A REVIEW

FOOD SCIENCE
RESEARCH JOURNAL

e ISSN-2230-9403 ■ Visit us : *www.researchjournal.co.in*
Volume 5 | Issue 2 | October, 2014 | 174-183
DOI : 10.15740/HAS/FSRJ/5.2/174-183

Underutilized food crops: treasure for the future India

MONIKA THAKUR

Underutilized crops are lesser-known plant species in terms of marketing and research, but well adapted to marginal and stress conditions. Their indigenous potential and ethnobotanical data are well known to people, whereas, commercial importance and market value is unknown to the public. The survey conducted and the indigenous data gathered gave information that, UUC's make Indian economy sounder and in many cases benefit the environment as well, by replacing the depleting resources with the new ones. In India, strategy development and appropriate policies are limited to a large extent because of the lack of authentic documentation on these crops. The Indian government policies and strategies for food security should take into account the diversity of underutilized crops. Although the options for scaling-up neglected crops for large-scale agriculture appear to be increasingly exhausted, many species have the potential to contribute to food security, nutrition, dietary and culinary diversification, health and income generation. Basically, these UUC's are multifold food crops as the treasures for the future India have greater potential for food and security, income generation and environmental services.

Key Words : Underutilized crops, Food security, Health benefits

How to cite this article : Thakur, Monika (2014). Underutilized food crops: treasure for the future India. *Food Sci. Res. J.*, **5**(2): 174-183.

INTRODUCTION

With the increasing population and fast depletion of natural resources, it became necessary to explore the possibilities of using newer indigenous plant resources. Agriculture in today's context is one of the most important sources of renewable wealth in the world. There are many plants species still lying unexplored and underexploited. Therefore, there has been focused attention by the researchers on exploiting alternative or underutilized plant species for multifarious use. "Underutilized crops" are plant species that are used traditionally for their food, fibre, fodder, oil or medicinal properties, but have yet to be adopted by large-scale agriculturalists. Underutilized plants, in general, constitute those plant species that occur as life support species in extreme environmental conditions and threatened habitats, having genetic tolerance to survive under harsh conditions and possess qualities of nutritional and/or industrial importance for a variety of purposes. Kunkel (1984) discussed that once underutilized food crops are properly utilized, they may help to contribute in food security, nutrition, health, income generation and environmental services when properly utilized. The underutilized foods can be defined as "the foods which are less available, less utilized or rarely used or region specific" (William and Haq, 2002).

Underutilized or neglected crops species are often indigenous ancient crop species which are still used at some level within the local, national or even international communities, but have the potential to contribute further to the mix of food sources than they currently do (Mayes *et al*., 2011). Neglected and underutilized plants are those that could be - and, in many cases, historically have been - used for food and other uses on a larger scale. Global Facilitation Unit (GFU) for Underutilized species also define UUC's as, "those plant species with under-exploited potential for contributing to food security, health (nutritional/medicinal), income generation and environmental services". These underutilized crop species have also been described as "minor", "orphan", "promising" and "little-used".

UUC's have poor shelf-life, un-recognized nutritional value, poor consumer awareness and reputational problems,

AUTHOR FOR CORRESPONDENCE
MONIKA THAKUR, Amity Institute of Food Technology, Amity University, NOIDA (U.P.) INDIA
Email: mthakur1@amity.edu, monika.harsh05@gmail.com

Annexture I : Some underutilized plant species and their uses

Sr. No.	Name of crop	Family	Common names	Uses	References
1.	*Aegle marmelos*	Rutaceae	Bael, bel, belli, golden/ stone / wood apple	Pulp used in diarrhoea, dysentery and other stomach ailments; marmelosin' extracted from fruits have therapeutic properties, trifoliate leaves are used in prayer /puja of Lord Shiva; treatment of digestive and gastrointestinal disorders; digestion, respiratory infections, scurvy, curing peptic ulcerism diabetes, chronic inflammation, snake bites. The bael fruit also bears anti-fungal and anti–malarial properties, which improves appetite and antiscorbutic; constipation, diarrhea and dysentery, peptic ulcer; respiratory affections	Chadha and Pareek, 1988; Ved, 1991; Patnaik *et al.*, 1996; Mazumdar, 2004; Bael Fruit, 2011; Kumari *et al*., 2011
2.	*Atrocarpus heterophyllus*	Moraceae	Jack fruit, Kathal	Fruit contains isoflavones, antioxidants, and phytonutrients, all of which are credited for their cancer-fighting properties; anti-ulcer properties and is also good for those suffering from indigestion; anti-ageing properties; treatment of a number of skin problems	Chadha and Pareek, 1988; Parimala, 2007; Patti, 2010
3.	*Averrhoa carambola*	Oxalidaceae	Carambola, Star fruit	Rich in antioxidants, potassium, and vitamin C; and low in sugar, sodium, and acid. It is also a potent source of both primary and secondary polyphenolic antioxidants. It has both has both antioxidant and antimicrobial activities	Kapoor, 1990; Ved, 1991
4.	*Carissa* sp.	Apocynaceae	Karonda, Karmada, Karvanda	Curing anemia and as an astringent, anti-scorbutic and as a remedy for biliousness; anticonvulsant; cardiotonic; antioxidant, hepatoprotective; antiviral and antibacterial	Vohra and De, 1963; Jigna *et al.*, 2005; Devmurari *et al*., 2009; Hedge *et al.*, 2009; Kumari *et al*., 2011
5.	*Cordia* sp.	Boraginaceae	Indian cherry, Lasora, Laseda, Gonda, Gondi	Eaten as pickle; to cure diseases of chest and is given in bilious infections as a laxative. leaves, fruit, bark and seed have been reported for possessing antidiabetic, antiulcer, anti-inflammatory, immune-modulator and analgesic activity. Normoglycemic and diabetes; Wound healing activity; Antimicrobial and antifungal activity; antidiabetic activity; ulcerative colitis; anti-inflammatory activity	Kuppast and Nayak, , 2006; Parekh and Chanda, 2007; Sharker *et al*., 2009; Maisale *et al.*, 2010; Patil *et al*., 2010; Ganjare *et al*., 2011; Shahapurkar, 2011; Nariya *et al.*, 2011; Jamkhande *et al.*, 2013
6.	*Garcinia* sp.	Clusiaceae	Kokam	Treatment of piles, dysentery, tumors and heart complaints; valuable edible fat known in commerce as 'kokum butter'; used in cooking, weight loss. Antimicrobial and antioxidant activity	Chadha and Pareek, 1988; Arora and Nayar, 1984; Arora and Pandey, 1996; Patil,2005; Gruère *et al*., 2006
7.	*Grewia subinaequalis*	Tiliaceae	Phalsa	Unripe fruits are said to remove vata, kapha and biliousness; astringent properties and used for several stomach ailments.	Chadha and Pareek, 1988; Ali and Rab, 2000
8.	*Madhuca indica*	Sapotaceae	Indian Butter Tree, Mahua	Relieves coughs, biliousness and heart-trouble, while the fruit is given in cases of consumption and blood diseases; Kernel oil (solid at ambient temperature) is used for skin care; bark of mahua is used to cure leprosy and to heal wounds Antidiabetic activity, Itch, swelling, fractures and snake-bite poisoning; antioxidant activity; anti-ulcer activity; analgesic activity; anti-inflammatory activity; anti-epileptic activity	Ved, 1991; Kumar *et al*. 2011; Tambekar and Kante, 2010; Roy *et al.*, 2008; Chandra, 2001; Gaikwad *et al.*, 2009; Sandip *et al.*, 2011
9.	*Millets (Penissetum, Eleusine, Setaria, Panicum* and *Paspalum)*	-	Pearl, Thinai, Varagu, Finger, Sorghum and Jowar etc.	These tiny "grain" is gluten-free and packed with vitamins and minerals; act as prebiotic, rich in Ca, P, Mg, Mn, tryptophan, fibre, Vitamin B group, antioxidant, antidiabetic	Ravi, 2004; Gruere et al., 2007; Upadhyaya, 2009; Ravi et al., 2010

