



## A review on diversity, conservation and nutrition of wild edible fruits

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**Abstract:** The United Nations adopted the Millennium Declaration of September 2009 to improve the global living conditions through reducing poverty and hunger. However, considerable numbers of people are still living in utter penury and are deprived of a dignified living. In such tough circumstances nature's free gift in the form of wild edible foods are benefiting the vulnerable and dependent communities. Wild edible plants (WEPs) are the species those are neither cultivated nor domesticated however are available in their wild natural habitat and used as sources of these plants have played a significant role in the development and civilization of human history throughout the ages and globe. These wild edible plants have played a significant role in supplying food and nutritional requirements of poor communities in many rural parts of the world. These wild edibles can be popularized only when they are compared for their nutritional and health benefits with major or widely used cultivated plants. The social, cultural, religious, and belief system of the rural communities are incomplete without these wild edible plants. Domestication of these wild edible plants can increase their use and their conservation as well. The present review paper has described the wild edible plants in context of their diversity, traditional knowledge, conservation practices and nutritional composition from the available secondary literature. Authors feel there is still scope to incorporate more contextual variables for explaining more variations embedded with local people's perception on values and usage of these wild edible fruits.

**Keywords:** Climate, Development, Domestication, Hunger, Nutrition, Poor

### INTRODUCTION

Wild edible plants (WEPs) are the species those are neither cultivated nor domesticated but growing wild and are however edible (Beluhan and Ranogajec, 2010). Different wild edible plants have played a significant role in all geographical regions of world throughout human history (Sekeroglu *et al.*, 2006). Poor communities through the world are dependent on these wild plants for their food, nutrition, subsistence needs and improving rural livelihoods as well (Sundriyal *et al.*, 2003; Mishra *et al.*, 2008; Tiwari *et al.*, 2010; Badhani *et al.*, 2011). Even nutritional superiority of some of the wild edibles was also reported over the cultivated ones (Burlingame, 2000). The traditional consumption of WEP is still supplemented today with staple crop plants staple crop plants by most agrarian societies throughout the world (Lulekal *et al.*, 2011). The role of WEPs in ensuring food and nutritional security to the rural or indigenous communities is now widely recognized. Unfortunately data available on their identification, composition or nutritional properties, use and management or user's preferences is scanty or less documented (Frison *et al.*, 2006; Vincetti *et al.*, 2008).

Many such food resources and valuable plants are still

to be explored (Mohan Ram, 2000). Interest on its research and development has now increased for developing superior varieties, genetic conservation and pre- and post-harvest management (Arora and Nayar, 1984; Rathore, 2001; Hebbar *et al.*, 2003; Bagra *et al.*, 2006; Deshmukh and Shinde, 2010; Deshmukh and Waghmode, 2011; Ekka and Ekka, 2016). Available literature indicates initiation of some systematic work though not detailed and complete. This article has compiled information from more than 100 research and review articles and has scanned the information on the present theme from them. A systematic attempt was made in the present review article in light of similar results collected from the available literature which are presented under the following heads:

Diversity and conservation

Associated traditional knowledge and cultural value of wild edible fruits

Utilization of wild edible fruits

Physico-chemical properties of wild edible fruits

### Diversity and conservation

Plant species richness in a region is primarily influenced by the climatic (temperature, rainfall, altitude), edaphic and biotic factors (Brockway, 1998; Hegazy *et*

*al.*, 1998; Le Brocq and Buckney, 2003; Wang *et al.*, 2003; Demel and Abeje, 2004; Zhao *et al.*, 2005; Mengistu and Hager, 2008; Pala *et al.*, 2015). Till date 2, 50,000-3, 00,000 higher plant species are documented, of which only a few hundred species are cultivated and a few thousands are gathered from the wild. Approximately 75, 000 species of plants world-wide are believed to be edible. These species are widely available but are important only *in situ* (Sekeroglu *et al.*, 2006; Sharma *et al.*, 2008). The national per capita supplies are significantly contributed by only 103 species of food plants (90 %) and of these, staples are only 20 to 30 species (Anon., 1999). More than 7000 species of WEPs are documented worldwide (Grivetti and Ogle, 2000). About 1000 species were identified in Americas, 1200 species in Africa and 800 species in Asia (Verheij and Coronel, 1991; Anon., 2005; Rathore, 2009; Paull and Duarte, 2011; Sthapit *et al.*, 2012; Lapeña *et al.*, 2014).

