cultivated fruit species	27

LIST OF FIGURES

Fig. no.	Title	Page no.
1.	Protein content in wild edible fruits	19
2.	Iron content in wild edible fruits	20
3.	Potassium content in wild edible fruits	20
4.	Cytotoxic potential of <i>Mimusops elengi</i> extracts on human cervical cancer (SiHa) cell lines	22
5.	Cytotoxic activity of <i>A. salvifolium</i> against Human Breast Cancer Cells (MCF-7)	23
6.	DPPH scavenging activity of wild edible fruits	24
7.	Antidiabetic activity of <i>Morinda citrifolia</i> on Alloxan induced diabetic rats	25
8.	Dietary fibre content in wild edible fruits	26
9.	Tribal household income of Kadar tribes in Peechi-Vazhani wildlife sanctuary	26

LIST OF PLATES

Plate no.	Title	Page no.
1.	Regions of the Western Ghats	9
2.	State wise distribution of wild edible fruit species in the Western Ghats	11
3.	Important wild edible fruit species of Gujarat	11
4.	Important wild edible fruit species of Maharashtra	13
5.	Important wild edible fruit species of Karnataka	14
6.	Important wild edible fruit species of Tamil Nadu	15
7.	Important wild edible fruit species of Kerala	17
8.	Value added products from wild edible fruits	29

Wild edible fruit crops- the unexplored gems of Western Ghats

1. Introduction:

India is the second most populous country in the world with a population of 1.3 billion. Even though the food grain production has reached a sustainable level, chronic malnutrition still remains as a threat in India. Nearly 195 million people in India, out of which 47 million are children are suffering from chronic malnutrition. Improving the nutrient intake as well as the dietary diversity will help to mitigate this problem. Wild edible fruits which are rich in nutrients can be a possible solution for meeting the day to day nutritional requirements of the population there by paving way to nutritional security.

Even though more than 3000 edible plant species are known to mankind, about 30 crops alone contribute to more than 90 per cent of the world's calorie intake and only about 120 crops are economically important at the national scale (Narayanan *et al.*, 2011). Several edible plant species still remain undiscovered in various habitats all over the country and the wild edible fruits are one such category which have the potential to diversify the human diet as well as act as a solution for sustainable agriculture. The Western Ghats which is one of the hottest biodiversity hotspots in India is the home for numerous species of wild edible fruits which can act as a remedy for nutritional insecurity among tribal and rural populations. They also possess various nutraceutical properties which makes them even more valuable.

1.1 The Western Ghats:

The mighty Western Ghats is one among the eight biodiversity hotspots in the world and has the world heritage site title given by the UNESCO. It has an area of about 1,40,000 km² and has a longitudinal stretch of about 1,600 km, with an average elevation of about 1,200 m above mean sea level. The range starts near Songadh town of Gujarat, south of the Tapi river, and runs parallel to the western coast of Indian peninsula through the states of Maharashtra, Goa, Karnataka, Kerala and Tamil Nadu, ending at Marunthuvazh Malai, at Swamithope, Tamil Nadu.

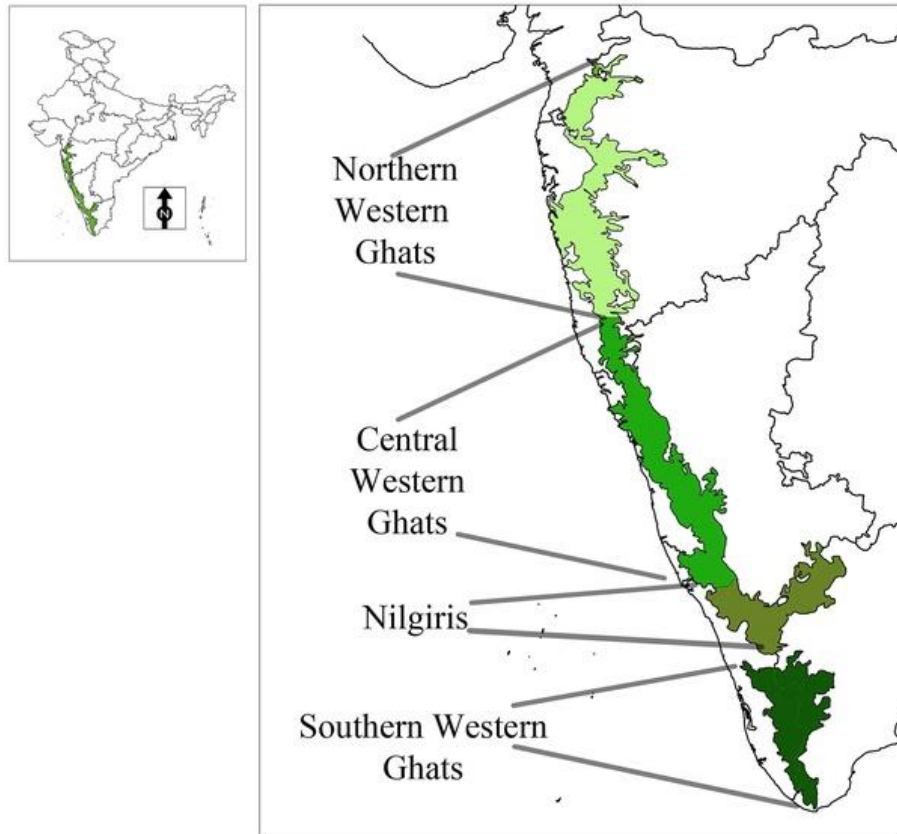


Plate 1: Regions of the Western Ghats

The Western Ghats can be divided into four major regions namely the Northern Western Ghats, the Central Western Ghats, the Nilgiris and the Southern Western Ghats. The Northern Western Ghats spreads across the states of Gujarat and Maharashtra. The Central Western Ghats traverses across parts of Maharashtra, Goa, Karnataka and Kerala. The Nilgiris or the blue hills, which is one of the most spectacular natural mountains ranges situated at the confluence of the Western and Eastern Ghats. This mountain range spreads across the states of Kerala and Tamil Nadu. The Southern Western Ghats is separated from the rest of the Western Ghats by the Palakkad gap and stretches through the states of Kerala and Tamil Nadu. The mountains of the Western Ghats (highest point 2,695 m, Anamudi Peak) mediate the rainfall regime of peninsular India by intercepting the monsoon storm systems. The southern end of the Ghats has a short dry season (2–5 months) as it receives rain from both the south-west (June–September) and north-east (October–January) monsoons. The northern reaches have a longer dry season (5–8 months), receiving rain mostly during the south-west monsoon.

A significant feature of the Western Ghats is their exceptionally high level of biological diversity and endemism. The Western Ghats harbour approximately 5,000 species of flowering plants, belonging to nearly 2,200 genera and 217 families among which about 1,700 species (34 per cent) are endemic. The Western Ghats has diverse ecosystems ranging from tropical wet evergreen forests to montane grasslands and is rich in wild edible fruit species which are primarily utilized by the tribal population in order to meet their nutritional requirements.

1.2 Wild edible fruits:

According to Chauhan et al. (2018), wild edible fruits are edible species that are not cultivated or domesticated and are accessible from various natural habitats. About 600 species of wild edible fruits have been reported so far from India. They are commonly collected from wild environments, especially forests and are the most widely used non-timber forest products by the tribal populations. According to Ajesh *et al.* (2012), they play an important role in the livelihoods of rural communities as they are an integral part of their subsistence strategy. They play a significant role in human nutrition, as they are rich sources of carbohydrates, proteins, vitamins, minerals and dietary fiber. They are also used as medicine, fodder, etc.

2. Wild edible fruits of Western Ghats:

About 344 species of wild edible fruits have been officially reported from Western Ghats of which a wide majority belonged to the plant families Anacardiaceae, Apocynaceae, Moraceae, Myrtaceae, Sapindaceae and Sapotaceae (Dandin and Kumar, 2016). The diversity of each family varies with different regions in Western Ghats. There are still more to be discovered and many of these undiscovered species gets extinct even before they are discovered. The fruiting period of these plants extends from two to six months in a year.

2.1 State- wise diversity of wild edible fruits:

The Western Ghats harbors a wide range of wild edible fruits and each state has its own share of wild edible fruits which are native to Western Ghats.

