

Some neglected and underutilized fruit -crops in Sri Lanka

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Abstract- In Sri Lanka there is a high potential for cultivating fruit-crops for the domestic and export markets. Sri Lanka's per capita consumption of fruits remains far below the required average daily intake of 40g (edible portion) for a balanced diet (Research Institute MRI). The present economic growth in Sri Lanka will create a higher demand for fruits in the local market that could to be matched with higher production. Hence the Fruit Sector also has a greater potential to contribute to increase the national income, employment opportunities, and the nutrition and health status of the people. Demand for underutilized fruits and fruit-products, could be increased through awareness programs on the benefits of these products and market promotion. Although the Sri Lankan fruits have high demand in local and foreign markets. The major challenge faced by exporters is finding exportable quality fruits in sufficient quantities.

Fruits could be used to prepare various value-added products. These products are nutritious and high in fiber and antioxidants. The products are different from those of mainstream commodities - limited and seasonal availability and difficulties in harvesting/collection make these commodities/products costly. High costs, lack of awareness, and ideological aspects keep products away from diets and adversely affect underutilized fruit business. A ten-year existing venture in Sri Lanka prepares and markets a number of long shelf-life products from underutilized fruits. Limited availability and seasonality, time and labor requirements for plucking and/or cleaning, and often smaller edible portions of the fruits make final products costly. High prices prevented the sale of products in local market. Generally available commodities and products are cheaper. Nevertheless, sales of products were limited due to availability of fresh crop and ideological barriers. Many products were successful in markets such as UK, Canada, USA, Australia, and Dubai. The demand for fruit preserves and preparations is increasing yearly.

Index Terms- underutilized fruits, Fruit Sector, fruit preserves

I. INTRODUCTION

Neglected and underused crops are domesticated plant species that have been used for centuries or even millennia for their food, fibre, fodder, oil or medicinal properties, but have been reduced in importance over time owing to particular supply and use constraints. These can include, *inter alia*, poor shelf life, unrecognized nutritional value, poor consumer awareness and reputational problems (famine food or "poor people's food"). Other than that, with modernization of agricultural practices

many of these crops have become neglected due to their being held in low esteem and some have been so neglected that genetic erosion of their gene pools has become so severe that they are often regarded as lost crops (Williams *et al.*, 2002). These species have to ensure food security, nutrition, health, income generation and environmental services. Sri Lanka has over 60 varieties of underutilized fruit crops. Underutilized fruit crops can be defined as fruit crops which have value but not widely grown, rarely found in the market and not cultivated commercially (Agent, 1994). A few districts lead the production of fruits at present in Sri Lanka. However it is important to note, that the statistics are still not available for newly liberated areas in the North and the East and these districts has much untapped potential to growth fruit (Table 1). The main products consumed by people are fruit cordial, jam, fruit drinks, chutney, candy, pickle and squash concentrate (Table 2). According to the corporate plan of the Ministry of Agriculture for 2011 – 2013 the objective of the Government is to improve the quality, sustainability and standards of fruit production and minimize the post harvest losses. Further the Ministry plans to increase the production of fruits over the years and also increase domestic value addition by establishing fruit processing units.

Due to the commercialization of few vegetables and other crop species the entire country is mainly depend on handful of crop species neglecting large number of vegetables, fruits and other crop species with high nutritional and medicinal values which were grown traditionally in the past, resulting these valuable crop species are critically endangered and facing the state of speedy disappearing.

Presently in Sri Lanka underutilized vegetables and other crop species face extinction or severe genetic loss, but detailed information is lacking. For most of the endangered vegetables and other crop species no conservation action has been taken. There is not even a complete inventory of these underutilized valuable plants, much of the knowledge on their use is held by traditional societies, whose very existence is now under threat. Little of this information has been recorded in a systematic manner. Besides the identification and selection of these underutilized plants for use in health services and increase the nutritional status of the people, there is the potential that these plants hold as resources bank for address the issues relating to the food security, upgrading the nutritional status of the community and socio economic development of rural communities in Sri Lanka.

