

NEGLECTED AND UNDERUTILIZED FRUIT SPECIES – AN INSURANCE AGAINST GLOBAL MAL AND UNDER NUTRITION



S.B. Dandin & N.K. Krishna Kumar

3rd - 5th Dec, 2016

Regional Expert Consultation of NUS, 2016 FAO Regional Office, Bangkok

NEGLECTED AND UNDERUTILIZED FRUITS



- Wild edible fruits were the important sources of food for mankind before dawn of civilization.
- The tribal groups inhabit in the forests depend on these fruits.
- They passed on valuable information on utility of fruits from generation to generation.
- 30000 edible plant species are known to mankind.
- 7000 species were reported to be used for food in the history.
- 150 plants are cultivated commercially.
- 103 plants are alone contribute to more than 90% of the world's calorie.
- Several hundreds of species remain underutilized or less utilized in the wild.



MINOR FRUIT AND NUTS WEALTH

	World	
Tropical	3000 Species	
Temperate	1200 Species	
Total	4200 Species	
	Wietmeyer (1990)	
	Asia Pacific Region	India
Families	45	34
Genera	106	56
Species	261	84

Source: Arora (1985) and Pareek et al., (1998)

DISTRIBUTION OF UNDERUTILIZED EDIBLE FRUITS AND NUTS IN THE REGIONS OF DIVERSITY

Region	Species Enumerated (No.)
Chinese-Japanese	222
Indochinese-Indonesia	226
Australian	57
Hindustani-Indian	344
Central Asian and Near Eastern	38
Mediterranean	30
African	131
European-Siberian	62
South American	263
Central American and Mexican	122
North American	255

Source: Zeven and de Wet (1982) in O.P. Pareek, Sunil Sharma and R.K. Arora (1998)



THEY REMAIN UNDERUTILIZED BECAUSE ...

- Under estimation of their potential use.
- Non availability of their complete botanical information.
- Inadequate research on their commercial exploitation.
- Lack of knowledge on their food and nutrition value/potential.
- Promotion and popularization of very few fruit crops.
- Fast disappearance of ecosystem and habitat destruction.
- Stigma attached as “Food of the Poor”.

WHY THEY ARE IMPORTANT NOW ...

- ❖ They are found harboring nutritionally rich compounds.
- ❖ Due to increased food and nutritional insecurity.
- ❖ Their climate resilient nature.
- ❖ Resistance to biotic and abiotic stress condition.
- ❖ Rich in nutraceutical and medicinal properties.
- ❖ Donors of important genes for crop improvement.



NEGLECTED AND UNDERUTILISED CROPS - HOPE OF THE FUTURE

- World population is expected to reach 900 billion by 2050.
- 30% Of the people are affected by malnutrition on the planet.
- 159 million children are reported to be stunted with low BMI.
- Two billion people are deficient in one or more micro nutrients.
- Narrow food basket with very few crop derivatives is the main region.
- Widening food basket diversity is imperative to mitigate.
- Neglected fruits and vegetables appear to hold promise to overcome the situation.

BIOVERSITY INTERNATIONAL INITIATIVES IN ASIA PACIFIC REGION

- ❖ TFT UNEP-GEF Project (2009-2014).
“Conservation and sustainable use of cultivated and wild tropical fruit diversity: promoting sustainable livelihoods, food security and ecosystem services”.
- ❖ Community Biodiversity Management (CBM).
- ❖ IFAD-NUS Project 4 Phases from (2001-2016).
“Reinforcing the resilience of poor rural communities in the face of food insecurity, poverty and climate change through on-farm conservation of local agrobiodiversity”.
- ❖ BFN UNEP-GEF Project (2012-2017).
“Mainstreaming biodiversity for nutrition and health”.
- ❖ *India_UNEP_GEF Project 2016-2021: Mainstreaming agricultural biodiversity conservation and utilization in agricultural sector to ensure ecosystem services and reduce vulnerability*
- ❖ Big idea on NUS-Fruit tree diversity for nutrition and food a new proposal.
- ❖ Neglected plants- food for future.