Annexture I: Contd……

Annexture I: Contd……

10.	*Musa acuminata, Musa balbisiana (Banana inflorescence)*	Musaceae	Banana	Good for stomach, good source of Vitamin C which helps to rebuild the immune System, helps to reduce and control high blood pressure, good source of potassium, fiber and other phytochemicals, healthy bowels, cardiovascular health, protection from strokes, protection from ulcers, improve blood pressure, may boost mood, boost energy, help reduce water retention	Solomaon, 1998, Angolo, 2008; Frison and Sharrock, 1999; Kumari *et al.,* 2011; Sampath *et al.,* 2012
11.	Mushrooms	Ascomycetes , basidiomycetes	Fungi	Antimicrobial, antioxidant, antidiabetic, immunomodulatory, hepatoprotective;	Ghosh and Singh, 1995; Wasser and Weis, 1999; Lakhanpal and Rana, 2005; Idowu, 2009; Okhuoya *et al.,* 2010; Tibuhwa, 2013; Manikandan, 2011.
12.	*Rhododendron* sp.	Buraansh	Ericaceae	Antimicrobial, antioxidants, anticancerous, anti-dermatitis, inflammatory pain, kidney and liver function, hepatoprotective property	Scott, 2012; Popescu and Kopp, 2013
13.	*Simarouba gluca*	Simaroubaceae	Paradise tree	Leaves and roots of this plant has an ability to fight against cancer cells, fruit pulp contains about 11% sugars and can be used in the preparation of squash, beverage and jam. The fruits can be a source of natural colourants. phytochemicals present in leaf, fruit pulp and seed are known to possess the medicinal properties such as amoebicide, analgesic, anthelmintic, antibacterial, antidysenteric, antile ukemic, antimalarial, antimicrobial, antitumorous, antiviral, astringent, cytotoxic, emmenagogue, febrifuge, skin hydrator, stomachic, sudorific, tonic, vermifuge. They are useful in curing amoebiasis, gastritis, ulcers in the alimentary system, diarrhea, chikun gunya and malaria.	Joshi and Joshi, 2008
14.	*Simmondsiachinensis Schnetder*	Simmondsiaceae	Jojoba	cosmetics purposes; treat sores, cure stomach problems and restore hair	Bhatnagar *et al.,* 1991
15.	*Syzygium cumini*	Myrtaceae	Jamun, jambul/ jambhul/ jambu/ jambula, black plum	Antioxidant activity, stomachic, carminative, antiscorbutic and diuretic, antimicrobial properties	Khurdiya and Roy, 1985; Chadha and Pareek, 1988; Ved, 1991; Luximon-Ramma *et al.,* 2003; Koley *et al.,* 2011
16.	*Tamarindus indica*	Fabaceae	Tamarind	Culinary use, antimicrobial, antidiabetic	Chadha and Pareek, 1988; Ved, 1991; Ali and Rab, 2000; Doughari, 2006; Maiti *et al.,* 2004.
17.	*Ziziphus mauritiana*	Rhamnaceae	Ber, Indian jujube, Indian plum, or desert apple	Rich source of calcium, phosphorous, protein, minerals, vitamin C and vitamin A Seeds and bark cure for dysentery and boils and fruit as laxative and aphrodisiac; root decoction is given as a febrifuge, taenicide and emmenagogue, and the powdered root is dusted on wounds; fruits are applied on cuts and ulcers; are employed in pulmonary ailments and fevers; and, mixed with salt and chili peppers, are given in indigestion and biliousness	Jawanda and Bal, 1978; Chadha and Pareek, 1988; FACT, 1998; Ved, 1991; Kumari *et al.,* 2011

therefore, also called as, "poor people's food". As the demand for food changes (re-discovery of nutritional and culinary value, therapeutic value–complete ethnobiology), UUC's can overcome the constraints to the wider production and use by the poor people. As a matter of fact, many formerly neglected crops are now globally significant crops (oilpalm, soybean, kiwi fruit) and have shown the potential to contribute to food security, nutrition, dietary and culinary diversification, health and income generation (Hammer *et al*., 2001). Underutilized plant species have a distinctive past, current, or potential use value, but their use is currently limited relative to their economic potential (Gruère *et al*., 2006).