II. CONSERVATION STRATEGY

Recently to facilitate the conservation of these underutilized fruit crops. The main components are; Identification and collecting live samples of neglected and underutilized crop species found in Sri Lanka, establishment of plant arboretum for neglected and underutilized vegetables, fruits and other crop species and promote studies, research and multiplication for the benefit of future generation, conducting awareness creation and educational workshops on the medicinal and nutritional values of identified underutilized species, conducting field research and studies to identify the most suitable techniques for the growing of these plant species and introduction of identified underutilized vegetables and other crop species to the rural home gardens and facilitate the community contribution for conservation of such crop species.

Underutilized fruit -crops in Sri Lanka

Katuanoda (*Annona muricata*). It is really interesting that the recent studies have revealed that Katuanoda fruit having strong anti-cancer effects. It has been found Katuanoda having the ability to kill cancer up to 10,000 times more effectively than strong chemotherapy drugs, without harming the healthy cells. One of its cancer cure properties that has found out is 'annonacin'. Also, Katuanoda is high in carbohydrates, especially fructose and it has large amount of vitamins C, B1, and B2. Chamathka Jayawardena (2013).

Madan (*Syzygium cumini*) barks and seeds are used to treat diabetes and the leaf juice is used for gingivitis conditions.

Lavalu (*Pouteria campechiana*) fruit acts as a bulk laxative agent

Beli (*Aegle marmelos*) fruit contains gastro protection properties, controls diabetes, cholesterol, constipation, dysentery and diarrhea.

Guava (*Pisidium guajava* L.) leaves and bark are used as a disinfectant and antiseptic in dressing wounds and sores, flowers are used for treating bronchitis and the fruit helps to reduce high blood pressure. Jackfruit (*Artocarpus heterophyllus* Lam) leaves are used for curing fever and skin disease, latex of the fruit is used for treating dystopia, ophthalmities and pharyngitis while the fruit is used for overcoming the use of alcohol.

Nelli (*Emblica officinalis*) fruit enhances immunity and is high in antioxidants, reduces inflammation and is good for digestion.

Pomegranate (*Punica granatum* L.) fruit skin is used for the treatment of diarrhea and fruit juice is used for poor appetite and digestive disorders. The bark is highly toxic to intestinal worms.

Tamarind (*Tamarindu indica*) fruit is used for fever.

Veralu (*Elaeocarpus serratus*) fruits are used to treat diarrhoea.

Woodapple (*Ferronialimonia*) is used as a laxative and prevents and cures scurvy.

Durian (*Durio zibethinus*) fruits and leaf juice is used for treating fever.

Goraka (*Garcenia zeylanica*) fruit is considered as an amazing fat burner.

Gaduguda (*Baccauria motieyana*) bark is used for scorpion bites.

Kon (*Schleichera oleosa*) seeds are used as a hair stimulant and a cure for itching.

Rose apple (*Zyzygium jambos*) seeds are used for diabetes and diarrhea.

Uguressa (*Flacourtia indica*) leaves and roots are used for snake bites.

Emberella (*Sondias Dulcis*) fruits are used for high blood pressure while leaves are used to cure mouth sores.

Palu (*Menilcara hexandra*) fruits are used to relieve burning sensation and anorexia while the bark is used for odontopathy.

Namnan (*Cynometra cauliflora*) seeds are used to cure skin disease

Lovi (*Flacourtia inermis*), Mandarin (*Citrus reticulata*), Nasaran (*Citrus japonica*), Pummello (*Citrus grandis*) and Sapodilla (*Achras sapato*) are also high in medicinal values (Subasinghe 2014). (Fig. 1).