Contd..

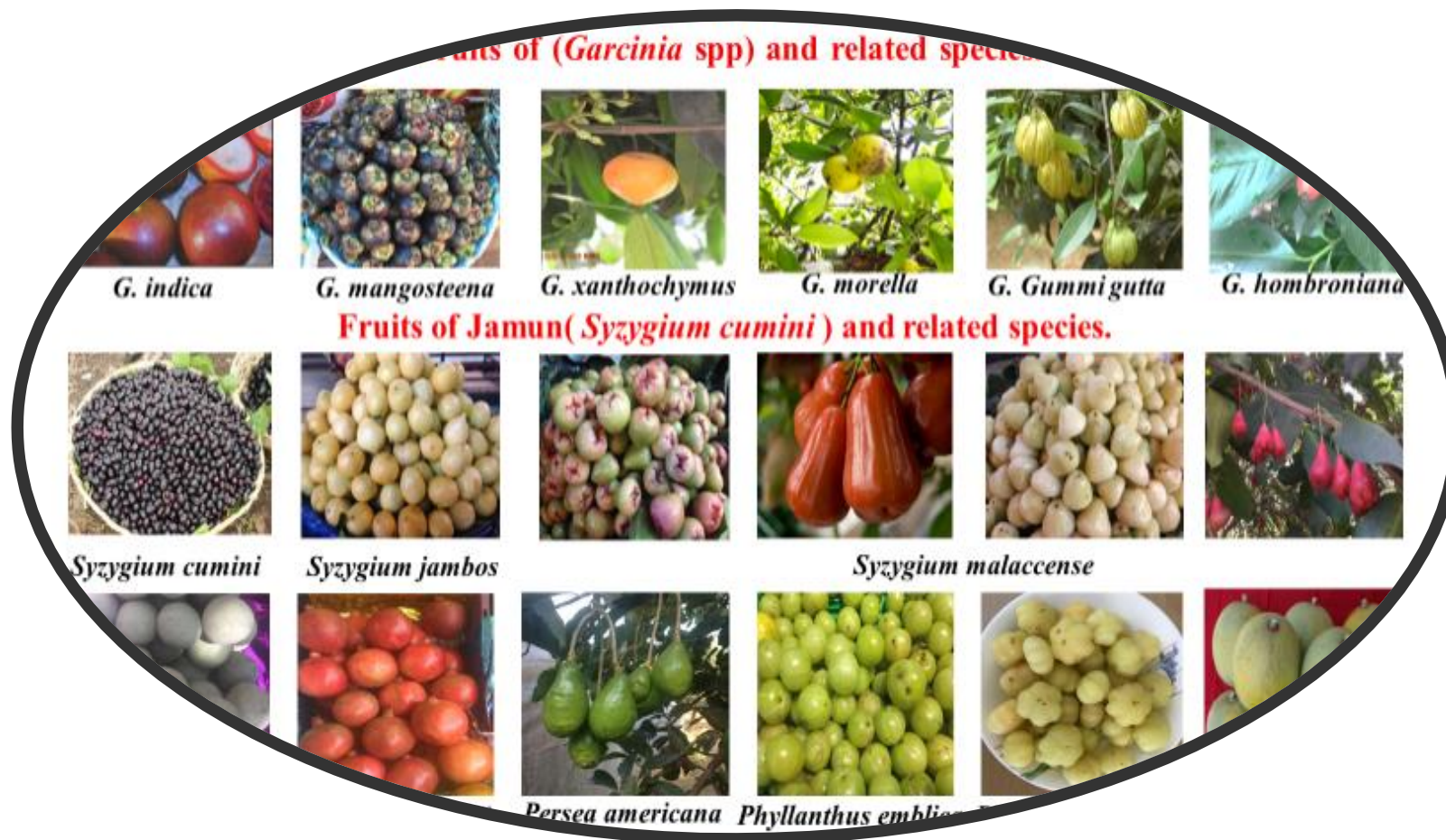
IFAD-NUS Phase 1: Enhancing the Contribution of Neglected and Underutilized Species to Food Security and to Incomes of the Rural Poor (IF-F01001)	IFAD	2001 - 2006	Peru, Bolivia and Ecuador; India and Nepal; Egypt and Yemen.
Study on Safflower germplasm (need to find the related project)		2000-2003	China
Conservation and use of rare tropical fruit species diversity with potential for enhanced use in Malaysia (Code: MA-F01001)	Malaysia	2005-2009	Malaysia
IFAD-NUS Phase 2: Empowering the rural poor by strengthening their identity, income opportunities and nutritional security through the improved use and marketing of neglected and underutilized species (IF-F01005)	IFAD	2007-2010	Peru, Bolivia, India, Italy, Republic of Yemen
Conservation and Sustainable Use of Cultivated and Wild Tropical Fruit Diversity: Promoting Sustainable Livelihood, Food Security and Ecosystem Services (Code: A1145)	UNEP-GEF	2009-2015	India, Indonesia, Malaysia and Thailand (regional focus)
Alternative approaches for cryopreservation of coconut, sweet potato and selected indigenous crops in the Asia Pacific (AP) region (Code: A1115)	KOREA	2011-2013	Malaysia; Asia Pacific (AP) region
IFAD-NUS Phase 3 (1st part): Reinforcing the resilience of poor rural communities in the face of food insecurity, poverty and climate change through on-farm conservation of local agrobiodiversity (Code: A1098)	IFAD	2011-2015	Bolivia, India, Nepal