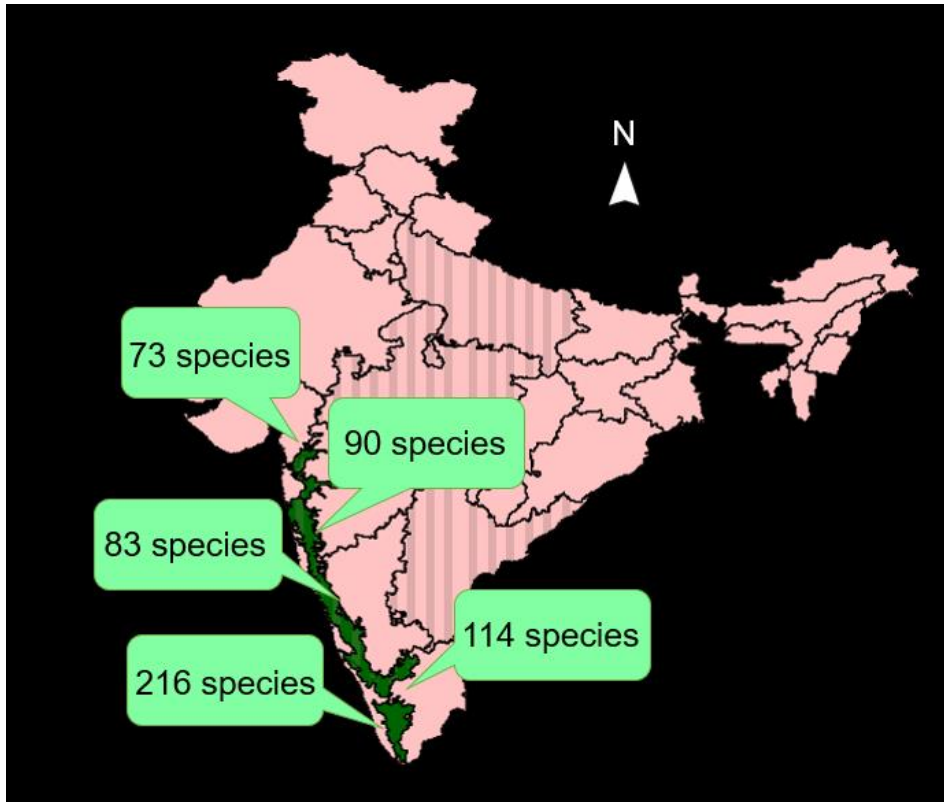


Plate 2: State wise distribution of wild edible fruit species in the Western Ghats

2.1.1 Wild edible fruits of Gujarat

About 73 wild edible fruit species have been reported from Gujarat, majority of which belonging to the families Boraginaceae, Malvaceae, Phyllanthaceae, Rhamnaceae, Rutaceae and Sapotaceae. The diversity of species is found to be higher in Saputara and Purna forests. The tribal population in this region (Dangs tribe) consumes the fruits either in fresh or dried form. Juices and pickles are also prepared from these species. Apart from their use as food, these wild edible fruits are also used in traditional medicine (Chauhan *et al*, 2018).





Plate 3: Important wild edible fruit species of Gujarat A) *Alangium salvifolium* B) *Bridelia squamosa* C) *Buchanania cochinchinensis* D) *Cordia dichotoma* E) *Ficus hispida* F) *Flueggea microcarpa*

Table 1: Wild edible fruit species of Gujarat

Sl. No.	Local name	Scientific name	Family	Uses
1.	Aakna	<i>Alangium salvifolium</i>	Alangiaceae	Wound healing, stomach disorders
2.	Akano	<i>Bridelia squamosa</i>	Euphorbiaceae	Treating cough, fever, etc.
3.	Charoli	<i>Buchanania cochinchinensis</i>	Anacardiaceae	Treating skin diseases, asthma, etc.
4.	Gunda	<i>Cordia dichotoma</i>	Ebenaceae	Ulcers and colic pains
5.	Koth umbo	<i>Ficus hispida</i>	Moraceae	Skin diseases, anemia
6.	Safed chini	<i>Flueggea microcarpa</i>	Euphorbiaceae	Rheumatism, arthritis
7.	Dhaman	<i>Grewia tiliaefolia</i>	Tiliaceae	Mild antibiotic
8.	Kotha	<i>Limonia acidissima</i>	Rutaceae	Treating bites and stings
9.	Mahuda	<i>Madhuca indica</i>	Sapotaceae	Hepato-protective action
10.	Rayan	<i>Manilkara hexandra</i>	Sapotaceae	Gum and teeth problems
11.	Behado	<i>Terminalia bellirica</i>	Combretaceae	Respiratory tract infections
12.	Ghat bor	<i>Ziziphus xylopyra</i>	Ebenaceae	Treating asthma, cough, etc.

2.1.2 Wild edible fruits of Maharashtra

About 90 species of wild edible fruits have been reported from Maharashtra, most of which belonged to the families Anacardiaceae, Ebenaceae, Boraginaceae,

Myrtaceae, Rhamnaceae and Rubiaceae. The species diversity was found to be the high in Tryambakeshwar, Kalsubai, Mulshi, Malshej Ghat, Nana Ghat and Varandha Ghat regions (Deshmukh and Waghmode, 2011).

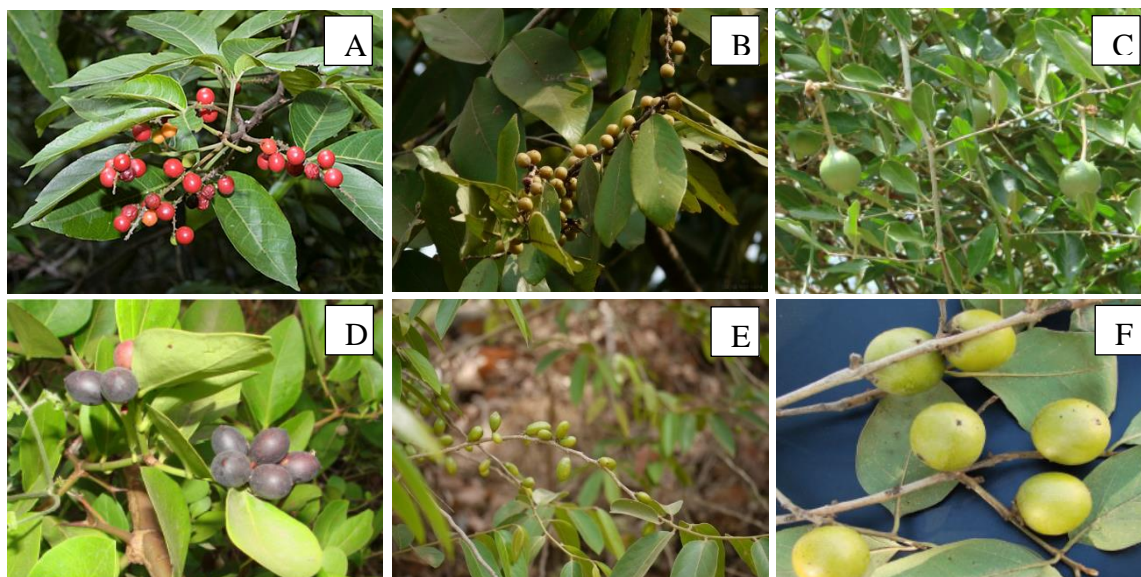


Plate 4: Important wild edible fruit species of Maharashtra A) *Allophylus cobbe* B) *Bridelia retusa* C) *Capparis zeylanica* D) *Carrisa congesta* E) *Casearia tomentosa* F) *Diospyros peregrina*

Table 2: Wild edible fruit species of Maharashtra

Sl. No.	Local name	Scientific name	Family	Uses
1.	Tipani	<i>Allophylus cobbe</i>	Sapindaceae	To treat diarrhea, fracture, etc.
2.	Asana	<i>Bridelia retusa</i>	Phyllanthaceae	To treat urinary disorders
3.	Waghatii	<i>Capparis zeylanica</i>	Capparaceae	To treat stomach disorders
4.	Karvand	<i>Carrisa congesta</i>	Apocynaceae	To treat wounds, anorexia, etc.
5.	Chilla	<i>Cordia dichotoma</i>	Boraginaceae	Anti-inflammatory, purgative
6.	Tendu	<i>Diospyros peregrina</i>	Ebenaceae	To treat wounds, ulcers, etc.
7.	Kirmith	<i>Grewia abutilifolia</i>	Malvaceae	Against diarrhea, gout, etc.
8.	Alu	<i>Meyna laxiflora</i>	Rubiaceae	To treat stomach disorders

9.	Sindhi	<i>Phoenix humilis</i>	Arecaceae	Antipyretic and against ulcers
10.	Amani	<i>Rhus sinuta</i>	Anacardiaceae	Mild antiseptic and astringent
11.	Pithwan	<i>Securinega virosa</i>	Phyllanthaceae	To treat menstrual problems
12.	Toran	<i>Ventilago madraspatana</i>	Rhamnaceae	Antidiabetic and carminative

2.1.3 Wild edible fruits of Karnataka

About 83 species of wild edible fruits have been reported from Karnataka with maximum diversity in Kodagu and Mudigere. The main plant families in this region are Clusiaceae, Flacourtiaceae, Moraceae, Myrtaceae and Rosaceae (Mundaragi *et al*, 2017). These are normally consumed in both fresh and dried form or in the form of juice, pickle, wine, *etc.*

