Review Article

NUTRACEUTICAL VALUE AND THERAPEUTIC APPLICATIONS OF BAEL, WOODAPPLE, AONLA, BER, AND KARONDA- A REVIEW

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Abstract

This review delves into the nutraceutical value and therapeutic uses of bael, woodapple, aonla, ber, and karonda fruits, revered for their medicinal properties across traditional medicine systems. Enriched with essential nutrients and bioactive compounds like phenolics, flavonoids, and alkaloids, they offer diverse health benefits, including immune support and digestive health enhancement. Through a meticulous analysis of scientific literature, the review underscores their potential in preventive and holistic healthcare. By acknowledging and leveraging their nutraceutical and therapeutic potentials, individuals and communities can endeavor towards improved health and well-being.

Keywords: Underutilized fruits, medicinal uses, therapeutic properties

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Introduction

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Underutilized fruits provide vital food, vitamins, and minerals, alongside contributing to livelihoods due to their medicinal properties (Das, 2021). Despite being used in local medicine, many of these fruits lack domestication and human selection efforts, restricting their cultivation mainly to the wild. Underutilized crops, although less explored in terms of promotion and research, thrive in diverse and challenging conditions. Their importance varies across different crops and regions but can be significantly enhanced through increased awareness. With a rich history of usage, underutilized wild edible plants are increasingly recognized for their high nutritional value, as evidenced by ongoing global research efforts (Kour et al., 2018).

Bael, woodapple, aonla, ber, and karonda are fruits deeply ingrained in the cultural and medicinal heritage of the Indian subcontinent. With a rich history of traditional use, these fruits are esteemed for their outstanding nutritional properties and therapeutic potentials. Packed with essential nutrients, bioactive compounds, and potent antioxidants, they offer a diverse range of health benefits deeply intertwined with ancient healing traditions like Ayurveda and Unani medicine. Beyond their culinary appeal, these fruits serve as vital ingredients in herbal formulations and natural remedies. This review meticulously examines their nutritional compositions, phytochemical profiles, and multifaceted therapeutic applications, highlighting their profound importance in promoting human health and well-being.

Bael

The bael tree, deeply rooted in Indian history and mythology, has long been recognized for its therapeutic value in traditional medicine. Modern research confirms its effectiveness, attributing to its antioxidant, and antimicrobial properties. Bael addresses various health concerns including gastrointestinal, and cardiac issues, while also exhibiting hepatoprotective, radioprotective, anti-diabetic, and wound-healing properties.

The subtropical fruit Aegle marmelos, commonly referred to as Bael, is a member of the Rutaceae family. The sacred Tripatra tree's leaves are vital in offerings to Lord Shiva. Its root, bark, leaf, flower, and fruit find diverse uses. While wild fruits are smaller and less commercial, cultivars like Kagzi Gonda, Gonda no 1, Gonda no 2, Kagzi Etawah, Mirzapuri, and Baghel are cultivated. (Sharma et al. 2007). Research on bael fruit indicates its rich nutritional composition, encompassing a diverse array of phytochemicals such as phenolic acids, flavonoids, alkaloids, tannins, and coumarins. Additionally, bael contains amino acids, fatty acids, various organic acids, minerals, carbohydrates, vitamins, and fibers, rendering it a highly nutritious fruit with significant health advantages (Bhardwaj,2014). Table 1 indicates the medicinal properties of bael.