Contd..

Innovative studies on the adaptability of buckwheat and oat genetic diversity to climate change in China (Code: to add)	China	2012-2015	China
Mainstreaming Biodiversity Conservation and Sustainable Use for Improved Human Nutrition and Well-being (GEF) (Code: A1075 and A1146)	UNEP-GEF and FAO-GEF	2012-2017	Brazil; Kenya; Sri Lanka; Turkey;
IFAD-NUS Phase 3 (2nd part): Improving smallholder farmers' food and nutrition security through sustainable use and conservation of agrobiodiversity (Code: A1100)	IFAD	2013-2015	Bolivia, India, Nepal
Integrating Traditional Crop Genetic Diversity into Technology: Using a Biodiversity Portfolio Approach to Buffer against Unpredictable Environmental Change in the Nepal Himalayas (Code: A1150)	UNEP-GEF + co-funding	2013-2017	Nepal
Bioversity Initiative in Bangalore, India: establishment of a gene bank (not sure if attached to a project?)	?	?	India
IFAD-NUS Phase 4: Linking agrobiodiversity value chains and climate adaptation: empowering the poor to manage risk (Code: A1184)	IFAD	2015-2016 (1 year)	Guatemala, India, Mali
Global Facilitation Unit for Underutilized Species (Code: GM-F09002)	GERMANY	2005-2008	Global

Source: Padulosi (2016)

NEW INITIATIVE ON NUFS GENETIC GARDEN TO SAFEGUARD MINOR FRUITS - PRELIMINARY SCOPING



AREAS EXPLORED

States-7

Districts-26

Farmers-62

Nurseries-18

Research Organizations-21



BIOVERSITY INTERNATIONAL, BENGALURU. GENETIC DIVERSITY PARK SITE.



STATUS OF PRESENT COLLECTION (As of 1-11-2016)

- ☐ Families: 31
- ☐ Genera: 55
- ☐ Species: 102
- ☐ Varieties: 175

FAMILIES, GENERA, SPECIES AND VARIETIES OF MINOR FRUIT SPP., MAINTAINED IN GENETIC DIVERSITY PARK, BENGALURU.