About 3000 tropical fruits worldwide were reported as still unexploited (Mugnozza, 1996). About 400 wild edible fruit species were reported from Kenya (Anon., 2005), 700 from Tanzania (Maduka, 2004), 150 from Eastern Madagascar (Styger *et al.*, 1999), 110 from Swaziland (Antonsson-Ogle, 1990), 300 from Cameroon and 105 from Uganda (Goode, 1998), 123 from southern Yunnan in China (Jin *et al.*, 1999), 33 from Rupandehi district, Nepal (Acharya and Acharya, 2010) and 11 from Dera Ismail Khan district of north western Pakistan (Marwat *et al.*, 2011). Very rich diversity of wild fruit species was reported from Nigerian lowland rainforest (Adekunle and Oyerinde, 2004) where in species richness of a few hectares is higher than the entire vegetation of Europe (Etukudo, 2000). In Ethiopia, the richness of WEP species is enormous (Abbink, 1993; Azene *et al.*, 1993; Redzic, 2006) and 38-182 edible fruit bearing species was reported to be consumed in Ethiopia (Guinand and Dechassa, 2000; Zemedede and Mesfin, 2001; Demel and Abeje, 2004; Addis *et al.*, 2013; Getachew *et al.*, 2013). The wild edible fruit species documented in India from Himalayas are more than 675 species (Samant and Dhar, 1997; Samant *et al.*, 2001; Chettri *et al.*, 2005; Sundriyal and Sundriyal, 2003, 2005), 118 species from Arunachal Pradesh (Angami *et al.*, 2006), 12 species from Uttara Kannada district of Karnataka (Hebbar *et al.*, 2010), 150 species from Orissa (Mahapatra *et al.*, 2012), 132 species from Assam (Sarma *et al.*, 2010) and 80 species from Chhattisgarh (Ekka and Ekka, 2016).

Undervaluation, underutilization, high population growth and modern development leading to deforestation have lead to loss of diversity of the wild edible fruit species (Ondachi, 1999; Ohiokpehai, 2003; Bagra *et al.*, 2006). In addition to this they are being exploited from wild without any effort to propagate them or any *ex situ* conservation strategies (Ondachi, 1999). Promoting and domesticating these wild fruit species

not only will improve nutritional status and improve livelihood of the local communities but also protect them from loosing from the wild and well being of environment (Brownrigg, 1985; Ohiokpehai and Ramosweu, 1999; Byron, 2003; Ohiokpehai, 2003; Rathore, 2009; Halewood *et al.*, 2014).

### Traditional knowledge and cultural value

Traditional or folk knowledge on plants is relationship between a society and its environment developed by the community variedly from region to region based on their real world experience and empirical testing (Aumeeruddy, 1996; Reyes-Garcia *et al.*, 2005; Setalaphruk and Price, 2007; Fentahun and Hager, 2008). WEPs has been integrally associated with needs, tradition and culture of indigenous people (Addis *et al.*, 2013; Bussmann *et al.*, 2006; Medley and Kalibo, 2007). The indigenous people are the custodian of these plant resources and the traditional knowledge associated with it (Demel and Abeje, 2004). Documenting traditional knowledge based on ethnobotany of WEPs will help in identifying species for domestication and is necessary to create rich and complex production systems for its sustainable development and utilization through commercialization and conservation as well (Bell, 1995; Melnyk, 1998; Ohiokpehai, 2003; Shrestha and Dhillion, 2006; Jasmine *et al.*, 2007; Qureshi *et al.*, 2007; Pilgrim *et al.*, 2008; Ubom, 2010; Shukla and Chakravarty, 2012; Biswakarma *et al.*, 2015). The past studies like Reddy *et al.* (2000) in Yanadis community of Andhra Pradesh; Shukla and Chakravarty, (2012) in Rava and Oraon tribes in North Bengal; Mishra *et al.* (2008) in ethnic communities of Tamil Nadu; Srivastav *et al.* (1981) in Amiches community in Ladakh (J & K) showed that different tribes have intensively used a number of similar wild fruits with different uses. This proves the diversification of knowledge among the indigenous people in region to region and nation to nation.