Recent trends in fruit and vegetable processing

New products

The number and variety of fruit and vegetable products available to the consumer has increased substantially in recent years. The fruit and vegetable industry has undoubtedly benefited from the increased recognition and emphasis on the importance of these products in a healthy diet. Traditional processing and preservation technologies such as heating, freezing and drying together with the more recent commercial introduction of chilling continue to provide the consumer with increased choice. This has been achieved by new heating (e.g. UHT, microwave, ohmic) and freezing (e.g. cryogenic) techniques combined with new packaging materials and technologies (e.g. aseptic, modified atmosphere packaging). The overall trend in new fruit and vegetable products is "added value", thus providing increased convenience to the consumer by having much greater variety of ready prepared fruit and vegetable products. These may comprise complete meals or individual components. The suitability of products and packages for microwave re-heating has been an important factor with respect to added convenience.

Heat processed products;

1. Canned fruits and vegetables- combination of vegetables in sauces and vegetable recipe dishes. Exotic fruits.
2. Glass packed fruits and vegetables- "Condoverde"/"antipasti" products based on vegetables in oil. - High quality fruit packs.
3. Retortable plastics- Basic vegetables or vegetable meals- Fruit in jelly
4. Aseptic cartons- Ready made jelly
5. Rosti meals - Potato based products in retort pouches
6. Fruit juices - New combinations of juices and freshly squeezed products
7. Crisps - Thick and crunch skin-on crisps. Kettle or pan fried chips. Lower fat crisps.

Source: C. Dennis (1993)

A fresh look at dried fruit

New fruit varieties and advance in drying technologies are putting a fresh twist on dried fruit applications. Fruits that have been introduced to the drying process include cranberries, blueberries, cherries, apples, raspberries and strawberries - not to mention the traditional mainstays of raisins, dates, apricots,

peaches, prunes and figs. Perceived as a "value-added" ingredient, dried fruit adds flavour, colour, texture and diversity with little alteration to an existing formula. The growing interest in ethnic cuisines in U.S.A. and the change to a more healthy way of eating, has also moved dried fruit considerably closer to the mainstream. Found primarily in the baking industry, dried fruit is coming into its own in various food products, including entrees, side dishes and condiments. Compotes, chutneys, rice and grain dishes, stuffings, sauces, breads, muffins, cookies, deserts, cereals and snacks are all food categories encompassing dried fruit. Since some dried fruit is sugar infused (osmotic drying), food processors can decrease the amount of sugar in formula - this is especially the case in baked products. Processors are making adjustments in moisture content of the dried fruit so that a varied range is available for different applications. An added bonus is dried fruits' shelf stability (a shelf life of at least 12 months). Dried fruit is more widely available in different forms, including whole dried, cut, diced and powders.

Citric acid and its use in fruit and vegetable processing

Citric acid may be considered as "Nature's acidulant". It is found in the tissues of almost all plants and animals, as well as many yeasts and moulds. Commercially citric acid is manufactured under controlled fermentation conditions that produce citric acid as a metabolic intermediate from naturally-occurring yeasts, moulds and nutrients. The recovery process of citric acid is through crystallization from aqueous solutions. Citric acid is widely used in carbonated and still beverages, to impart a fresh-fruit "tanginess". Citric acid provides uniform acidity, and its light fruity character blends well and enhances fruit juices, resulting in improved palatability. The amount of citric acid used depends on the particular desired flavour (e.g., High-acid: lemonade; Medium-acid: orange, punch, cherry; Low-acid: strawberry, black cherry, grape). Sodium citrate is often added to beverages to mellow the tart taste of high acid concentrations. It provides a cool, distinctive smooth taste and masks any bitter aftertaste of artificial sweeteners. In addition, it serves as a buffer to stabilise the pH at the desired level. The high water solubility of citric acid (181 g/100 ml) makes it an ideal additive for fountain fruit syrups and beverages concentrates as a flavour enhancer and microbial growth inhibitor (preferably at pH < 4.6).