Sl. No	Families	No. Genera	No. Species	No. Varieties	Sl. No	Families	No. Genera	No. Species	No. Varieties
	TOTAL 31	55	102	175	17	Malvaceae	2	2	2
1	Annonaceae	1	6	10	18	Oxalidaceae	1	2	3
2	Anacardiaceae	4	4	8	19	Palmae	2	2	2
3	Apocynaceae	1	1	4	20	Passifloraceae	1	1	1
4	Boraginaceae	1	2	2	21	Phyllanthaceae	3	4	4
5	Cacataceae	1	1	1	22	Proteaceae	1	1	1
6	Celastraceae	1	1	1	23	Puniceae	1	1	3
7	Clusiaceae	1	6	7	24	Rhamnaceae	1	2	3
8	Dilleniaceae	1	1	1	25	Rosaceae	1	1	1
9	Ebenaceae	1	2	2	26	Rubiaceae	1	1	1
10	Elaeocarpaceae	1	1	1	27	Rutaceae	3	6	10
11	Lauraceae	1	1	1	28	Salicaceae	1	2	2
12	Leguminosae	3	3	3	29	Sapindaceae	2	3	4
13	Moraceae	3	11	34	30	Sapotaceae	6	9	12
14	Myrtaceae	3	15	23	31	Salvadoraceae	1	1	1
15	Malpighiaceae	3	4	4					
16	Meliaceae	1	1	1					

Minor fruit species maintained in Exsitu genetic diversity park



1. *Anacardium occidentale*



2. *Buchanania cochinchinensis*



3. *Semecarpus anacardium*



4. *Spondias pinnata*



5. *Spondias mombin*



6. *Spondias dulcis*



7. *A. squamosa*



8. *A. muricata*



9. *A. reticulata*



10. *A. Cherimola*



11. *A. atemoya*



12. *A. glabra*



13. *Carissa carandas*



14. *Cordia myxa*



15. *Capparis decidua*



16. *Hylocereus undatus*



17. *Opuntia ficus indica*



18. *Celastrus paniculatus*



19. *Garcinia gummi-gutta*



20. *Garcinia indica*



21. *Garcinia morella*



22. *Garcinia mangostana*



23. *Garcinia xanthochymus*



24. *Garcinia hombroniana*



25. *Dillenia indica*



26. *Diospyros melanoxylon*



27. *Persea americana*



28. *Tamarindus indica*



29. *Prosopis cineraria*



30. *Pithecellobium dulce*



31. *Acacia senegal (Gum)*



32. *Malpighia punicifolia*



33. *Durio zibethinus*



34. *Lansium parasiticum*



35. *Sandoricum koetjape*



36. *Artocarpus altilis*



37. *A. heterophyllus*



38. *A. lacucha*



39. *A. hirsutus*



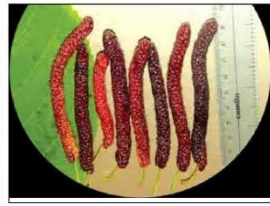
40. *A. integer*



41. *Morus alba*



42. *M. nigra*



43. *M. laevigata*



44. *M. indica*



45. *Ficus carica*



46. *Ficus racemosa*



47. *Syzygium cumini*



48. *Pisidium cattleianum*



49. *S. jambos*



50. *S. malaccense*



51. *Eugenia uniflora*



52. *A. bilimbi*



53. *A. carambola*



54. *Borassus flabellifer*



55. *Salacca zalacca*



56. *Phoenix dactylifera*



57. *Punica granatum*



58. *Ziziphus mauritiana*



59. *Ziziphus oenoplia*



60. *Ziziphus rugosa*



61. *Eriobotrya japonica*



62. *Gardenia gummiifera*



63. *Citrus maxima*



64. *Citrus peradici*



65. *Citrus sinensis*



66. *Aegle marmelos*



67. *Limonia acidissima*



68. *Flacourtia rukam*



69. *Flacourtia montana*



70. *Nephelium lappaceum*



71. *Dimocarpus longan*



72. *Chrysophyllum cainito*



73. *Manilkara hexandra*



74. *Manilkara zapota*



75. *Pouteria campechiana*



76. *Synsepalum dulcificum*



77. *Madhuca indica*



78. *Mimops elangi*



79. *Salvadora oleoides*



80. *Grewia subinaequalis*



MAINSTREAMING

- Jack - *Artocarpus* Species
- Custard Apple - *Annona* Species
- Jewish Plum - *Syzygium* Species
- Ber - *Ziziphus mauritiana* Species
- Drumstick - *Moringa oleifera*
- Tamarind - *Tamarindus indica*