The intensity of use and knowledge of the WEPs was reported to be function of characteristic of the used plants, habitat of the plants where it is found, frequency of food shortages and peoples way of life in terms of their social, cultural, religious and economical domains (Guinand and Dechassa, 2000; Puri and Vogl, 2005; Shrestha and Dhillion, 2006; Pardo-de-Santayana *et al.*, 2007; Suresh *et al.*, 2014). This knowledge differs among the communities and within a community in terms of age and gender where senior women folks were reported to be more knowledgeable in describing these plants as compared to their male counterparts (Koizumi, 2005; Shrestha and Dhillion, 2006). This is because communities and individuals may have different objectives, interests, perceptions, beliefs and access to information and resources. The use of WEPs in the life of rural and indigenous people is not only in terms of food, income or farm inputs but

also in terms of social, cultural and religious purposes as in sacred groves (Arnold, 1995; Clarke *et al.*, 1996; Arora, 1998; Ohiokpehai and Ramosweu, 1999; Ohiokpehai, 2003; Pala *et al.*, 2013). Unfortunately this traditional culture and knowledge is losing importance by the encroaching traditions of modern outside community along with spread of agriculture and homogenization of agricultural landscapes (Pretty, 2002). The use of these wild plants for food and other uses by the rural and indigenous communities can be continued by developing harmonious correlation among farming and wild biodiversity (Pretty, 2003). In order to deliver the economic benefits of the development programs meant for the rural and indigenous communities, it is imperative to renew, document and utilize the traditional knowledge systems of the target communities where the intangible, edible, economic and environmental roles of the WEPs can be the key.

### Utilization

From time immemorial the WEPs have been a source of 'hidden harvest' which had supplemented the community with food and income (Heywood, 1999; Grivetti and Ogle, 2000). The traditional knowledge system and economic demand of a community influences the exploitation of WEPs in a particular area (Edeoga *et al.*, 2003; Pauline and Linus, Tabuti 2004; Tabuti *et al.*, 2004; Jasmine *et al.*, 2007). In terms of wild edible fruits, its consumption indicates user's evaluation of the fruits in terms of its availability, tastes and preferences (Minae *et al.*, 1994) along with duration of settlement near to a forest from where the community is procuring these fruits (Styger *et al.*, 1999). World's poorest and the poor those who are bereft of a dignified life and are most vulnerable dominates South Asia, Latin American, Northern Africa, Sub-Saharan Africa and the Caribbean (Pender and Hazell, 2000; SCN, 2002; Harris and Mohammed, 2003; FAO, 2004; Tiisekwa *et al.*, 2004; Ahmed *et al.*, 2007; Behrman *et al.*, 2007; Misra *et al.*, 2008; Afolayan and Jimoh, 2009; FAO, WFP and IFAD, 2012). There is prevalence of undernourishment in these regions due to production of insufficient food grains and at times food supplies are not easily available. Foods obtained from WEPs serve as 'buffer food' rescuing lives during food shortages and famines (Abbink, 1993; Bell, 1995; Anon., 1999; Debarata, 2002; Kebu and Fasil, 2006; Akinnifesi *et al.*, 2008).

The vulnerability towards hunger and malfunctioned ecosystem services lead these people rely for food and other products more on intensive agriculture (Erickson *et al.*, 2009). Studies strongly indicate that the WEPs can significantly substantiate the global food basket in today's era of climate instability (Maghembe, 1995; Nazarudeen, 2010). These vulnerabilities has developed a greater understanding among the scientists, policy makers, national governments and international

institutions of a strong linkage between nutritional security and biodiversity for formulating policy support to promote utilization, value addition and conservation of WEPs (Hegde *et al.*, 1996; Ramadhani, 2002; Bharucha and Pretty, 2010).