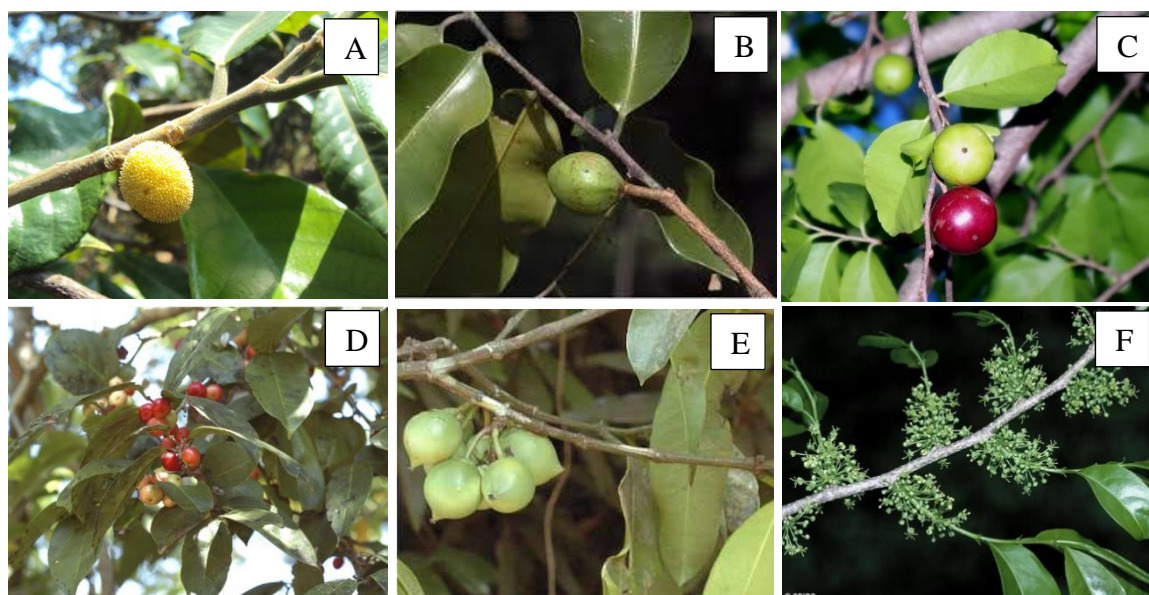


Plate 5: Important wild edible fruit species of Karnataka A) *Artocarpus gomezianus* B) *Chrysophyllum roxburghii* C) *Flacourtia indica* D) *Flacourtia montana* E) *Garcinia xanthochymous* F) *Margaritaria indica*

Table 3: Wild edible fruit species of Karnataka

Sl. No.	Local name	Scientific name	Family	Uses
1.	Salle mara	<i>Aporosa cardiosperma</i>	Phyllanthaceae	To treat diabetes, infertility and hepatic diseases
2.	Vatte huli	<i>Artocarpus gomezianus</i>	Moraceae	Antiviral properties

3.	Bimbuli	<i>Averrhoa bilimbi</i>	Oxalidaceae	To treat diabetes, hyper cholesterol and obesity
4.	Nurukalu hannu	<i>Buchanania cochinchinensis</i>	Anacardiaceae	Good source of carbohydrates and protein
5.	Kare hannu	<i>Canthium coromandelicum</i>	Rubiaceae	Anti-microbial and antioxidant activity
6.	Kouli hannu	<i>Carissa spinarum</i>	Apocynaceae	Wound healing and anti-microbial activity
7.	Hale	<i>Chrysophyllum roxburghii</i>	Sapotaceae	To treat wounds
8.	Karimullu hannu	<i>Flacourtia indica</i>	Flacourtiaceae	Against fever and throat infections
9.	Sampige hannu	<i>Flacourtia montana</i>	Flacourtiaceae	To treat kidney disorders
10.	Devajarige	<i>Garcinia xanthochymous</i>	Clusiaceae	To make sherbats
11.	Papaskalli	<i>Opuntia dillenii</i>	Cactaceae	To treat burns & ulcers
12.	Kuntu nerle	<i>Rhodomyrtus tomentosa</i>	Myrtaceae	To treat mouth ulcers
13.	Gerr hannu	<i>Semecarpus anacardium</i>	Anacardiaceae	Anti-inflammatory, antioxidant and antimicrobial activity
14.	Kuntu nerle	<i>Syzygium caryophyllatum</i>	Myrtaceae	Possess anti-inflammatory properties
15.	Kadu manasu	<i>Toddalia asiatica</i>	Rutaceae	To treat cough & influenza

2.1.4 Wild edible fruits of Tamil Nadu

About 114 species of wild edible fruits are reported so far from Tamil Nadu. Majority of the species reported were from the plant families Apocynaceae, Moraceae, Myrtaceae, Rhamnaceae and Rosaceae with maximum species diversity in Anamalais, Nilgiri hills and Kotagiri hills (Sasi and Rajendran, 2012).





Plate 6: Important wild edible fruit species of Tamil Nadu A) *Carissa paucinervis* B) *Cordia monoica* C) *Diospyros ferrea* D) *Ficus exasperata* E) *Grewia villosa* F) *Kirganelia reticulata*

Table 4: Wild edible fruit species of Tamil Nadu

Sl. No.	Local name	Scientific name	Family	Uses
1.	Alanji	<i>Alangium salvifolium</i>	Cornaceae	Wound healing, stomach disorders
2.	Jakkala	<i>Berberis tinctorial</i>	Berberidaceae	Hepatoprotective activity
3.	Sirukkilaa	<i>Carissa paucinervis</i>	Apocynaceae	To treat wounds
4.	Nruveli	<i>Cordia monoica</i>	Boraginaceae	To treat edema, fever, etc.
5.	Irumballi	<i>Diospyros ferrea</i>	Ebenaceae	Laxative
6.	Maramthinni athi	<i>Ficus exasperata</i>	Moraceae	Wound healing & to treat fever
7.	Thottukalla	<i>Grewia villosa</i>	Malvaceae	To cure body pains
8.	Arunelli	<i>Kirgaelia reticulata</i>	Euphorbiaceae	To treat cough, fever & dyspnea
9.	Actaralee	<i>Polygonum chinensis</i>	Polygonaceae	To treat dysentery and enteritis
10.	Kattumunthiri	<i>Rubus molucanus</i>	Rosaceae	To cure urinary disorders
11.	Mulluvettilla	<i>Rubus rugosus</i>	Rosaceae	To heal wounds
12.	Kodalli	<i>Scolopia crenata</i>	Salicaceae	To heal wounds & cure body pain
13.	Neerodam	<i>Syzygium calophyllifolium</i>	Myrtaceae	To treat fever

14.	Pisin maram	<i>Tarenna asiatica</i>	Rubiaceae	To treat skin diseases and cuts
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2.1.5 Wild edible fruits of Kerala

About 216 species of wild edible fruits are reported from Kerala and the maximum species diversity is found in Attappady, Wayanad and Idukki regions. The diversity among the plant families Moraceae, Myrtaceae, Phyllanthaceae, Rutaceae and Sapotaceae are found to be the highest (Narayanan *et al*, 2011).

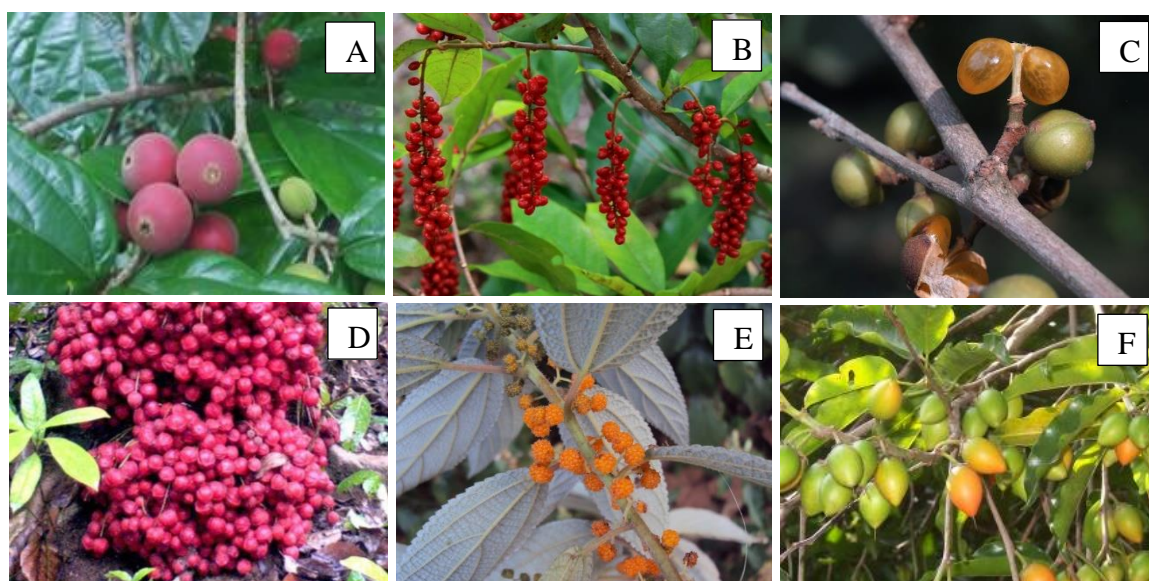


Plate 7: Important wild edible fruit species of Kerala A) *Alangium salvifolium* B) *Antidesma ghaesembilla* C) *Aporosa lindleyana* D) *Baccaurea courtallensis* E) *Debregeasia longifolia* F) *Mimusops elengi*