Table 1: Medicinal properties of bael (Chhetri., 2021)

Parts of Bael	**Bioactive Compounds**	**Medicinal Properties and Therapeutic Properties**	**Reference**
Fruits	Marmelosin	Anthelmintic and antibacterial activity	Badam *et al.* 2002, Rastogi and Mehrotra 1998; Ghosh and Playford 2003, Shoba and Thomas 2001
	Aurapten	Treatment of hypertension	Rastogi and Mehrotra 1998
	Psoralean	Antispasmodic	Hansel *et al*. 1994
	Tannin	Diarrhoea	Shoba and Thomas 2001

Roots and Bark	Fagarine	Abortifacient property	Takase *et al*. 1994, Duke *et al.* 1992
	Marmin	Antiulcer activity	Takase *et al.* 1994
Leaves	Cuminaldehyde	Antifungal, antibacterial and anticancer property	Gurjar et al., 2015; Rahman and Pravin., 2014 Maity et al., 2009

Wood apple (Thakur *et al*., 2020)

The botanical name of Wood apple is *Feronia limonia* belongs to Rutaceae family. The native of wood apple is India. The other names of wood apple are elephant apple; monkey fruit; curd fruit and kathbel. The tree is small to medium size, deciduous with thorny branches, hardy in nature and can withstand salt and drought (Troup., 1921). The fruit type is Amphisarca which is a hard shelled berry and fruit has sweet aromatic edible pulp (Meena et al., 2022). The processed products of wood apple are powder, jam, RTS, pickle, candy, preserve, squash, toffee and wine (Vidhya and Narain., 2011). The medicinal uses of wood apple fruit includes several treatments such as cardiac tonic, Sore throat, peptic ulcer, tumors, hepatitis, asthma, diarrhoea, liver problems and blood purification. Wood apple leaves are used to cure diarrhoea, dysentery, breast cancer, uterus cancer, respiratory disorders, Carminative and Hepatoprotective activity. The bark is used to cure venomous wounds, constipation, diarrhoea and Haemoorrhage (Bagul et al., 2019; Dhakar et al., 2019; Parvez & Sarker, 2021). Table 2 and 3 indicates chemical composition and pharmacological activities of wood apple.

Table 2: Chemical composition of Wood Apple (Pal *et al*., 2019; Thakur *et al.,* 2020)

Characters	**Composition**
Moisture (%)	72.00 ± 2.04
Protein (%)	7.14 ± 0.24
Fat (%)	1.45 ± 0.09
Carbohydrates (%)	7.24 ± 0.12
Ash (%)	4.98 ± 0.02
Calcium (%)	0.12 ± 0.07
Phosphorus (%)	0.07 ± 0.002

Iron (%)	1.0 ± 0.03

Table 3: Pharmacological activities of Wood Apple

Part	**Pharmacological activities**	**Reference**
Fruit	Anti- tumor activity	Saima *et al.* (2000); (Haque *et al.,* 2000)
Fruit	Anti- diabetic activity	Gupta *et al.* (2009); Priya *et al.,* 2012
Fruit pulp	Wound healing property	Senthilkumar et al., 2010; Wakchoure *et al., 2023*
Leaves	Anti- microbial activity	Bellah *et al.,* 2015; Kumar *et al.* (2010)
Seeds	Anti- microbial activity	Sonawane *et al.,* 2013
Root and bark	Hepatoprotective activity	Jain *et al.,* 2012
Fruit	Antioxidant activity	Phapale and Thakur, 2010
	Neuroprotective activity	Rakhunde *et al.* (2014)

Aonla (Diwan *et al.,* 2018)

Aonla, also known as Indian gooseberry (*Emblica officinalis* Gaertn.), is a member of the Euphorbiaceae family, revered for its medicinal properties since ancient times in India. This indigenous fruit of the Indian subcontinent is widely utilized in the Indian System of Medicine. Aonla fruits are characterized by their round shape, ribbed texture, and pale green color. The fruit's surface is shiny, divided into six segments by pale liner grooves, and varies in size from small marble to large plum. Despite its nutritional value, the raw fruit's high acidity and astringent taste make it unpalatable to consumers (Singh et al., 2019). Aonla, also known as Amla, Adiphal, Amlaki, and Nelli in various languages, is commonly grown in arid zones and saline soils. It is a major component of traditional medicines like Chyawanprash. The fruit is rich in vitamin C (600 mg/100g) and possesses various medicinal properties. Fresh fruit is used to treat dysentery, fevers, indigestion, and eye inflammation. Dried fruit acts as an astringent, stomachic, and blood purifier, beneficial for diarrhea, dysentery, and anemia. A decoction of dried fruits is effective for gonorrhea, and when combined with iron, it treats jaundice and dysentery. Aonla seeds are infused for fever, diabetes, and eye diseases, while the oil extracted from seeds treats dandruff and darkens hair. The smoke from burning seeds is inhaled to relieve asthma and bronchitis. Overall, aonla fruit and seeds offer diverse therapeutic benefits for various ailments (Kumar, 2011). Table 4 indicates the medicinal uses of aonla.