### Physico-chemical properties

Physico-chemical analysis of wild edible fruits will help in selection of valuable wild species which can then be improved through hybridization for development of a cultivated variety (Mahapatra *et al.*, 2012). There are several analytical studies related to these wild fruits from different parts of the world which are important for commercial and dietary values (Parmar and Kaushal, 1982; Sundriyal *et al.*, 1998; Koyuncu *et al.*, 2004; Zatylny *et al.*, 2005; Paull and Duarte, 2011). Total soluble solid (TSS) is an important characteristics giving information about sugar content of fruits. Sugar, a main source of energy is found to be high in many wild fruits. Titratable acidity indicates the total or potential acidity such that it includes the total number of acid molecules, both protonated and unprotonated. TSS, sugar and acidity of many wild edible fruits have been reported from many parts of the world (Parmar and Kaushal, 1982; Sundriyal *et al.*, 1998; Sundriyal and Sundriyal, 2001; Elmac and Altuq, 2002; Koyuncu *et al.*, 2004; Zatylny *et al.*, 2005; Ercisli and Orhan, 2007; Nath *et al.*, 2008; Deshmukh and Waghmode, 2011). Certain essential amino acids are also derived from plants (Fox and Cameron, 1976). Protein and fat content of wild edible fruits reported varied from 0.4-18 % and 2.0-5.0 %, respectively (Sundriyal and Sundriyal, 2001; Deshmukh and Waghmode, 2011). The fruits were *Prunus cerasoides*, *Diploknema butyraceae*, *Spondias axillaris*, *Machilus edulis*, *Passiflora indica*, *Eleagnus latifolia*, *Eriolobus indica*, *Terminalia chebula*, *Capparis zeylanica*, *Carissa congesta*, *Elaeagnus conferta* and *Limonia acidissima*.

Antioxidants are substance present in low concentrations that restricts oxidation in a chain reaction (Leong and Shui, 2002; Halliwell and Whitemann, 2004) while ascorbic acid are also antioxidant that reduces free radical damage by scavenging oxyradicals (Fischer-Nielsen *et al.*, 1992). Many wild edible fruits like berries are reported as rich sources of antioxidants like vitamins  $\beta$ -carotene (pro-vitamin A),  $\alpha$ -tocopherol (vitamin E), and ascorbic acid or vitamin C (Beekwilder *et al.*, 2005; Netzel *et al.*, 2007; Abu Bakar *et al.*, 2009; Ikram *et al.*, 2009). Wild edible fruits like mulberry, *Ficus roxburghii* and *Capparis zeylanica* are rich source of vitamin C (Parmar and Kaushal, 1982; Holford Fox and Cameroon, 1976, 1998; Imran *et al.*, 2010; Deshmukh and Waghmode, 2011).

Carotenoids reported from many wild edible fruits like sea buckthorn and mulberry are the chemo-protective agents or are antioxidants and are responsible for ap-

pearance and attractiveness of fruits (Young and Lowe, 2001; Eccleston *et al.*, 2002; McGhie and Ainge, 2002; Nishiyama *et al.*, 2005; Gropper *et al.*, 2005; Rodriguez-Bernaldo de Quiros and Costa, 2006; Venkatesh and Chauhan, 2011). Anthocyanin is a polyphenolic pigment of flavonoid group that imparts orange, red, blue and violet colour to many wild edible fruits like chokeberry and bilberry (Chandra *et al.*, 1992). Cyanidin 3-glucoside is the most common anthocyanin found in these fruits (Fukumoto and Mazza, 2000) that potential protective effects against disease.

## Conclusion

The present article was an attempt to review the available information regarding the diversity, conservation, indigenous knowledge and physico-chemical characteristics of wild edible fruits. The research work on these aspects seems to be confined to certain limited regions with severe poverty. In order to achieve the Millennium Development Goals to improve the living condition, more regions needs to be brought under this type of study and more research work be initiated to determine the nutritional composition of wild edible fruits so that they can be compared with widely cultivated major fruit crops. Use of these fruits also has the potential through selective conservation and domestication which can contribute to the maintenance of plant biodiversity. There is a need to distinguish/recognize these fruits and their value added products in the local or national or international market. It is also important to analyze the market environment for these fruits compared with alternative possibilities such as exotic fruits or agricultural crops. In general, future contemplations on wild edible fruits around the globe need to be studied at forefront by involving local indigenous communities.

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