1. Jack (*Artocarpus heterophyllus*)

- Native to Western Ghats of South India.
- Adoptable to varied types of soils and climate.
- Every part of the plant has distinct use.
- Rich source of vitamin-A and C, readily digestible sugar with high calorific value.
- Young and mature fruits, seeds, rind etc are used in several food preparations.
- Important products manufactured are chips, pappad, jam, jelly, starch, etc.
- Five species and 26 varieties are maintained in Genetic Diversity Park for detailed analysis.
- Wood is a valuable timber.



Artocarpus Species

A. altilis



A. heterophyllus



A. lacucha



A. integer



A. hirsutus

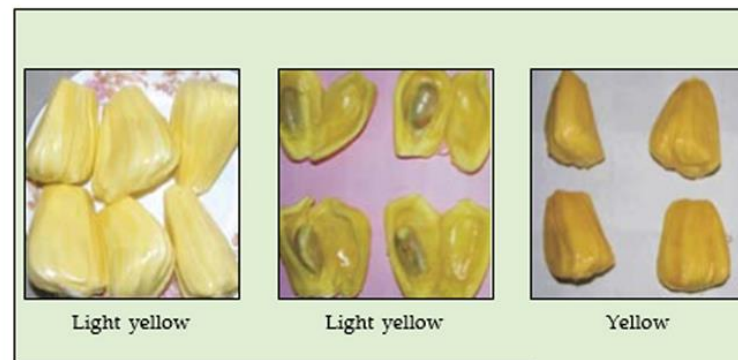




VARIABILITY IN JACK FRUITS &



JACK FLACK →



Flake colour variation in jackfruit accessions

JACK PRODUCTS AND DISHES



MEDICINAL VALUES OF JACK

- Jack leaves may help in improving glucose tolerance in diabetes.
- Jack is having powerful laxative & anti-aging properties.
- Jack fruits are very effective in lowering high blood pressure.
- Jack is a safe fruit for health conscious individuals.
- Jack fruits contain anti-oxidants.

2. Custard Apple (*Annona spp*).



- Genus *Annona* is native to South and Central America.
- Genus has large number of species having economic importance.
- Three species are popular for edible fruits.
- several food product such as, ice cream, sweets, juice, pastries, chocolates and mixed fruit jam are prepared.
- *A. muricata* is a good source of medicine used for curing cancer.
- Seeds and leaves of most of this species are having insecticidal properties and can be used for manufacture of bio-pesticides.

Annona Species

A. squamosa



A. reticulata



A. muricata



A. cherimola



A. galbra



A. atemoya



MEDICINAL VALUES OF *ANNONA*

- The paste of the leaf is useful to treat boils, abscesses and ulcers.
- Good in curing of diarrhoea and dysentery.
- Act as anti cancer agent.
- Magnesium in custard apple is good in prevention of strokes and heart attacks.
- Regular intake of custard apple reduces the chances of rheumatism and other forms of arthritis as it helpful in flux out of excessive acids.
- Custard apple is the excellent source of copper. Brittleness of bone is due to lack of copper.

3. Jamun/Jewish Plum (*Syzygium cumini*)



- Genus *Syzygium* is a native to Southeast Asia.
- Distributed in India, Thailand, Malaysia, Philippines, Indonesia, Sri Lanka, etc.
- In the genus, 15 species are reported to produce edible fruits and show high amount of genetic diversity.
- Jamun is most important among all species.
- Fruits are good source of iron, sugar, minerals and carbohydrates.
- Besides, fruits and seeds possess anti-diabetic compounds and popularly used as medicine.
- Fruits of *Syzygium jambos*, *Eugenia uniflora* and *Syzygium malaccense* are also very popular and eaten as fresh.
- 10 species and 15 varieties are maintained in the gene bank for further studies.