Table 5: Wild edible fruit species of Kerala

Sl. No.	Local name	Scientific name	Family	Uses
1.	Ottangadi, Kilikuthipazham	<i>Alangium salvifolium</i>	Alangiaceae	Fruits have astringent properties
2.	Karankolam	<i>Aleurites moluccana</i>	Euphorbiaceae	Antibacterial activity, termite resistant properties
3.	Kaattupulinchi	<i>Antidesma ghaesembilla</i>	Phyllanthaceae	To cure head ache, fever, abdominal swellings and menstrual irregularities
4.	Eachil, Vetti	<i>Aporosa lindleyana</i>	Phyllanthaceae	Antibacterial, analgesic and hypoglycaemic activity

5.	Mootipazham	<i>Baccaurea courtallensis</i>	Phyllanthaceae	Used against constipation, diarrhea, skin infection, <i>etc.</i>
6.	Nendravalli	<i>Bridelia scandens</i>	Phyllanthaceae	Anti-inflammatory activity
7.	Karanda	<i>Carissa congesta</i>	Apocynaceae	Possess antidiuretic activity
8.	Pulichakka	<i>Chrysophyllum roxburghii</i>	Sapotaceae	Antibacterial activity
9.	Kattunochi, Neerinch, Monili	<i>Debregeasia longifolia</i>	Urticaceae	Used to cure scabies
10.	Cherala	<i>Ficus virens</i>	Moraceae	Used as a refrigerant and to heal wounds
11.	Njalli	<i>Leea indica</i>	Sapotaceae	Used as a neurotonic
12.	Illippa	<i>Madhuca indica</i>	Sapotaceae	Anti-inflammatory, analgesic and antipyretic activity
13.	Elenji	<i>Mimusops elengi</i>	Sapotaceae	Leaf and bark extracts have anticancer activity
14.	Koratta	<i>Rhodomyrtus tomentosus</i>	Myrtaceae	Roots have antipyretic activity
15.	Tholnjalval	<i>Syzygium hemisphericum</i>	Myrtaceae	Antibacterial activity
16.	Njalval	<i>Syzygium zeylanicum</i>	Myrtaceae	Antibacterial, antioxidant and anti-inflammatory activity
17.	Malankara	<i>Tamilnadia uliginosa</i>	Rubiaceae	To cure diarrhoea and dysentery
18.	Thaanni	<i>Terminalia bellirica</i>	Combretaceae	Respiratory tract infections

3. Why wild edible fruits are important?

Wild edible fruits are now gaining importance owing to their nutritional quality as well as nutraceutical properties. They can also be used as component in sustainable agriculture due to their climate resilient nature and resistance to biotic and abiotic stress. They also act as potential gene donors in crop improvement to combat various stress conditions.

3.1 Wild edible fruits for nutrient security

Most of the wild edible fruits are found to be rich in dietary nutrients such as proteins, carbohydrates, vitamins and minerals. Most of these fruits have nutritional levels comparable to commercial fruits. They play an important role in diversifying the diet of tribal population and also help in prevention of deficiency disorders.

Nazarudeen (2008) reported that the WEFs possess equivalent or better nutritional quality when compared to that of commercial fruit crops. The fruits of *Alangium salvifolium* and *Debregeasia longifolia* were rich in protein and iron contents respectively. The fruits of *Aporosa lindleyana* were found to have potassium content comparable to that of banana (Nazarudeen, 2008).