To be considered as an 'underutilized food crop', a plant must have the following features :

- Crop must have a scientific or ethnobotanical proof of food value.
- Crop must have been cultivated, either in the past, or only being cultivated in a specific geographical area,
- It must be currently cultivated less than other conventional crops,
- Crop must have weak or no formal seed supply system,
- Crops are recognized to have indigenous uses in localized areas,
- Received little attention from research, extension services, farmers, policy and decision makers and technology providers,
- May be highly nutritious and/or have therapeutic medicinal or therapeutic properties or other multiple uses.

Need of explore UUC :

With the increasing population pressure, India is facing serious challenges of food security, unemployment and environment degradation. About 65 per cent of the Indian population is presently living in rural areas and 85per cent of these rural families are dependent on agro-based activities for their livelihood (Williams and Haq, 2002). Staple crops face major challenges in the near future and a diversification away from over-dependency on staple crops will be important as part of the progress towards the goal of achieving security of food production. Just three crops-rice, maize and wheat account for about 40 per cent of the world's consumption of calories and protein. About 95 per cent of the world's food needs are provided for by just 30 species of plants. In contrast, at least 12,650 plant species names have been compiled as edible (Kunkel, 1984). From past UUC's continue to play a persistent role in the subsistence and economy of poor people throughout the developing countries. Despite their potential for dietary diversification and the provision of micro-nutrients such as vitamins and minerals, they still continue to attract little research and development attention. Therefore, the developing countries like India are being encouraged to diversify their food exports by developing new resources.

In India, there are large areas of marginal and wasteland, which are not suitable for cultivation of staple crops, either due to poor quality soil or lack of water resources. Most of UUC species are tolerant to harsh agro-climatic conditions; they have excellent potential for establishment on marginal and wasteland throughout the tropics (Hegde, 2002). Many underutilized fruit crops such as ber, tamarind, jamun, gooseberry etc. which are in good demand but these crops are not very popular among farmers (Hegde, 2002). Most of these lesser known fruit trees establish through natural regeneration of the seeds grow slowly without any nutrition, start bearing fruits after a long period. Hence, these species are renamed as neglected without any commercial importance.

Neglected or underutilized crops have the potential to play a number of roles in the improvement of food security in India that include being :

- part of a focused effort to help the poor for subsistence and income,
- a way to reduce the risk of over-dependency on very limited numbers of major staple food crops,
- a way to increase sustainability of agriculture through a reduction in inputs,
- increase the food quality;
- a way to preserve and celebrate cultural and dietary diversity,
- a way to use marginal and wastelands for agricultural purposes to meet the ever increasing food demand (Mayes *et al*., 2011).

Thus, these UUC's because of their untapped potential shall be very soon explored to combat food security. Unfortunately, the lack of attention and authenticated data claim their potential value as under-exploited, and they are in danger of continued genetic erosion, ultimately leading to disappearance," (ICUC, 2006). Therefore, there has been a concern to diversity the agriculture and explore the possibilities of newer plant resources and promote utilization of underutilized nutritive food crops. Apart from being the store house of nutrients, these crops are evolved with very important genetic pool for resistance to biotic and abiotic stress.

Current research status of UUC :

The past three decades have seen a wide and varied range of research interests on underutilized crops. Whereas most of these interests were focused on particular projects of individual researchers, there have been a number of significant programmes to promote underutilized species for agricultural systems, as alternative crops or as sources of new products; and these programmes have been undertaken in both developing and developed countries. Additionally, there has

been a broader recognition that underutilized crops should always be promoted, to improve food security. A report on current research and research proposals for enhanced cooperation on UUC's was documented by Williams and Haq (2002). Various international research organizations have been established to focus on UUC's which have been enlisted:

International centre for underutilized crops (ICUC) :

This is a research, development and training organization. It provides expertise and acts as a knowledge hub and supported research on national priorities for germplasm collections, agronomy and post harvest methodology of underutilized species and associated scientific conferences and training events. In recent years, the focus has expanded to include processing and marketing assessments and entrepreneurship development only. ICUC have several professional networks in twenty one countries in particular as UTFANET (Underutilized Tropical Fruits in Asia Network), UTVAPNET (Underutilized Tropical Vegetables for Asia and the Pacific Network), SEANUC (Southern and East Africa Network for Underutilized Crops and ACUC (Asian Centre for Underutilized Crops) etc.

Global facilitation unit (GFU):

The GFU is a multi-institutional initiative that acts globally to promote a wider use of underutilized plant species through supporting and facilitating the work of other stakeholders. The mission rather to create an enabling environment for stakeholders who are engaged in developing underutilized species.

Convention on biological diversity (*CBD*) :

Became a rallying point and promoted the concept of maintaining local agro-biodiversity. All these various international units which are working on underutilized species have led to a better liaison between relatively isolated groups of workers but there are still major gaps. The Consultative Group on International Agricultural Research (CGIAR) organized a workshop in 1999 at Chennai (India) followed the major FAO Global Plan of Action. One of the outcomes was a recommendation to survey all ongoing activities on underutilized species worldwide.