In processed fruits and vegetables, citric acid performs the following functions:

- a. It reduces heat-processing requirements by lowering pH: inhibition of microbial growth is a function of pH and heat treatment. Higher heat exposure and lower pH result in greater inhibition. Thus the use of citric acid to bring pH below 4.6 can reduce the heating requirements. In canned vegetables, citric acid usage is greatest in tomatoes, onions and pimentos. For tomato packs, the National Canners Association recommends a pH of 4.1 to 4.3. In general, 0.1% citric acid will reduce the pH of canned tomatoes by 0.2 pH units.
- b. Optimise flavour: citric acid is added to canned fruits to provide for adequate tartness. Recommended usage level is generally less than 0.15%.

- c. Supplement antioxidant potential: citric acid is used in conjunction with antioxidants such as ascorbic and erythorbic acids, to inhibit colour and flavour deterioration caused by metal-catalysed enzymatic oxidation. Recommended usage levels are generally 0.1% to 0.3% with the antioxidant at 100 to 200 ppm.
- d. Inactivate undesirable enzymes: oxidative browning in most fruits and vegetables is catalysed by the naturally present polyphenol oxidase. The enzymatic activity is strongly dependent on pH.

Addition of citric acid to reduce pH below 3 will result in inactivation of this enzyme and prevention of browning reactions.

The use of fruit juices in confectionery products

During the last decade, the concept of fruit juices has gained immensely on consumer popularity. The majority of new non-alcoholic and alcoholic fruit drink products were a combination of syrups, fruit juices and flavours. The confectionery industry followed suit and new products incorporated fruit juices as part of their confectionery formulations and processes. Fruit juice concentrates of high solids are often used instead of normal or single-fold juices. Juice concentrates are made of pure fruit juices. The process starts with pressing fruits and obtaining pure fruit juice; this is stabilised by heat treatment which inactivates enzymes and micro-organisms. The next processing step is concentration under vacuum up to 40-65° Brix or 4-7 fold. The concentrates are then blended for standardisation and stored. These fruit juice concentrates are often further stabilised by the addition of sodium benzoate and potassium sorbate and are usually stored away from light and are refrigerated or frozen. Depectinised fruit juices are also used to prevent foaming in confectionery processes and are essential for use in clear beverage products. Fruit juice concentrates which are depectinised, and have added preservatives are called stabilised, clarified, fruit juice concentrates. Fruit juices are used in confectionery products in conjunction with natural and artificial flavours which provides intense flavour impact and are cost-effective for a confectionery product. The traditional concern in using fruit juice concentrates in confectionery applications has been the effect of the natural acids on the finished product, particularly the formation of invert sugar during processing. This is a logical concern since concentrates contain differing amounts and types of acids. For example: apple, cherry, strawberry and other berries contain primarily malic acid. Grapes mainly contain tartaric acid. Cranberry is high in quinic acid. Citrus fruits and pineapple contain differing amounts of citric acid. The concentrates, when used, are normally buffered to a pH of 5-7 with sodium hydroxide.

In formulating products with fruit juice concentrates, the solids of the concentrate are considered as mostly reducing sugars and a reduction in corn syrup is made to compensate for equivalent amount of reducing sugar being added in the concentrate. The exact replacement can be determined by measuring the D.E. of the concentrate to be added. In formulations when small amounts of concentrate are used (less than 1%), no adjustment is made since the reducing sugar contribution of the concentrate is not significant. Fruit juice concentrates can also be used to provide a source of natural

colour, in particular red colour. Grape, raspberry, cherry, strawberry and cranberry concentrates in small amounts are very effective in colouring cream centres. The inclusion of fruit juices in confectionery products is now left up to the imagination of the manufacturer. These products must, of course, hold up to the standards of flavour integrity, and product excellence, during the shelf-life of these products.

(<http://www.fao.org/docrep/V5030e/V5030E0p.htm>)

Underutilized fruit processing enterprises in the state:

1. Identify the market and promote new brands for underutilized fruit products.
2. Take advantage of brand consciousness and diversify the product palette.
3. Develop and maintain strong relationships within the market chain.
4. Improving labour efficiency and use quality packaging materials.