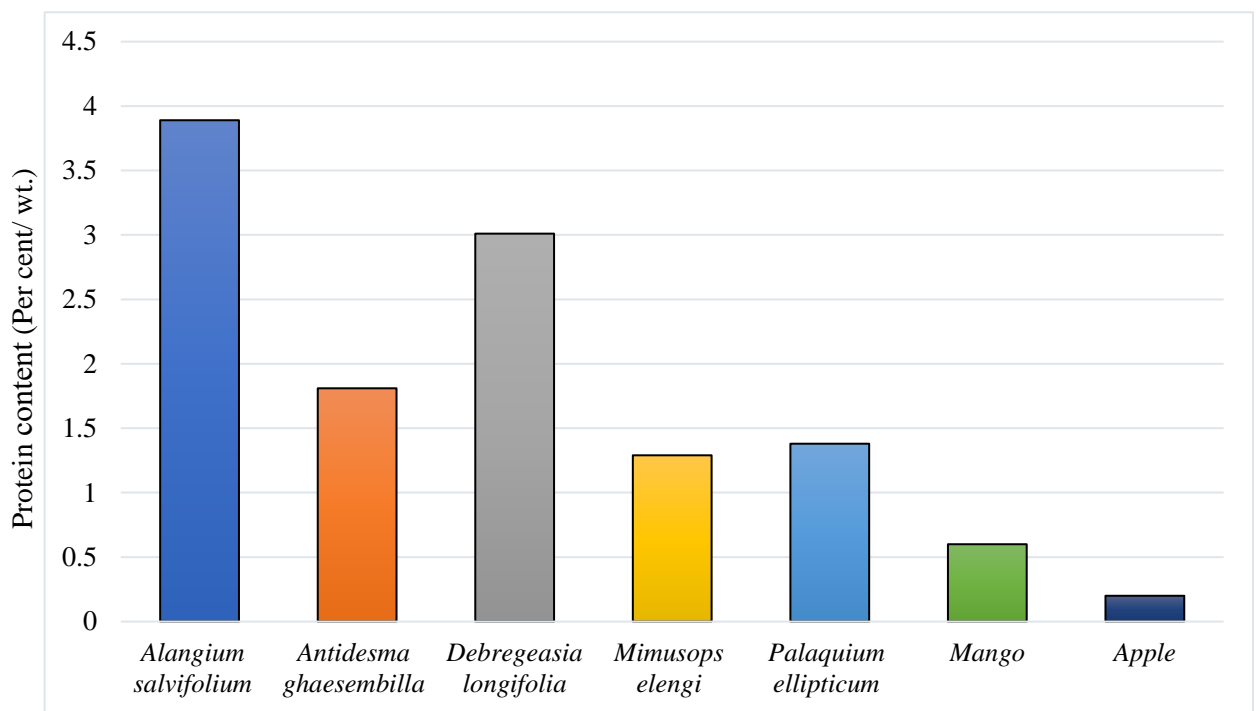


Fig 1: Protein content of wild edible fruits

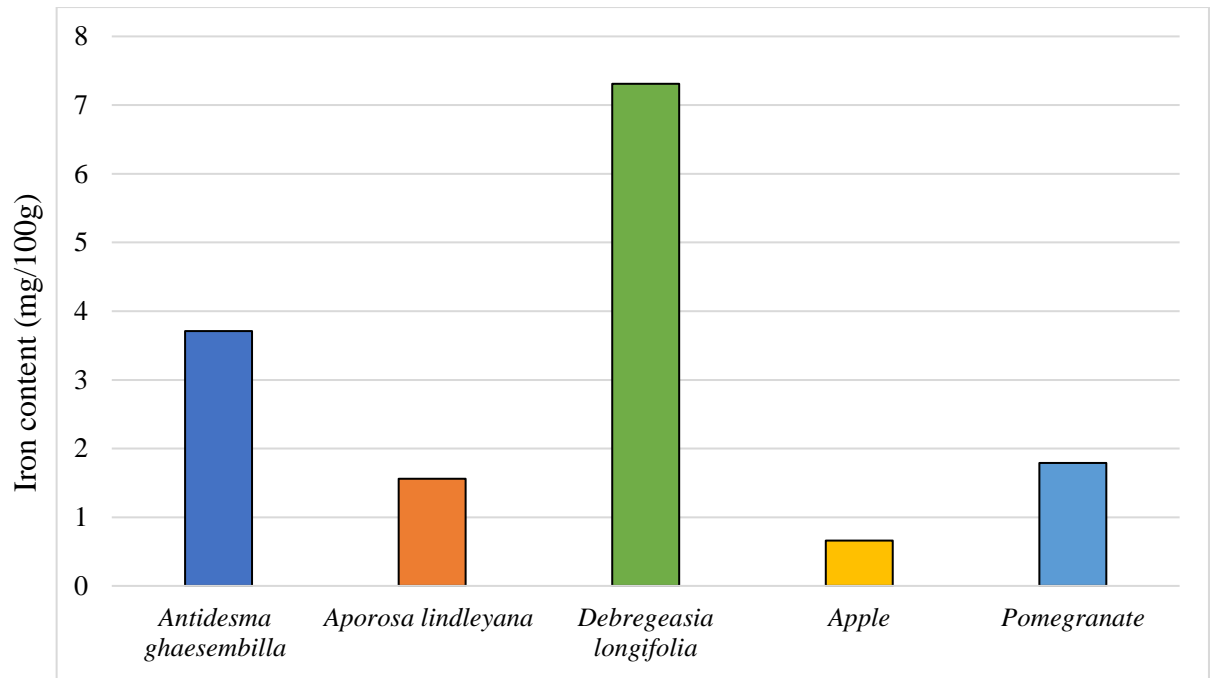


Fig 2: Iron content in wild edible fruits

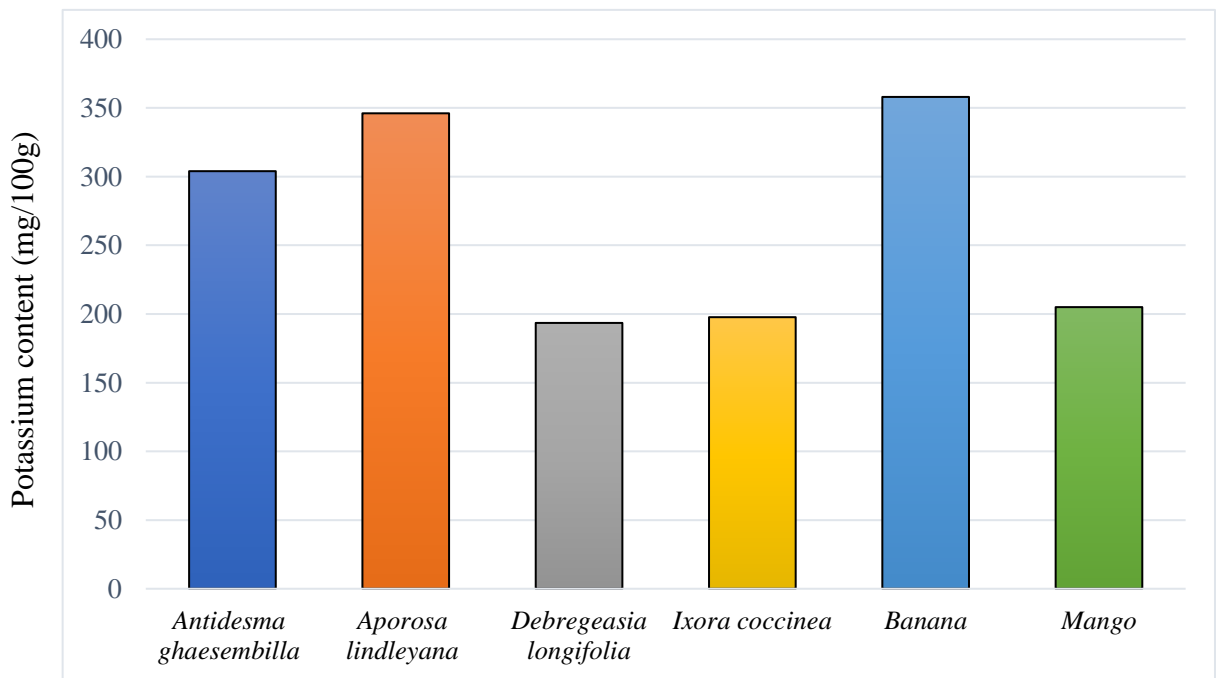


Fig 3: Potassium content in wild edible fruits

Khilari and Sharma (2016) investigated the vitamin C contents of wild edible fruits using standard protocols. From this study it was found that karvand (*Carissa congesta*) was having the highest vitamin C content among the wild edible fruits under study.

Table 6: Ascorbic acid content in wild edible fruits

Sl. No.	Scientific name	Family	Local name	Ascorbic acid content (mg/100g)
1.	<i>Carissa congesta</i>	Apocynaceae	Karvand	36.68
2.	<i>Opuntia stricta</i>	Cactaceae	Nivdung	31.68
3.	<i>Terminalia catappa</i>	Combretaceae	Deshi badam	29.04
4.	<i>Limmonia acidissima</i>	Rutaceae	Kavath	15.84
5.	<i>Elaegnus conferta</i>	Elaeagnaceae	Ambal	13.20

3.2 Nutraceutical properties of wild edible fruits

Wild edible fruits have been used from time immemorial for preparing various traditional medicinal preparations. Apart from the fruits all the other plant parts including leaves, flowers, stem, roots and even the whole plant are used for preparing medicinal decoctions for treating ailments such as fever, cough, stomach disorders, body pain, etc.

Table 7: Wild edible fruits used in traditional medicine

Sl. No.	Disease	Plants used
1.	Fever	<i>Bridelia squamosa</i> (Akano) <i>Phoenix humilis</i> (Sindhi) <i>Flacourtia indica</i> (Atak)
2.	Respiratory diseases	<i>Buchanania cochinchinensis</i> (Charoli) <i>Semecarpus anacardium</i> (Bibba) <i>Terminalia bellirica</i> (Behado)
3.	Stomach disorders	<i>Alangium salvifolium</i> (Aakna) <i>Cordia dichotoma</i> (Gunda) <i>Polygonum chinensis</i> (Chimati saag)
4.	Rheumatism	<i>Flueggea microcarpa</i> (Safed chini) <i>Grewia villosa</i> (Kirmith) <i>Scolopia crenata</i> (Chiralu)
5.	Menstrual irregularities	<i>Antidesma ghaesembilla</i> (Bujada) <i>Ixora coccinea</i> (Rugmini) <i>Securinega virosa</i> (Pithwan)
6.	Wound healing	<i>Carrisa congesta</i> (Karvand)

		<i>Margaritaria indica</i> (Kaalikudari) <i>Scolopia crenata</i> (Chiralu)
7.	Skin diseases	<i>Ficus hispida</i> (Koth umbo) <i>Rhus sinuta</i> (Amani) <i>Tarenna asiatica</i> (Bingi papadi)
8.	Burns	<i>Balanites aegyptica</i> (Hingan) <i>Opuntia dillenii</i> (Hath hathoria) <i>Ziziphus mauritiana</i> (Ghat bor)

Recently a few studies were done to study the nutraceutical properties of wild edible fruits and it was found that some of these fruits were having anticancer, antioxidant, laxative, anti-diabetic and antianemic properties.

3.2.1 Anticancer activity

Anticancer activity was reported a few wild edible fruits such as *Mimusops elengi*, *Alangium salviifolium*, *Leea indica*, etc.

Cytotoxic activity of methanolic extracts of *Mimusops elengi* leaves and bark on Human Cervical Cancer cells has been reported by Ganesh *et al.* (2013). The methanolic extracts of both leaves and bark of *M. elengi* were incubated with the human cervical cancer cells (SiHa cells) at four different concentrations namely, 10, 25, 50 and 100 µg/ ml. Here maximum cancer cell growth inhibition was obtained from the methanolic bark extracts of *M. elengi* at a concentration of 100 µg/ml.