Crops for the future (*CFF*) :

has been an independent, international organization that works with its partners and has a mandate to promote and facilitate the greater use of neglected and underutilized crops to advocate research, policies, and capacity building on underutilized crops for the diversification of agricultural systems and diets (Crops for the Future, 2009-13). It was formed in 2008 following a merger between the International Centre for Underutilized Crops (ICUC) and the Global Facilitation Unit (GFU) for Underutilized Species. In addition, Crops for the Future Research Centre (CFFRC), a research arm of CFF being built adjacent to UNMC is the first-of-its-kind, with a global mandate for research and development of underutilized plants for food and non-food uses.

Consumption, marketing and promotion of underutilized crop products :

There are very many difficulties in popularizing UUC's at market and consumer level because of a variety of reasons. Hence, there has been uttermost need to give guidance and knowledge to consumers about the use of UUC's. Major fruit and vegetable distributors, failed to market UUC's and their products in the most desired and tempting way by displaying the quality, price and information results in ignorance about the fruit texture, colour, flavour, and optimum maturity before consumption by consumers. Basically most of the consumers are unaware about these plant products, their mode of usage, expectation of sensory qualities, and mode of storage and ripening. Finally, there is a lack of sustained and informative research on the same field.

The availability of information has been always a major constraint in the promotion of underutilized plant species. The possibility of accessing these data to guide workers at local level should be also addressed. Opportunities for strengthening informatics capacities, for instance one computer per village managed by local extension officers, should not be seen as far fetched. Improving the availability of information on underutilized crops has been one of the most important areas demanding our immediate attention. At the formal level, individual studies on underutilized crops continue to need support to ensure their publication. At local level, there has been a need to gather and document information which has been maintained within farming communities. The recognition of the value of this by researchers and scientists can often act as a powerful stimulus to improve a community's own valuation of the knowledge (Singh *et al.*, 2008). A spectacular wide strategy has to be developed for underutilized crops for the benefit of mankind. But for the same protocol for increasing use of underutilized crops for food security involves overcoming many constraints and obstacles, from genetic through management, cultural acceptability, and marketing, to policy and decision-makers in government (Padulosi *et al*., 2002). There are very good examples for the development of an indigenous crop within its local community where it provides direct benefits to that community through food and often income security, providing the local community with purchasing power (Mayes *et al*., 2011).

Constraints in utilization and marketing of UUC's :

Overall, the slow progress and poor popularity in the

effective development and utilization of underutilized crops results from a number of constraints which are summarized below :

- Lack of information on production, nutritional quality, consumption and utilization of many of the underutilized plant products which are unpopular compared to major fruits.
- Lack of awareness on economic benefits and market opportunities.
- Lack of technology for value addition through village level food processing.
- Lack of improved quality planting material.
- Lack of technology to reduce the gestation period and enhance the fruit production.
- Lack of interest by researchers, agriculturists and extension workers.
- Lack of producer interest.
- Low yield.
- Post-harvest and transport losses.
- Non-existence of marketing network and infrastructure facility for underutilized fruits.
- Lack of national policy.
- Lack of credit and investment.
- Non-availability of scientific resources for testing, valuation and post harvest management of different underutilized fruits.
- Disorganized communities.

Advantages of UUC's :

The benefits of these underutilized plant species are many fold :

- They have potential to contribute to poverty elimination through employment opportunities and income generation and also through improved efficiency and profitability of farm household labour use in both rural and urban environments.
- With the use of underutilized crops, there is a way to reduce the risk of over-reliance on very limited number of major crops.
- They can contribute to sustainable livelihoods through household food security as they can widen the food edibility options.
- They add nutrients to the diet and are sometimes convenience food for low income urban people. They are adapted to fragile environments and can contribute to the stability of agroecosystems, particularly in the arid, semi-arid lands, mountains, steppes and tropical forests.
- They provide a broad spectrum of crops to improve productivity and global food security and to meet new market demands.
- They assist development of rural community through small-scale investment.
- They have a strong cultural and sacred identify and are associated with traditional customs and beliefs. Therefore, a best way to preserve and celebrate cultural and dietary diversity.

Indian government strategy :

In India, strategy development and appropriate policies are limited to a large extent by a lack of authentic documentation on underutilized crops. The Indian government policies and strategies for food security should take into account the diversity of underutilized cops. For this thing the Ethnobotanical data available on indigenous, neglected Indian crops is more valuable. Indigenous knowledge must be tapped and combined from various localities and merged with scientific solutions to create new opportunities. Recognition of UUC's in India was initiated in 1960's at the Indian Agricultural Research Institute, New Delhi. This research was later extended by, All India Coordinated Research Project (AICRP) on Under-utilized plants (UUP) in 1982, with its headquarters at National Bureau of Plant Genetic Resources (NBPGR), New Delhi, towards, collection, evaluation, utilization and conservation/ maintenance of under utilized crops. Later on, this work was also carried out in various parts of India (Paroda, 1979; Bhag Mal, 1988; Bhag Mal and Joshi, 1991; Paroda and Bhag Mal, 1989, 1992; Joshi *et al*., 2002; Joshi, 2005). So far, 115 leafy vegetables and 46 other vegetables have been documented as underutilized in India (Anonymous, 2003). Ravi *et al*. (2010) discussed the mobilizing neglected and underutilized crops to strengthen food security and alleviate poverty in India. In India, also a national co-ordinated project by Ministry of Agriculture has been launched to do research on UUC's. Still the threat has been for the crops as their underutilized potential is continued to be under utilized, ultimately this will lead to disappearance of the same crop.

Some underutilized crops of India :

There are many underutilized food crops in India and majority are not well known or well documented (Solomon, 1998). Singh *et al*., 2012 studied the diversity of underutilized vegetable crops species in North-East India. Bal (2003) studies the underutilized fruits for Punjab subtropics. The ethnobotanical data for all the underutilized species is still to be explored for such species. Some of the underutilized plant species are documented in Annexure-I.