Syzygium Species



Syzygium cumini



Syzygium jambos



Syzygium malaccense



Syzygium malaccense

MEDICINAL VALUES OF JAMUN

- Jamun fruits are having anti-diabetic properties.
- Jamun fruit is good for digestive system because of its coolant features.
- Rich in antioxidants.
- Jamun has adequate amount of iron and Vitamin-C.
- Iron content in Jamun acts as blood purifying agent besides, helping in cure of jaundice and anemia.

4. Ber (*Ziziphus mauritiana*)

- Genus *Ziziphus* is native to South Asia and three species produce edible fruits.
- Ber is a common fruit cultivated in India where as Jujube is predominantly cultivated in China.
- The plant is highly drought resistant and gift to arid regions.
- Fruits are eaten fresh and also processed to prepare delicious murraba and candies.
- Fruits can also be used for preparation of jam and wine.
- Four varieties of Ber are being maintained for further nutritional analysis and genetic diversity study.
- Fruits are produced from September to January.

Ziziphus mauritiana



MEDICINAL VALUES OF BER

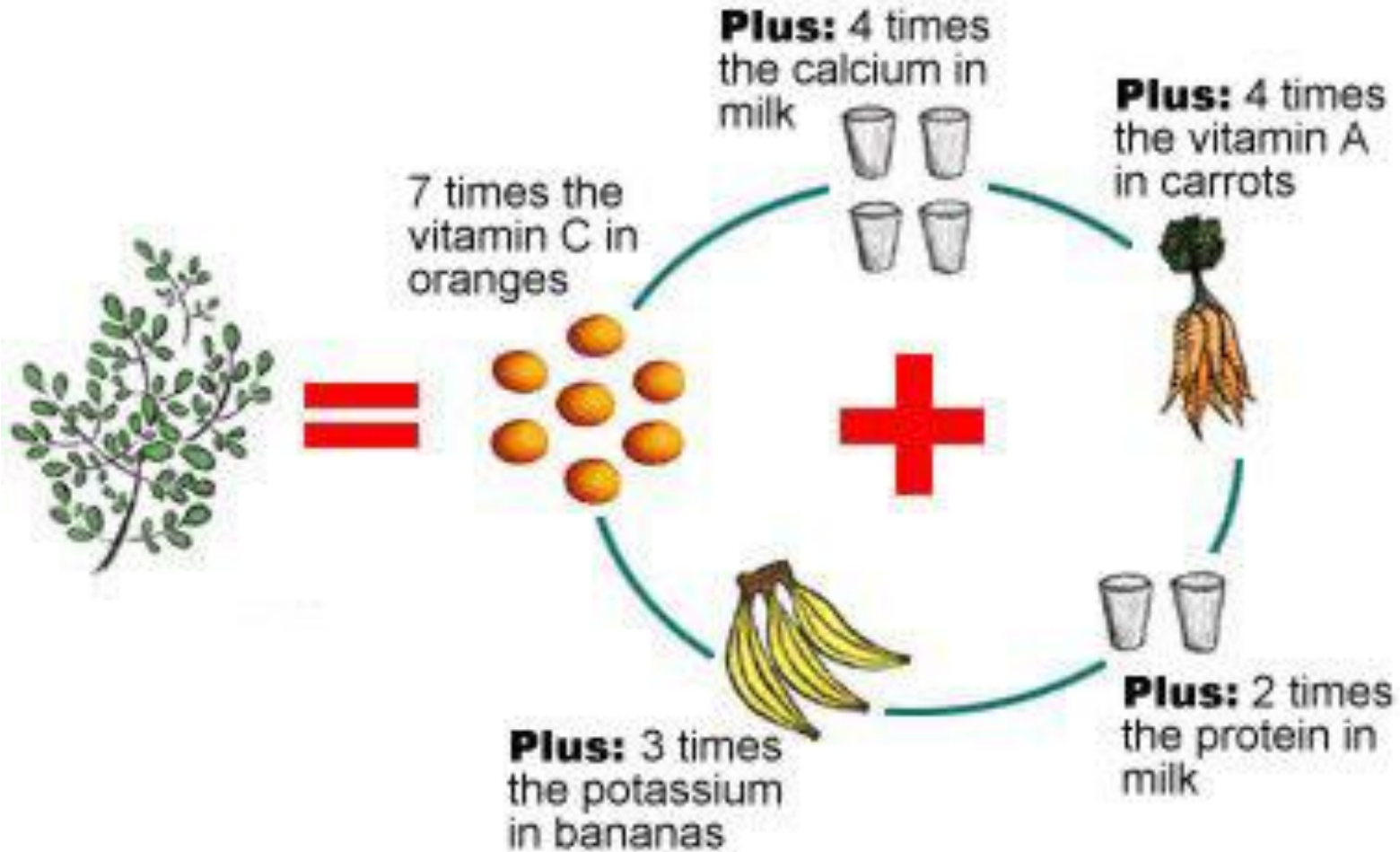
- Ber fruits helps in weight loss.
- Strengthens the immune system.
- Soothes the nervous system with its sedative properties.
- Recent research indicates that ber fruit could help fight Alzheimers.