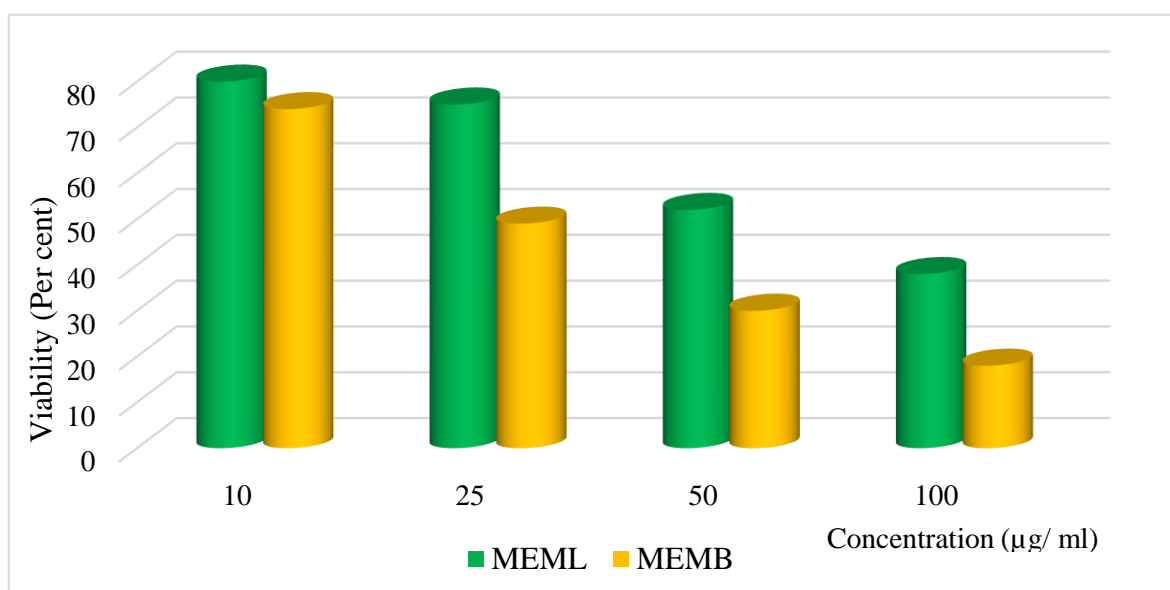


Fig 4: Cytotoxic potential of *Mimusops elengi* on Human Cervical Cancer (SiHa) cell line

The Cytotoxic activity of *Alangium salviifolium* against Human Breast Cancer Cells (MCF-7) were studied by Bama (2011). Two active compounds with cytotoxic activity were isolated from the leaves of *A. salviifolium* namely Deoxytublosine and β -carboline-Harmaline which prevent the proliferation of non-hormone dependend human breast cancer cells (MCF-7 cells). Both Deoxytublosine and β -carboline-Harmaline were incubated with the MCF-7 cells for five days at two different concentrations namely, 160 μ M and 320 μ M. The decrease in the viability of the cancer cells were recorded over the period of five days. The maximum cytotoxic activity was recorded in the treatments with Deoxytublosine and β -carboline-Harmaline at a concentration of 320 μ M at five days after incubation.

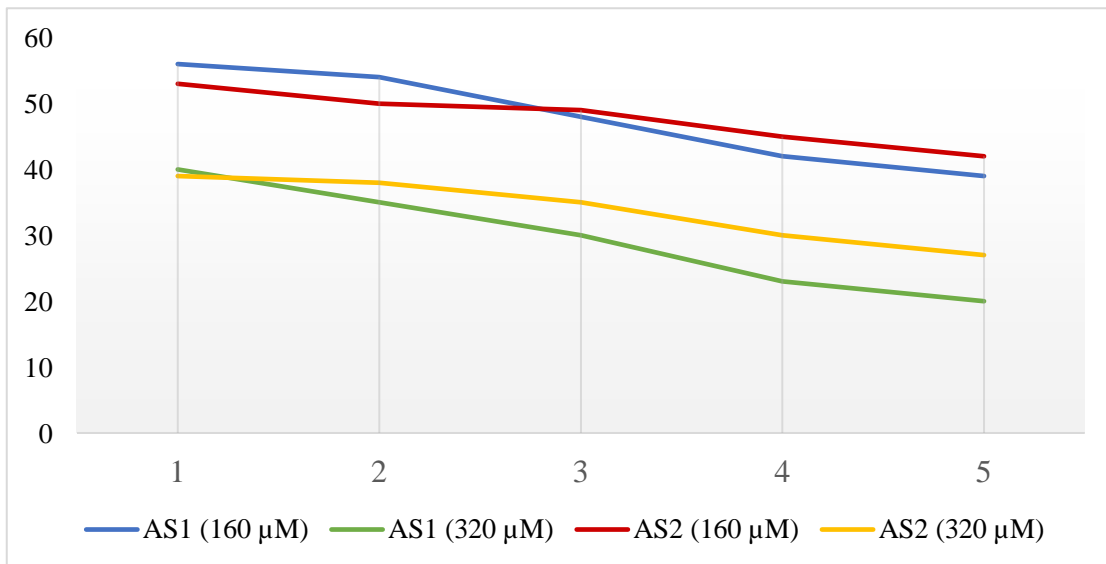


Fig 5: Cytotoxic activity of *A. salviifolium* against Human Breast Cancer Cells (MCF-7)

3.2.2 Antioxidant activity

The antioxidant activity of wild edible fruits is contributed by ascorbic acid and secondary metabolites such as phenolics, flavonoids, etc. The antioxidant activity of wild edible fruits is measured in terms of DPPH (2,2- diphenyl- 1- picrylhydrazyl radicle) scavenging activity *i.e.*, the rate of scavenging of Reactive Oxygen Species (ROS) and other free radicals.

Karuppusamy *et al.* (2011) compared the ascorbic acid content as well as the content secondary metabolites such as anthocyanins and flavonoids in wild edible fruits. The ascorbic acid content in the fruits were estimated using dye-titration method and expressed in terms of ascorbic acid equivalent and anthocyanins by pH differential

method, expressed in terms of cyanidine-3-glucoside equivalents. The total phenolics content was estimated by folin-ciocalteu method and was expressed in terms of gallic acid equivalents whereas the total flavonoid content was estimated by Arvouet-Grand method and was expressed in terms of quecetin equivalents.

Table 8: Anthocyanin, ascorbic acid, phenolic and flavonoid contents in wild edible fruits

Fruit species	Anthocyanin (CGE/ 100g)	Ascorbic acid (AAE/100g)	Total phenolics (GAE/100g)	Total flavonoids (QE/100g)
<i>Flueggea leucopyrus</i>	0.34±0.09	39.4± 4.93	31.7± 4.92	76.8± 0.46
<i>Gaultheria fragrantissima</i>	2.47± 0.07	67.6± 8.41	80.4± 3.18	94.3± 1.35
<i>Grewia tilaefolia</i>	2.60± 0.09	70.5± 3.07	44.1± 1.81	47.1± 0.92
<i>Mahnonia leschenaultia</i>	8.58± 0.02	69.9± 9.76	86.8± 0.30	95.5± 1.76
<i>Rubus ellipticus</i>	1.71± 0.08	44.0± 4.95	72.0± 1.25	86.4± 2.04
<i>Ziziphus rugosa</i>	0.34± 0.02	35.0± 3.21	41.8± 0.20	41.8± 1.20

The antioxidant activity these wild edible fruit species were also measured in terms of DPPH scavenging activity and the maximum antioxidant activity was reported in the wild edible fruit species *Mahnonia leschenaultia*.

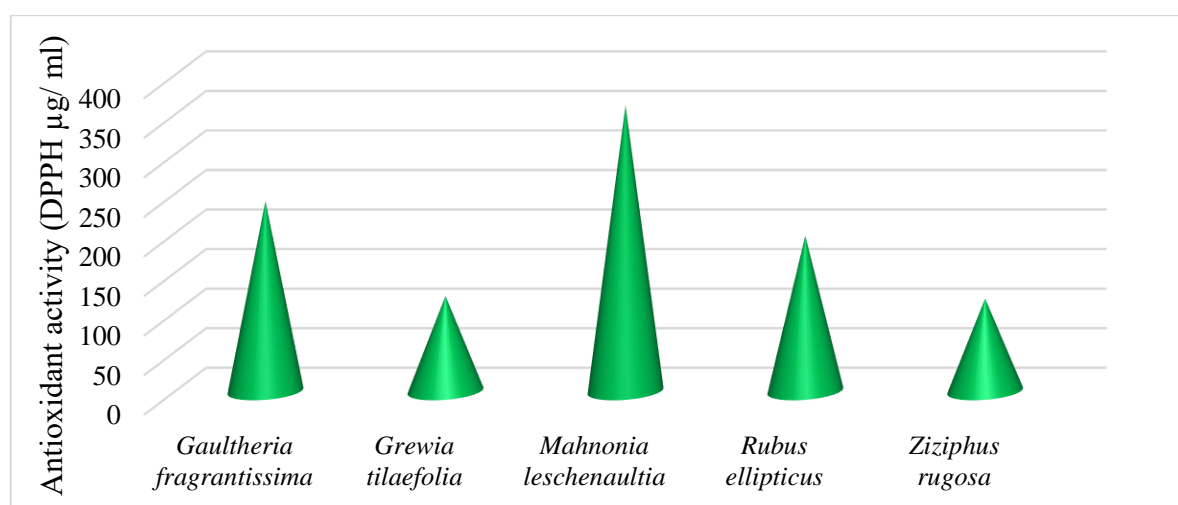


Fig 6: DPPH scavenging activity of wild edible fruits

3.2.3 Antidiabetic activity

Some of the wild edible fruit species such as *Morinda citrifolia*, *Diospyros peregrina*, *Aegle marmelos*, *Ficus racemosa*, etc. were found to have antidiabetic activity. It was found that the antioxidants and flavonoids present in the fruits and other plant parts prevent the oxidation of β - cells of pancreas and thereby prevent Reactive Oxygen Species (ROS) mediated diabetes.