Various processed products from under utilized fruits :

The main processed products consumed by people were jam, RTS – fruit drinks, chutneys, candies, pickles, squashes, concentrate etc. (Fig. 1; Roy, 2000; Khurdiya, 2001 a and b; Singh *et al*., 2008). Various processed products like canned

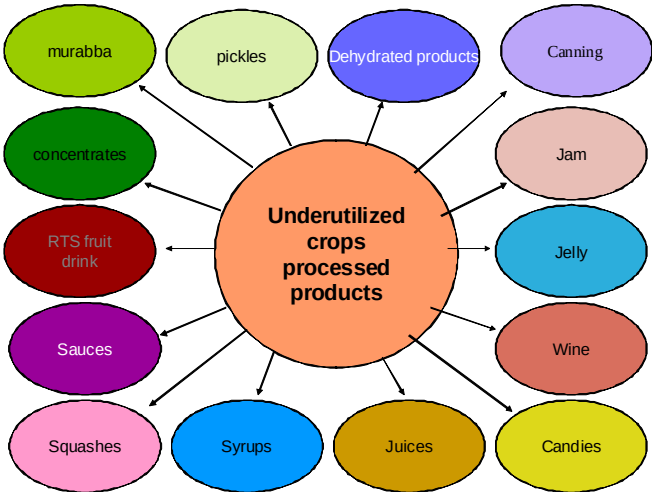

Fig. 1 : Various processed food products from underutilized fruits

jackfruit bulbs in syrup, squash, raw jack pickle, roasted jack seeds, jack seed flour, and candied jackfruit, have been prepared from Jack fruit (Berry and Kalra, 1998; Chadha and Pareek, 1988; Chandra and Prakash, 2009). Various processed products such as nectar, squash, slab, toffee powder, etc. can be made with Bael pulp. Ber can be processed to prepared murrabba, candy, dehydrated ber, pulp, jam, and ready-to-serve beverage (Khurdiya, 1980; Pareek, 2001). Jamun fruits can be processed into excellent quality fermented and non-fermented beverages. Besides that, good quality jelly, jam, leather can be prepared. A good quality jelly can also be prepared from its fruits. The seeds can be processed into powder, which is very useful to cure diabetes (Khurdiya, 2001 a and b). The main processed product made from Karonda is pickle. Ripe ber fruit is consumed as popular dessert and processed for various value added products such as murabba, candy, sharbat, squash and powdered fruits after drying are also consumed.

Banana hearts are used as a vegetable (Solomaon, 1998) either raw or steamed with dips or cooked in soups, curries and fried foods (Duda Online, 2009).

Conclusion :

Many underutilized crops were once more widely grown but are today falling into disuse for a variety of agronomic, genetic, economic and cultural factors. Farmers and consumers are using these crops less because they are in some way not competitive with other crop species in the same agricultural environment. The general decline of these crops may erode the genetic base and prevent the use of distinctive useful traits in crop adaptation and improvement. Production, post harvest handling and processing of underutilized fruits practiced today perpetuate heavy loses, inadequate infrastructure facilities cripple marketing prospects, low production of under utilized fruits results in lesser yield of processed products, there by increasing the production cost during processing. To overcome these problems, the development of technologies is required urgently to minimize the losses during post harvest handling and also technologies suitable for specific processing purposes, products development and storage of fresh and processed products.

Whatever research and field projects have been carried out these are mostly fragmented and information on them is difficult to compile. However, this paper will attempt to provide the background, current research, constraints for sustainable production, approaches to research and potential strategies and action plans which we hope would be helpful to lead the strategic development of underutilized crops for sustainable food and nutrition security and poverty alleviation. By corroborating the ethnobotanical data, the ways to combat food security can be unlocked. UUC's are indispensable for food and nutrition security and will have a greater potential for income generation and environmental services. As underutilized crops have a great potential to alleviate hunger directly through increasing food production in the challenging environments where major food crops are severely limited day by day. This paper finally concludes that with the realization of importance and uses of the underutilized crops in India, the potential for agricultural - rural development and food and nutrition security can be unlocked.

LITERATURE CITED

Anonymous (2003). Annual Report for Central Institute of Arid Horticulture, Bikaner (RAJASTHAN) INDIA .

Arora, R.K. and Pandey, A. (1996). Wild edible plants of India: Diversity, conservation and use. National Bureau of Plant Genetic Resources, NEW DELHI. INDIA.

Arora, R.K. and Nayar, E.R. (1984). Wild relatives of crop plants in India. NBPGR Science Monograph No. 7, NEW DELHI (INDIA).

Berry, S.K. and Kalra, C.L. (1987). *Cultivation and processing of jackfruit. Indian Ed Pack.*, **42** (5) : 62-67.

Bhag Mal and Joshi, V. (1991). *Plant genetic resources – Conservation and management*. R.S. Paroda and R.K. Arora (eds.) Malhotra Publishing House, NEW DELHI (INDIA).

Bhag Mal (1988). Underutilized plant programme in India – concept and future perspective. In: *Life support species: diversity and conservation*, R.S. Paroda, Promila Kapoor, R.K. Arora and Bhag Mal (eds.). Proc. CCS/ICAR International Workshop in maintenance and evaluation of Life Support Service in Asia and Pacific Region. April 4-7, NBPGR, NEW DELHI (INDIA).

Bhatnagar, N, Bhandari, N.C., Dwivedi, N.K. and Rana, R.S. (1991). Performance and potential of Jojoba in Indian arid regions. *Indian J. Pl. Genet. Resour.*, **4** (2) : 57-66.

Chadha, K.L. and Pareek, O.P. (1988). Genetic resources of fruits crops: achievements and gaps. *Indian J. Pl. Genet. Resour.*, **1**: 43-48.

Chandra, D. (2001). Analgesic activity of aqueous and alcoholic extract of *Madhuca longifolia*. *Indian J. Pharmacol.*, **33** : 108-111.