5. Drum Stick (*Moringa oleifera*)



- Drum stick is perennial multi-purpose tree.
- Popularly grown in home gardens of Sri Lanka, India, Indonesia, Thailand, Vietnam, etc.
- All parts of the tree possess one or the other nutritional elements.
- Leaves are rich source of iron, fibre and vitamin-A.
- Popular as food for anemic patients especially women and children.
- Pods are produced four times a year and used as vegetable.
- Pods are rich source of vitamin-A & C, iron, calcium and potassium.
- Seeds are used for extraction of high value oil.
- All genetic variability has been collected for further study.

A PICTORIAL VIEW OF MINERAL CONTENTS



MINERAL CONTENTS OF LEAVES AND PODS



Nutrients	Pods	Leaves	Nutrients	Pods	Leaves
Moisture (%)	86.9	75.0	Potassium (mg)	259	259
Carbohydrate (g)	3.7	13.4	Copper (mg)	0.03	0.01
Protein (g)	2.5	6.7	Manganese (mg)	0.05	-
Fat (g)	0.1	1.7	Zinc (mg)	0.16	0.16
Minerals (g)	2.0	2.3	Chromium (mg)	0.003	-
Fiber (g)	4.8	0.9	Choline or Vit .b (mg)	423	423
Calories	26	92	Thiamin or Vit B1(mg)	0.05	0.06
Carotene (mg)	0.11	6.8	Riboflavin or Vit B2 (mg)	0.07	0.05
Calcium (mg)	30	440	Niacin or Vit B3(mg)	0.2	0.8
Phosphorus (mg)	110	70	Vitamin C (mg)	120	220
Iron (mg)	5.3	7.0	Oxalic acid (mg)	10	101
Magnesium (mg)	28	24	Source: Foidl et al. (2001)		

6. Tamarind (*Tamarindus indica*)



1. Tamarind is indigenous to Tropical Africa and South India.
2. The species is highly drought tolerant and grown in marginal and waste lands.
3. Unripe fruits are used as an ingredient in vegetable dishes.
4. Ripe fruits are rich source of vitamin-C and tartaric acid.
5. Tamarind pulp is an important ingredient in several food preparations.
6. Seeds are used for extraction of starch, protein and oil.
7. Four genotypes of Tamarind are subjected for further study.