The fruit juice of *Morinda citrifolia* were found to have hypoglycemic effects on four to six weeks old Alloxan induced diabetic Wistar rats, comparable to that of the standard drug Metformin (Jadhav *et al.*, 2017). In this study, both Metformin and *M. citrifolia* fruit juice were administered to Wistar rats at four to six weeks age, at a concentration of 100 mg/kg body weight and 2 ml/kg body weight of the test rats. The blood glucose levels in the test rats were recorded and the maximum reduction in blood glucose levels were obtained after 28 days of administration *M. citrifolia* fruit juice.

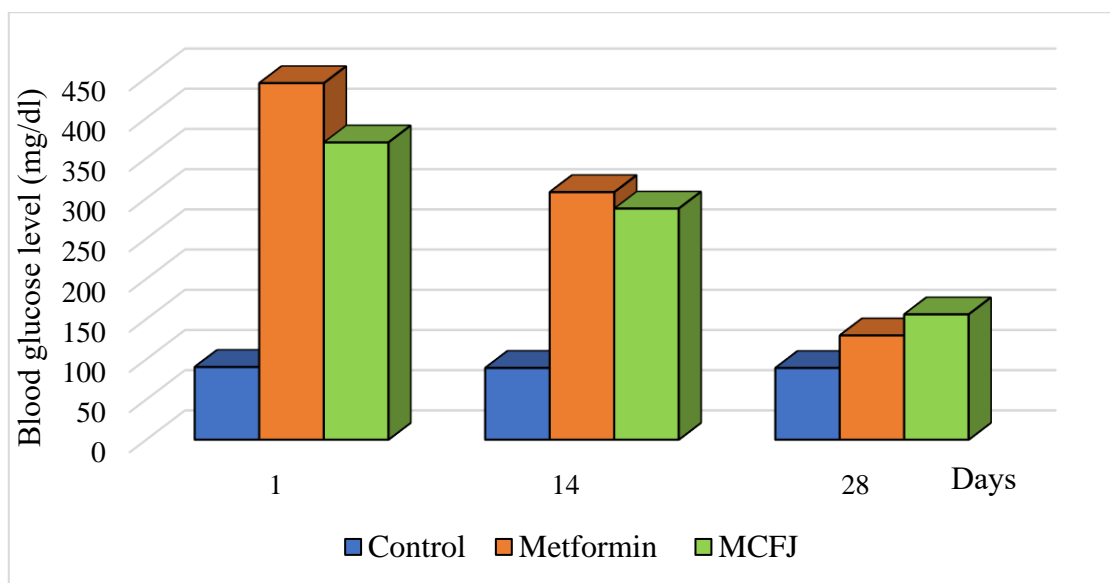


Fig 7: Antidiabetic activity of *Morinda citrifolia* on Alloxan induced diabetic rats

3.2.4 Laxative property

Most of the WEFs are rich in dietary fibre, which contributes to their laxative property. They increase the bowel movement and thereby reduce constipation. According to Nazarudheen (2008), *Baccaurea courtallensis*, *Debregeasia longifolia*, *Mimusops elengi*, *Palaquium ellipticum* and *Ficus racemosa* were found to have comparatively higher dietary fibre content which makes them good laxative agents.

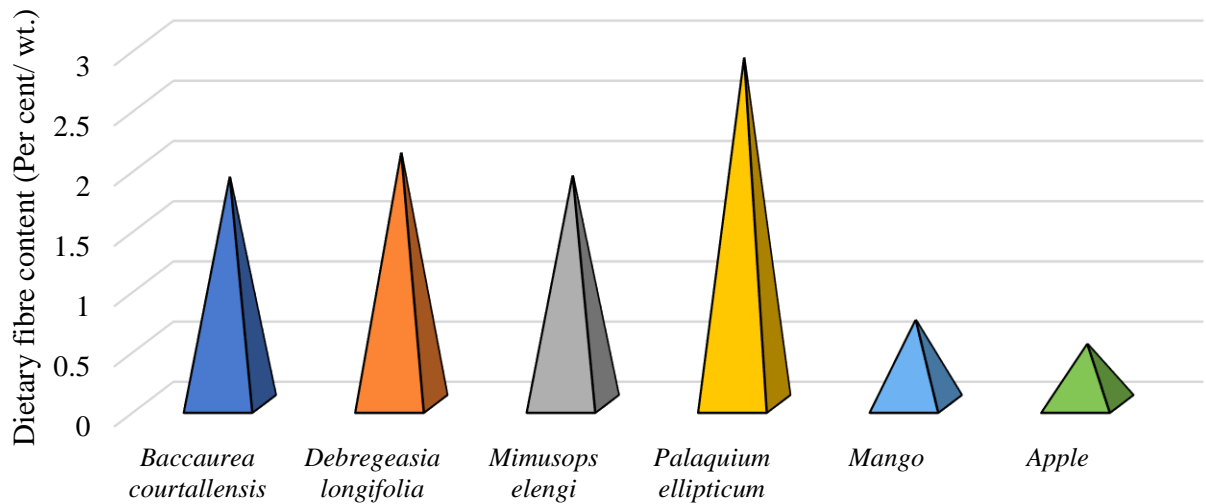


Fig 8: Dietary fibre content in wild edible fruits

3.3 Wild edible fruits as a source of income

Wild edible fruits acts as a source of income among various tribal populations in India such as the Muthuvan tribes in Idukki, the Kuruma, Kurichiya and Kattunaikka tribes in Wayanad, the Mugudas in Attappady and the Kadar and Malayar tribes in Parambikkulam regions.

In a study conducted in Peechi-Vazhani wild life sanctuary by Kumar (2015), it was found that the Non timber forest products among which WEFs are a main component, contributes to 33.77 per cent of the household income of the Kadar tribe. These wild edible fruits collected from forests were mainly utilized as food, medicine and also for religious rituals.

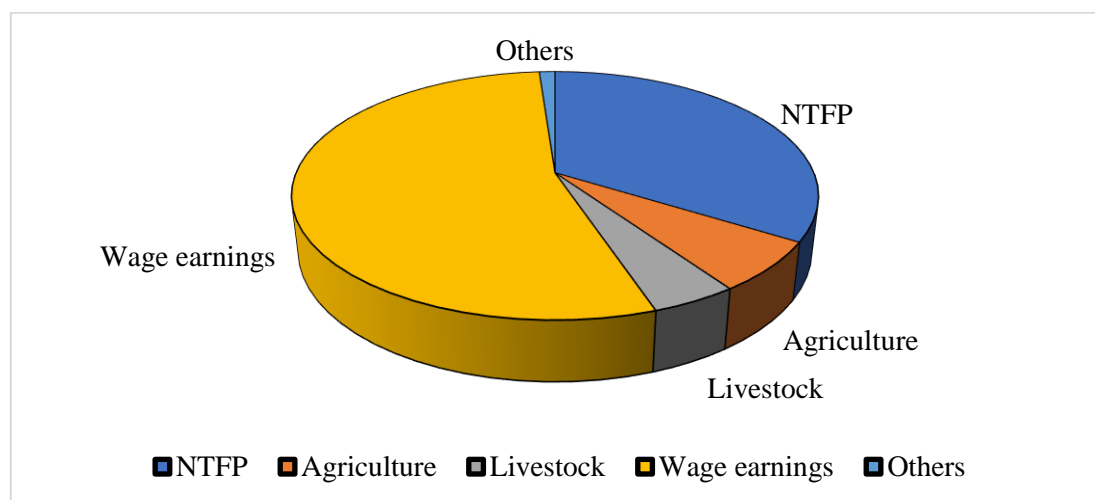


Fig 9: Tribal household income of Kadar tribes in Peechi-Vazhani wildlife sanctuary

Even though WEFs has a significant contribution to tribal income, the main reasons for their underutilization are:

- Under estimation of their potential use
- Non availability of complete botanical information
- Inadequate research on commercial utilization
- Lack of knowledge on their nutritional value
- Fast disappearance of ecosystem and habitat destruction
- Stigma attached as “Food of the Poor”

3.4 Wild edible fruits and climate resilient agriculture

Most of the wild edible fruit crops are capable of producing and synthesizing secondary metabolites which are metabolic intermediates that are not essential for plant growth, but is required for interacting with their environment. These compounds are usually produced in response to various biotic and abiotic stresses. The major classes of plant secondary metabolites include terpenes, phenolics and nitrogen compounds such as alkaloids, glycosides, glucosinolates and cyanogenic glycosides. They contribute to the climate resilient nature and stress resistance in wild edible plants.