Chandra, D.S. and Prakash, J. (2009). Minor fruits: a livelihood opportunity for the tribal peoples of Tripura. II[nd] International Symposium on pomegranate and minor including Mediterranean fruits, ISPMMF 2009.

Devmurari, V., Shivanand, P., Goyani, M.B., Vaghani, S. and Jivani, N.P. (2009). A review: *Carissa congesta*: Phytochemical constituents, traditional use and pharmacological properties. *Pharmacogonosy Re.*, **3** (6) : 375-377.

Doughari, J.H. (2006). Antimicrobial activity of *Tamarindus indica* Linn. *Tropical J. Pharmaceutical Res.*, **5** (2) : 597-603.

Duda Online (2009). Fried banana flowers. Retrieved on 20th March, 2013.

Frison, E.A. and Sharrock, S.L. (1999). Introduction: The economic, social and nutritional importance of banana in the world." In: *Bananas and food security,* edited by C. Picq, E. Fouré, and E.A. Frison, International Symposium, Douala, Cameroon, 10–14 November (1998). Montpellier, France: INIBAP, pp. 21–35.

Gaikwad, R.D., Ahmed, L.M., Khalid, M.S. and Swamy, P. (2009). Anti-inflammatory activity of *Madhuca longifolia* seed saponin mixture. *Pharmaceutical Biol.*, **47**: 592-597.

Ganjare, A.B., Nirmal, S.A. and Patilm, A.N. (2011). Use of apigenin from *Cordia dichotoma* in the treatment of colitis. *Fitoterapia*, **82**: 1052–1056.

Hammer, K., Heller, J. and Engels, J. (2001). Monographs on underutilized and neglected crops. *Genetic Resources & Crop Evolution*, **48**(1):3–5. doi:10.1023/A:1011253924058. Accessed on 15th November, 2013.

Hegde, K., Thakker, S.P., Joshi, A.B., Shastry, C.S. and Chandrashekhar, K.S. (2009). Anticonvulsant activity of *Carissa carandas* Linn. Root extract in experimental mice. *Tropical J. Pharmaceutical Res.*, **8** (2) : 117-125.

Hegde, N.G. (2002). Promotion of underutilised fruit crops. In: *Fruits for the future in Asia*. Haq, N. and Hughes, A. (eds). Proceedings of the Regional Consultation Meeting, Bangkok, Thailand. International Centre for Underutilised Crops, University of Southampton, Southampton, UK, pp. 45-53.

ICUC (2006). Annual Report 2005-2006 (PDF online reproduction). Colombo, Sri Lanka: International Centre for Underutilised Crops. ISBN 955-1560-03-5. ISSN 1800-2315.

Idowu, O.O. (2009). Contribution of neglected and underutilized crops to household food secuirity and health among rural dwellers in Oyo state, Nigeria. *Acta Hort.* (ISHS) **806** : 49-56.

Jamkhande, P.G., Barde, S.R., Patwekar, S.L. and Tidke, P.S. (2013). Plant profile, phytochemistry and pharmacology of *Cordia dichotoma* (Indian cherry): A review. *Asian Pacific J. Tropical Medicine.*, **3** (12) : 1009–1012.

Jawanda, J.S. and Bal, J.S. (1978). The ber, highly paying and rich in value. *Indian Hort.*, **23** : 19-21.

Jigna, P., Rathish, N. and Sumitra, C. (2005). Preliminary screening of some folklore medicinal plants from western India for potential antimicrobial activity. *Indian J. Pharmacol.*, **37** (6) : 408-409.

Joshi, V., Gautam, P.L., Mal, Bhag, Sharma, G.D. and Kochar, S. (2002). Conservation and use of underutilized crops: An Indian prespective. In: *Managing plant genetic diversity*, JJM Engels; V. Ramanatha Rao, A.H.D Brown and M.T. Jakson (Ed.) CABI Publishing USA, 359-370 pp.

Joshi, V. (2005). Some promising under utilized industrial crops for cultivation on wastelands of India. Green page: Article. *Natur. Prod. Radiance*, **4** (5) : 396-403.

Kapoor, L.D. (1990). *CRC* handbook of Ayurvedic medicinal plants, Boca Raton, Fla.: CRC Press, 58 pp., ISBN 0-8493-0559-4.

Khurdiya, D.S. and Roy, S.K. (1958). Processing of jamun (*Syzygium cumini* Linn.) fruits into ready-to-serve beverage. *J. Food Sci. Technol.*, **22**: 27–30.

Khurdiya, D.S. (1980). A new beverage from dried ber (*Zizyphus mauritiana* Lam). *J. Food Sci. Technol.*, **17**: 158-159.

Khurdiya, D.S. (2001a). Post harvest management of underutilized for fresh marketing. Winter school on exploitation of underutilized fruits, pp. 266–274.

Khurdiya, D.S. (2001b). Post harvest management of underutilized fruits for processed products. Winter school on exploitation of underutilized fruits, pp. 291–298.

Koley, T.K., Barman, K., Koley, T.D. and Asrey, R. (2011). Nutraceutical properties of Jamun (*Syzygium cumini* L.) and its processed products. *Indian Food Industry*, **30** (4) : 34-37.

Kumar, P.K., Vidyasagar, G., Ramakrishna, D., Reddy, Madhusudhana I., Gupta, V.S.S.S., Atyam and Raidu, S. (2011). Screening of *Madhuca indica* for antidiabetic activity in streptozotocin and streptozotocin–Nicotinamide induced diabetic rats. *Internat. J. Pharm. Tech. Res.*, **3** (2) : 1073-1077.

Kumari, P., Joshi, G.C. and Tiwari, L.M. (2011). Diversity and status of ethno-medicinal plants of Almora district in Uttarakhand, India. *Internat. J. Biodiversity & Conservation*, **3** (7) : 298-326.

Kunkel, G. (1984). *Plants for human consumption*. Koeltz Scientific Books, Koenigstein, Germany.