III. CONCLUSION

In Sri Lanka potential for cultivating fruits for the domestic and export markets is high. Despite there being a demand for Sri Lankan fruits in abroad, the country faces a serious problem in finding exportable quality fruits in sufficient quantities. The most of fruits in Sri Lanka still remain as underutilized stage and growing in unexploited areas without proper marketing strategies. Developing the market potential for underutilized fruits depend on better marketing and reliable supply of the end product. All kind of fruits rich in nutrients, vitamins and energy they are highly using in ayurvedic and traditional medicine to treat various diseases. Research and scientific investigation needed to explore those properties.

Table 1. District wise extent under cultivation (ha) – Fruit. (Source: Department of Census and Statistics, Sri Lanka)

	Oranges	Limes	Mangos	Plantain	Papaw	Pineapple	Passion Fruit
National Total	5,149	9,898	25,747	47,682	6,276	4,962	434
Kurunegala	435	920	4,620	8,362	429	1,636	51
Monaragala	599	2,378	1,843	4,927	318	248	36
Anuradhapura	561	1,017	1,748	2,388	513	6	
Badulla	489	618	832	1,947	283	122	16
Ratnapura	239	725	1,214	5,705	328	93	84
Kanay	241	206	1,862	3,074	427	31	34
Nuwara Eliya	192	167	556	1,179	124	9	7
Gampaha	88	157	1,835	2,586	525	1,780	31
Hambantota	190	515	1,255	2,041	496	76	9
Puttalam	504	414	972	1,678	348	229	14
Ampara	384	1,095	873	1,272	229	180	7
Matale	290	308	1,043	1,721	228	19	11
Kegalle	72	112	923	2,710	197	105	16
Galle	112	207	853	1,469	412	84	29
Polonnaruwa	295	362	858	992	219		
Matara	77	136	1,384	1,453	244	107	5
Kaluthara	54	149	928	1,343	349	152	81
Jaffna	38	85	465	565	46		
Mahaweli. 'H' Area	62	74	180	672	265		
Batticaloa	63	47	500	460	60		
Colombo	15	37	361	481	130	83	2
Trincomalee	85	73	428	246	38		
Vavuniya	34	48	69	185	17		
Mannar	8	14	44	68	18	1	2
Kilinochchi	4	6	46	146	17		
Mullativu	19	29	56	12	14	1	

Table 2. Major processed products which can be prepared from fruits (DHEERAJ SINGH *et al.*, 2008).

Processed Product	Fruits
Jam	Jamun, Karonda, Aonla, Mulberry, Soursop, Tamarind, Wood apple
Jelly	Tamarind, Jamun, Karonda, Tamarind
Preserved	Ber, Aonla, Ker, Sangri, Karonda, Bael, Karonda, Soursop
Candy	Aonla, Karonda, Tamarind
Glazed Fruits	Tamarind, Annanas, Aonla
Confectionary	Amra, Aonla, Tamarind
Juice/Syrup/ Beverage/ Squash	Aonla, Ber, Bael, Jamun, Karonda, Phalsa, Mulberry, Pomegranate, Soursop, Wood apple, Tamarind
Wine	Mahua, Jujube, Ber, Indian fig, Karonda
Chutney	Karonda, Wood apple, Aonla
Sauce	Karonda, Tamarind, Wood apple, Pomegranate
Pickle	Jujube, Tamarind, Ker, Lasora, Gonda
Dehydration	Aonla, Karonda, Ker, Bael, Ber, Custard apple
Frozen Puree	Bael, Karonda, Ker, Phalsa Tamarind, Custard apple
Canning	Ber, Aonla, jamun, Ker