4. Domestication of wild edible fruits

Most of the commercial fruits were wild at some point of time and these have been domesticated over centuries. Some of such crops are mango, jack, aonla, custard apple, hog plum, jamun, lovi-lovi, etc. Many wild relatives of these species still remain in the forest ecosystems of Western Ghats. Domestication of these species should be undergone in a systematic fashion in order to ensure their survival in a new ecosystem. This is important especially in the case of endemic species like *Baccaurea courtallensis*, *Artocarpus hirsutus*, etc.

Table 9: Wild relative of cultivated fruit species

Sl. No.	Cultivated fruit species	Wild relatives
1	Mango (<i>Mangifera indica</i>)	<i>Mangifera sylvatica</i>
2.	Jack fruit (<i>Artocarpus heterophyllus</i>)	<i>Artocarpus gomezianus</i>

		<i>Artocarpus hirsutus</i> <i>Artocarpus incisa</i>
3.	Aonla (<i>Phyllanthus emblica</i>)	<i>Phyllanthus acidus</i> <i>Phyllanthus reticulatus</i>
4.	Custard apple (<i>Annona squamosa</i>)	<i>Annona muricata</i> <i>Annona reticulata</i>
5.	Jamun (<i>Syzygium cumini</i>)	<i>Syzygium caryophyllatum</i> <i>Syzygium densiflorum</i> <i>Syzygium gardneri</i> <i>Syzygium hemisphericum</i> <i>Syzygium laetum</i> <i>Syzygium malaccense</i> <i>Syzygium mundagam</i> <i>Syzygium jambos</i>
6.	Karonda (<i>Carissa carandus</i>)	<i>Carissa spinarum</i> <i>Carrisa congesta</i> <i>Carissa paucinervia</i>
7.	Lovi-lovi (<i>Flacourtia indica</i>)	<i>Flacourtia montana</i>
8.	Ber (<i>Ziziphus mauritiana</i>)	<i>Ziziphus oenopolia</i> <i>Ziziphus rugosa</i> <i>Ziziphus caracatta</i>

5. Conservation of wild edible fruits

Bioversity International plays a key role in the conservation of wild edible fruits in India. About 102 species of wild and underutilized fruits belonging to 31 families and 58 genera are conserved in the Genetic Diversity Park at Bengaluru functioning under Bioversity International. Other projects under Bioversity International include International Fund for Agricultural Development- Neglected and Underutilized Species (IFAD-NUS) Project and projects by United Nations Environment Programme – Global Environment Facility (UNEP-GEF). Apart from these, diversity of wild fauna and flora in the Western Ghats is being conserved under the Western Ghats Development Programme (WGDP). WGDP was launched in 1974-75 as a part of the programme for the development of hilly areas of the country. The delineation of the Western Ghats

Region for inclusion in the programme was settled in 1981 by the one-man Committee headed by Dr. M.S. Swaminathan, the then Member-Incharge of the Hill Areas in the Planning Commission. The programme is being implemented in 159 talukas comprising of the Western Ghats in five States viz. Maharashtra (62 talukas), Karnataka (40 talukas), Kerala (29 talukas), Tamil Nadu (25 talukas) and Goa (3 talukas).

In situ conservation of WEFs can also be done in Biosphere reserves, Wild life sanctuaries, *etc.*

6. Value addition of WEFs

Numerous value-added products are prepared from WEFs by various tribal populations across the Western Ghats such as pickles, medicinal decoctions, juice, wine, liquor, *etc.* Nowadays products from wild edible fruits are becoming popular due to their medicinal and health benefits. Some of these products include fruit oils, essential oils, fruit powder, nuts, jams, spreads, *etc.* These products are often highly priced and their price range varies from Rs. 120 to 500.



Plate 8: Value added products from wild edible fruits A) Mahuda oil B) Chironji nuts C) Wood apple jam D) Baheda powder

7. Challenges

The major challenges in the popularization of WEFs include the erosion of traditional knowledge among the tribal populations, loss of diversity, constraints in domestication, climate change, low market preference, comparatively less appealing tastes compared to that of commercial fruit crops.

8. Future thrust areas

Since wild edible fruit species comprise broad-spectrum essential nutrients, vitamins and secondary metabolites they can be considered for cultivation, consumption and utilization. In order to bring them to the mainstream, it is necessary to resurvey, document, characterize and conserve the wild germplasm in Western Ghats. It is necessary to domesticate and popularise these species to increase their availability. Developing value chain and providing market support will improve the market value of these crops which in turn improves the tribal income.

9. Conclusion

The Western Ghats range is enriched with numerous wild edible fruit crops which can be a potential source of dietary nutrients and nutraceuticals. They also have immense potential as components in crop improvement and sustainable agriculture. Hence these wild edible fruit crops should be conserved.

10. Discussion

1. Where is Moottipazham cultivated in Kerala?

Moottipazham (*Baccaurea courtallensis*) is cultivated in Idukki (Vannappuram region), Thiruvananthapuram and Wayanad districts

2. What is the average yield and price of Moottipazham?

On an average, 50 kg yield is obtained from a tree and it costs about 150 to 200 rupees per kilogram of Moottipazham fruits.

3. Which are the wild edible fruit crops that are endemic to the Western Ghats?

Wild edible fruit crops such as *Baccaurea courtallensis*, *Artocarpus hirsutus*, etc. are endemic to western Ghats

4. What do you mean by GAE?

GAE or gallic acid equivalent is the unit used to measure the total phenolics present in wild edible fruits by Folin Ciocalteu method

5. Are there any toxic compounds present in wild edible fruits?

A few wild edible fruit crops have toxic principles such as in *Ficus racemose*, *Flacourtia indica*, *Meyna laxiflora*, etc. due to the presence of phytates, oxalic acid, tannins and saponins.

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**KERALA AGRICULTURAL UNIVERSITY
COLLEGE OF HORTICULTURE, VELLANIKKARA
Department of Fruit Science**

FSC 591: Masters Seminar

Name	: Reshma Ravi P.	Venue	: Seminar Hall
Admission No.	: 2018-12-006	Date	: 06-12-2019
Major Advisor	: Dr. K. Ajith Kumar	Time	: 10:45 am

Wild edible fruit crops - the unexplored gems of Western Ghats

Abstract

India is the second most populous country in the world with a population of 1.3 billion. Even though the food grain production has reached a sustainable level, chronic malnutrition still remains as a threat in India. Nearly 195 million people in India are suffering from chronic malnutrition out of which 47 million are children. Improving the nutrient intake as well as the dietary diversity will help to mitigate this problem. Wild edible fruits which are rich in nutrients can be a possible solution for meeting the day to day nutritional requirements of the population and thereby ensuring nutritional security.

Wild edible fruit crops are plant species producing edible fruits with the ability to thrive in diverse environments which are neither domesticated nor cultivated. About 344 species of wild edible fruits have been enumerated so far from India (Dandin and Kumar, 2016). Western Ghats which is one among the eight biodiversity hotspots in the world is the home for more than 250 species of wild edible fruits. These species are reported from the states of Gujarat, Maharashtra, Karnataka, Tamil Nadu and Kerala. Bioversity International plays a key role in the conservation of wild edible fruits in India and 102 species of wild and underutilized fruits are conserved in the Genetic Diversity Park at Bengaluru. These are now gaining importance owing to their nutritional quality, nutraceutical properties, climate resilient nature, resistance to biotic and abiotic stress and as potential gene donors in crop improvement.

Nazarudheen (2010) reported that the fruits of *Alangium salvifolium* (Ottangadi) and *Debregeasia longifolia* (Neerinch) were rich in protein and iron contents respectively. The fruits of *Aporosa lindleyana* (Ponvetti) were found to have potassium content comparable to that of banana.

Cytotoxic activity of methanolic extracts of leaves and bark of *Mimusops elengi* (Elengi) on human cervical cancer cells was studied by Ganesh *et al.* (2014). They reported that maximum cancer cell growth inhibition was obtained from the methanolic bark extracts of *M. elengi* (100 µg/ml). The fruit juice of *Morinda citrifolia* were found to have hypoglycemic effect on Alloxan induced diabetic Wistar rats which was comparable to that of the standard drug Metformin (Jadhav *et al.*, 2017).

As the wild edible fruit species contain broad-spectrum essential nutrients, vitamins and secondary metabolites they can be considered for cultivation, consumption and utilization. In order to bring these fruit species into the mainstream, it is necessary to resurvey, document, characterize and conserve the wild germplasm in Western Ghats. It is also important to domesticate and popularise these species to increase their availability. Developing value chain and providing market support will improve the market value of these crops which in turn will improve the tribal household income.

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