Kuppast, I.J. and Nayak, P.V. (2006). Wound healing activity of *Cordia dichotoma* Forst. fruits. *Indian J. Natur. Prod. & Resour.*, **5** (2) : 99–102.

Lakhanpal, T.N. and Rana, M. (2005). Medicinal and nutraceutical genetic resources of mushrooms. In: Plant genetic resources: Characterization and utilization, pp. 288-303.

Luximon-Ramma, A., Bahoru, T. and Crozier, A. (2003). Antioxidant actions and phenolic and vitamin C contents of common Mauritian exotic fruits. *J. Sci. Food & Agric.*, **83** (5): 496–502.

Maisale, A.B., Attimarad, S.L., Haradigatti, D.S. and Karigar, A. (2010). Antihelmintic activity of fruit pulp of *Cordiad dichotoma. Internat. J. Res. Ayurveda & Pharm.*, **1** (2) : 597–600.

Maiti, R., Jana, D., Das, U.K. and Gosh, H. (2004). Antidiabetic effect of aqueous extract of seed of *Tamarindus indica* in streptozotocin-induced diabetic rats. *J. Ethnopharmacol*., **92** (1) : 85–91.

Manikandan, K. (2011). Nutritional and medicinal values of mushrooms. In: M. Singh, B. Vijay, S. Kamal and G.C. Wakchaure (Eds). *Mushroom: cultivation, marketing and consumption*. (pp. 11-14). Directorate of Mushroom Research, Solan (H.P.) INDIA.

Mayes, S., Massawe, P.G., Alderson, J.A., Roberts, S.N., Azam-Ali and Hermann, M. (2011). The potential for underutilized crops to improve security of food production. *J. Exp. Bot.*,1-5.

Mazumdar, B.C. (2004). *Minor fruit crops of India–tropical and sub-tropical*. Daya Publishing House, NEW DELHI, INDIA.

Nariya, P.B., Bhalodia, N.R., Shukla, V.J. and Acharya, R.N. (2011). Antimicrobial and antifungal activities of *Cordia dichotoma* (Forester F.) bark extracts. *Ayurveda,* **32**:585–589.

Okhuoya, J.A., Khuoya, J.A., Akapaja, E.O., Osemwegie, O.O., Ghenekaro, A.O. and Ihayere, C.A. (2010). Nigerian mushrooms: Underutilized non-wood forest resources. *J. Appl. Sci. Environ. Mgmt.*, **14** (1) : 43–54.

Padulosi, S., Hodgkin, T., Williams, J.T. and Haq, N. (2002). Underutilized crops: Trends, challenges and opportunities in the 21st Century. In: *Managing plant genetic diversity* (eds. Engels, J.M.M., Rao, Ramanatha V., Brown, A.H.D., Jackson, MT) Rome, Italy, **30**: 323-338.

Pareek, O.P. (2001). Ber. International Centre for Crops. Southampton (U.K.).

Parekh, J. and Chanda, S. (2007). *In vitro* screening of antibacterial activity of aqueous and alcoholic extracts of various Indian plant species against selected pathogens from Enterobacteriaceae. *African J. Microbiol. Res.*, **1**(6): 92–99.

Paroda, R.S. (1979). Plant resources of Indian arid zone in industrial uses. In: *Arid land plant resources* (J.R. Goodin and David, K. Northinghton (eds.) Texas Technical University, Texas, 729 pp.

Paroda, R.S. and Mal, Bhag (1989). New plant resources for food and industry in India. In: New crops for food and industry, GE Wickens, N Haq and P Day (eds.) Chapman and Hall, London, pp. 135-149.

Paroda, R.S. and Mal, Bhag (1992). Developing national programme for research on underutilized crops in India. Proceedings of International Crop Science Congress, Ames, Iowa (U.S.A.). 14-22 July.

Patil, D.N., Kulkarni, A.R., Shahapurkar, A.A. and Patil. B.S. (2010). Release of drug neomycin from*Cordia dichotoma* transdermal film. *Internat. J. Pharma & Bio. Sci.*, **2**: 1–5.

Pattnaik, S., Subramanyam, V.R. and Kole, C. (1996). Antibacterial and antifungal activity of ten essential oils *in vitro*. *Microbios.*, **86** (349) : 237–246.

Popescu, R. and Kopp, B. (2013). The genus Rhododendron: an ethnopharmacological and toxicological review. *J. Ethnopharmacol.*, **147** (1): 42-62.

Ravi, B.S. (2004). Neglected millets that save the poor from starvation. *LEISA India*. (1): 34-36.

Ravi, S.B., Hrideek, T.K., Kumar, A.T.K., Prabhakaran, T.R., Mal, B. and Padulosi, S. (2010). Mobilizing neglected and underutilized crops to strengthen food security and alleviate poverty in India. *Indian J. Pl. Genet. Resour.*, **1** (23): 110-116.

Roy, S.P., Shirode, D., Patel, T., Prabhu, K., Shetty, S.R. and Rajendra, S.V. (2008). Antiulcer activity of 70 per cent ethanolic extract of bark of *Madhuca longifolia*. *Indian J. Natur. Prod. & Resour.*, **24**: 8.

Sampath, K.P., Bhowmik, D., Duraivel, S. and Umadevi, M. (2012). Traditional and medicinal uses of banana. *J. Pharmacognosy & Phytochemistry*, **1** (3): 51–63.

Sandip, P., Patel, S. and Patel, V. (2011). Investigation into the mechanism of action of *Madhuca longifolia* for its anti-epileptic activity. *Pharmacognosy Commu.*, **1**: 18-22.

Shahapurkar, A.A. (2011). Drug neomycin release from *Cordia dichotoma* transdermal film and anti-inflammatory activity. *Internat. Res. J. Pharm.*, **2** (9): 107–109.