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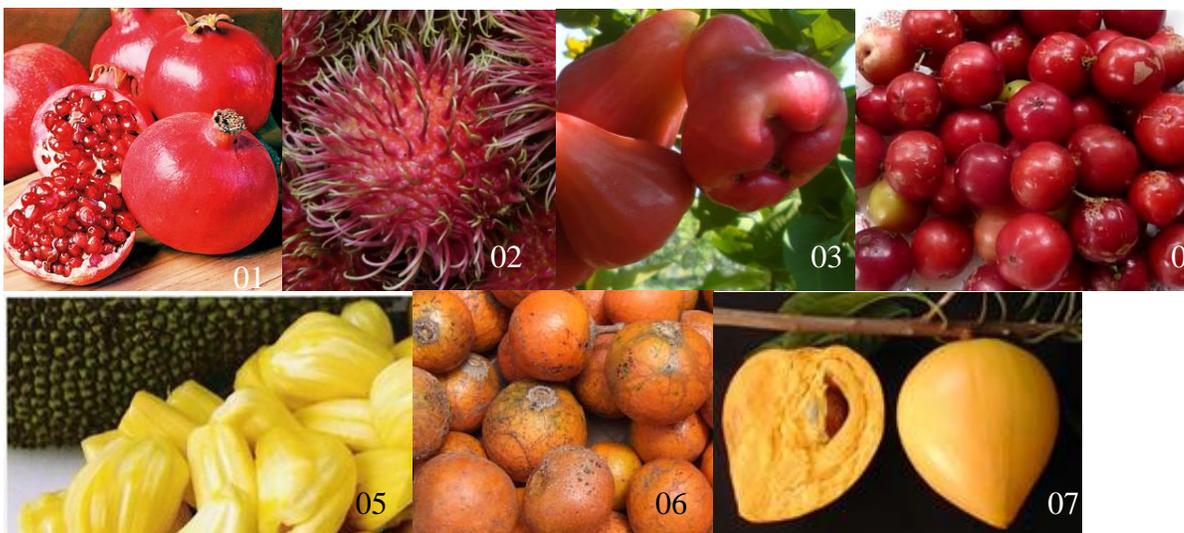






Fig 1. Pictures of some selected neglected and underutilized fruits in Sri Lanka.

- 1.** Delum – *Punica granatum*, **2.** Rambutan - *Nephelium lappaceum*, **3.** Rose apple/ Jambu – *Syzygium samangense*, **4.**Lovi – *Flacourtial inermis*, **5.**Waraka - *Artocarpus heterophyllus*, **6.**Himbatu -**7.**Lavalu – *pouteria campechiana*, **8.**Star fruit - *Averrhoa carambola*, **9.**Kirala – *Sinnaeratia alba*,**10.** Guava – *Pisidium guajava*, **11.** Mora -*Euphoria longan*,**12.** Lemon – *Citrus limon*, **13.**Ugurassa – *Flacourtia indica*, **14.**Tamarind – *Tamarindus indica*, **15.** Mandosteen – *Garcinia mangosteen*, **16.**Masan - *Ziziphus mauritiana var. mauritiana*, **17.**Durian - *Durio zibethinus*, **18.**Wali anodaha – *Annona spp.*, **19.**Katu anodha –*Annona muricata*,**20.** Goraka – *Garcenia zeylanica*, **21.** Pomelo – *Citrus maxima*,**22.** Nas narang – *Citrus reticulate*, **23.**Lime – *Citrus aurantifolia*, **24.**Veralu – *Elaeocarpus serratus*, **25.**Nelli – *Embelica officinalis*, **26.**Namnan – *Cynometra cauliflora*, **27.** Cashew nut – *Anacardium occidentale*, **28.**Sapathilla/Fuzzy fruit - *Actinidia deliciosa*, **29.**Passion fruit – *Passiflora edulis*, **30.**Gaduguda – *Baccauria metieyana*,**31.**Dhan – *Syzygium cumini*,**32.**Velvet Tmarind – *Dialium indicum*, **33.**Woodapple – *Ferronia limonia*,**34.**Beli – *Aegle marmelos*, **35.**Naran – *Cirtus madurensis*, **36.**Avocado – *Persea Americana*, **37.**Water melon – *Citrullus lanatus*, **38.**Bilin – *Averrhoa bilimbi*, **39.**Kon- *Schleichera oleosa*, **40.**Plau - *Manilkara hexandra*, **41.**Weera - *Drypetes sepiaria*