FOOD COMPOSITION OF POTENTIAL MINOR FRUITS

Sl. No	Food Components	Jack Fruit	Custard Apple	Jamun	Tamarind	Ber	Drumstick
1	Water (g)	72-94	69-75	83.7-85.8	17.8-35.8	81-83	69.9
2	Calories (Kcal)	72-98	88-96	62.00	-	63.00	-
3	Protein (g)	1.3-2.0	1.53-2.38	0.7	2.0-3.0	0.8-1.8	2.5
4	Fat (g)	0.1-0.4	0.26-1.10	0.15-0.3	0.6	0.07	0.1
5	Carbohydrates (g)	16.0-25.4	19-25	14.0-16.0	41.1-61.4	14.17	3.7-8.5
6	Fibre (g)	1.0-1.5	1.14-2.50	0.3-0.9	2.9	0.6	4.8
7	Calcium (mg)	20-37	19.4-44.7	8.0-15.0	34.0-94.0	25.6	30.0
8	Phosphorus (mg)	18-38	23.6-55.3	15.0-16.2	34.0-78.0	26.8	110.0
9	Iron (mg)	0.5-1.1	0.28-1.34	1.2-1.62	0.2-0.9	0.8-1.8	5.3
10	Vitamin-A (IU)	152-540	5.0-7.0	80.0	-	34.0-35.0	184.0
11	Thiamine (mg)	0.03-0.09	0.1-0.13	0.01-0.03	0.33	0.02	0.05
12	Riboflavin (mg)	0.03-0.05	0.11-0.17	0.01	0.10	0.02-0.04	0.07
13	Niacin (mg)	0.4-4.0	0.65-0.93	0.2-0.29	1.00	0.7-0.9	0.2
14	Ascorbic acid (mg)	8.0-10.0	34.0-42.0	5.7-18.0	44.00	65.0-76.0	120.0

Source: Pareek and Sharma (2009)

VIEWS AND ASPIRATIONS OF CUSTODIAN FARMERS

Interaction with farmers during exploration trips, custodian farmers have highlighted the following important aspects;

- On farm conservation is cheapest and effective method for sustainable use of this fruit diversity.
- Documentation of farmers practices and their validation is imperative.
- Need for capacity building and promotional opportunities.
- Better publicity and recognition of custodian farmers efforts/activities.
- Long term arrangements for establishment mother plat orchard, multiplication and supply of seed/planting material to harness this wealth.
- Establishment of value chain and marketing facilities for sustainable income.
- Networking of all custodian farmers with
 - a. Other stake holder farmers/ Self - Help groups
 - b. Nursery men/Seed banks
 - c. Marketing agencies
 - d. Food industry

WAY FORWARD – RESEARCH AND DEVELOPMENT

- Resurvey and documenting the genetic diversity of these underutilized fruit species.
- Characterization of all the species and available varieties along with their wild relatives and *ex situ* conservation.
- Documentation of available worldwide information on ethnobotanical aspects and traditional knowledge including local food recipes.
- In depth studies on chemical analysis with respect to food and nutritional and other health benefits for better exploitation for food and nutrition security.
- Developing multiplication protocol and good agricultural practices to get better production, improved quality for higher income.
- Promoting custodian farmers approach for effective conservation and sustainable utilization.
- Developing value chain and market support.
- Popularizing family nutrition garden involving women SHGs.

WAY FORWARD – POLICY INITIATIVES

- Establishment of a single global body by all organizations engaged on this important issue for promotion of crops these as “Crops of the Future” (CFF).
- Developing an acceptable model of benefit sharing for better reward to all the stake holders.
- Providing propaganda and publicity highlighting the strength and future resilience.
- Convincing policy making bodies to include some of these nutri-rich underutilized crops in common/social food security programmes such as mid-day meals, hospital menus, grains for work etc.
- Attracting the attention of donors for liberal funding on research programmes aiming at popularizing and mainstreaming these crops.
- Initiating a long-term network programme for overall development of these crops as “crops of the future”.



Thank you

Shankar Dandin

s.b.dandin@cgiar.org



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