Sharker, S. Md., Khadiza, P. and Shahid, I.Z. (2009). Analgesic, antibacterial and cytotoxic activity of *Cordia dichotoma*. *Pharmacologyonline.*, **2**: 195–202.

Singh, D., Wangshu, L. and Prahalad, V.C. (2008). Processing and marketing feasibility of underutilized fruit species of Rajasthan. IAMO Forum, pp. 1-12.

Singh, S.J., Batra, V.K., Singh, S.K. and Singh, T.J. (2012). Diversity of underutilized vegetable crops species in North-East India with special reference to Manipur: *A review. NeBIO.* **3** (2): 87-95.

Tambekar, D.H. and Khante, B.S. (2010). Antibacterial properties of traditionally used medicinal plants for enteric infections by adivasi's (bhumka) in melghat forest (Amravati district). *Internat. J. Pharmaceutical Sci. Rev. & Res.*, **1**: 120-128.

Tibuhwa, D.D. (2013). Wild mushroom-an underutilized healthy food resource and income generator: experience from Tanzania rural areas. *J. Ethnobiology & Ethnomedicine.*, **9**: 49.

Ved, P. (1991). *Indian medicinal plant: Current status in Himalayan medicinal plants: Potential and prospects* (Edited by Samant, S.S., Dhar, U., Palni, L.M.S.), Gramodaya Prakashan, Nainital, pp. 45-63.

Vohra, M.M. and De, N. N. (1963). Comparative cardiotonic activity of *Carissa carandas* (L). and *Carissa spinarum (*A). *Indian J. Medical Res.,* **51** (5): 937-940.

Wasser, S.P. and Weis, A.L. (1999). Medicinal properties of substances occurring in Higher Basidiomycetes mushrooms: current perspectives. *Internat. J. Medicinal Mushrooms,* 31–62.

Williams, J.T. and Haq, N. (2002). Global research on underutilized crops - an assessment of current activities and proposals for enhanced cooperation. Southampton, UK: International Centre for Underutilized Crops. ISBN 92-9043-545-3. Accessed on 21st August 2013.

■ WEBLIOGRAPHY

Ali, R. and Rab, F. (2000). Research needs and new products development from underutilized tropical fruits. Acta Hort. (ISHS) 518:241-248. Retrieved from *http://www.actahort.org/books/518/518_33.htm*. Accessed on 10th April, 2014.

Angolo, A. (2008). Banana plant with five hearts is instant hit in Negros Occ. ABS-CBN Broadcasting Corporation. Retrieved from: *http://www.abs-cbnnews.com/classified-odd/05/13/08/banana-plant-five-hearts-instant-hit-negros-occ.* Accessed on 11th March, 2014.

Bael Fruit. (2011). Bael fruit - Medicinal properties and health benefits. Retrieved from *blog.onlineherbs.com/bael-fruit-medicinal-properties-an...* - United States. Accessed on 11th March, 2014.

Bal, J.S. (2003). Genetic resources of under-utilized fruits in Punjab subtropics. *http://www.actahort.org/books/623/623_37.htm. Acta Hort.* (ISHS) **623**: 325-331.

Crops for the Future (2009-13). Crops for the future strategic plan 2009-2013. Retrieved from: *http://www .crops forthefuture org/wp-content/uploads/2009/03/strategic-plan-2009-2013.pdf*. Accessed on 10th March, 2014.

FACT (1998). Ziziphus mauritiana - a valuable tree for arid and semi-arid lands. Retrieved from: *http://www.winrock.org/fnrm/factnet/factpub/FACTSH/ziziphus.htm. Accessed on 29th June, 2012.*

Gruère, G., Giuliani, A. and Smale, M. (2006). Marketing of underutilized plant species for the benefit of the poor: A Conceptual framework. Environemnt and Production Technology Division. Retrieved from International Food Policy Research Institute; *www.ifpri.org;* pp 1-54.

Gruere, G.P., Nagarajan, L., King, E.D.I. and Oliver (2007). Collective action and marketing of underutilized plant species. International Food Policy Research Institute (IFPRI). Series No. 69. Retrieved from: *http://www.ifpri.org/publication/collective-action-and-marketing-underutilized-plant-species.* Accessed on 11th April, 2014.

Joshi, S and Joshi, S. (2008). *Simarouba glauca* D.C. (Paradise tree) (brochure) - Ideas. Retrieved from *ideas.repec.org/p/ags/uasbcp/43624.html.* Accessed on 11th May, 2014.

Parimala (2007). Medicinal uses of jack fruit. Retrieved from *www.jaspari.info/2007/03/medicinal-uses-of-jackfruit.html.* Accessed on 26th July, 2013.

Patti, A.K. (2010). Jackfruit (Artocarpus heterophyllus or Artocarpus heterophylla). by Abhay Kumar Pati, Odisha, India, retrieved from: *http://prlog.org/10748390.*

Roy, S.K. (2000). Promotion of underutilized tropical fruit processing and its impact on world trade. Retrieved from: *http://www.actahort.org/books/518/518_31.htm. Acta Hort.*, (ISHS) **518**: 233-236.

Scott, S. (2012). Benefits of *Rhododenderon* herb. Retrievd from: *www.livestrong.com/article/120355-benefits-rhododendron-herb/.*

Solomon, C. (1998). Encyclopedia of Asian Food (Periplus ed.). Australia: New Holland Publishers. Retrieved from: *ISBN 0855616881. http://www.asiafood.org/glossary_1.cfm?alpha=B&wordid=3219&startno=1&endno=25.* Accessed on 20th April, 2014.

Upadhyaya, H.D. (2009). Sustainable conservation and utilization of genetic resources of two underutilized crops – finger millet and foxtail millet – to enhance productivity, nutrition and income in Africa and Asia. Monograph. Retrieved from: *http://oar.icrisat.org/id/eprint/5199.* Accessed on 12th May, 2014.

Received : *29.05.2014;* **Accepted :** *26.09.2014*