Table 4: Medicinal uses of aonla

Part	Medicinal uses	Reference
Fruit extract	Cancer treatment	Alam and Gomes, 2003
	Diabetics treatment	Suryanarayan *et al.,* 2007
	Immunomodulation	Sai, *et al*., 2002
	Memory enchancer	Vasudevan and Parle, 2007
	Cholesterol and Dyslipidemia treatment	Kim *et al*., 2005; Anila and Vijayalakshmi, 2002
	Snake venom neutralizer	Alam and Gomes, 2003
	Antimicrobial activity	Srikumar *et al*., 2007
	Antigenotoxicity	Srikumar *et al*., 2007
	Antimutagenecity	Singh *et al*., 2008

Ber

The ber tree, a thorny small tree native to India, has been cultivated since ancient times for its highly nutritious fruits, rich in vitamin C, A, and B12, with almost all parts possessing medicinal properties. The roots are bitter, cooling, and tonic, beneficial for cough, fever, wounds, and ulcers, while stem bark treats dysentery, diarrhea, and boils. Leaves are used for various ailments including stomatitis, wounds, asthma, and obesity, and boiled leaves are applied to promote suppuration in boils and abscesses. Fruits are sour, sweet, and cooling, beneficial for digestive issues, constipation, and wounds. Seeds, acrid and soporific, are used for encephalopathy, cough, and insomnia, with kernels applied as a liniment for rheumatism (Kumar, 2011). Table 5 indicates the medicinal uses of ber.

Table 5: Medicinal uses of ber

Part	Medicinal and therapeutic properties	Reference
Fruit	Anticancer property	Lee *et al*., 2003
	Antidiabetics property	Jarald *et al.*,2009
	Hepatoprotective	Dahiru *et al*., 2010
	Antimicrobial Activity	Tanvir *et al.* 2014
	Anti-inflammatory Effect	Huang *et al*., 1990
	Antispastic Effect	Huang *et al*., 1990
	Antiallergic	Su *et al*., 2000

Karonda

Karonda (Carrisa spp.) is an underutilized fruit belongs to Apocyanaceae (Wiart, 2006) which is commonly known as Christ thorn and it is an evergreen spiny shrub. The native of karonda is Indo-Malaysia. It is suitable for tropical and subtropical climate. *Carissa carandas; Carissa grandiflora; Carissa ovata; Carissa grandiflora; Carissa edulis; Carissa macrophylla; Carissa spinarum; Carissa bispinosa; Carissa diffusa* are the cultivated species of Karonda (Pareek and Sharma, 1993; Singh and Arora, 1978). Flowers are white in colour and the fruit type is berry. Flowering takes place in March-April and fruiting occurs in October-November. Unripe fruits are white in colour and ripe fruits are purplish in colour (Muhammad., 2016). Karonda is rich source of Iron (39.1%) and used to cure anaemia (Kumar et al., 2007; Saha et al., 2010). It is also used to cure malaria, head ache, cold, cough, leprosy, nervous disorders and myopatic spasms (Hasmah., 2013). Karonda is sexually propagated by seeds and asexual propagation through cuttings, air layering and inarching. The value-added products prepared from karonda are curries, condiments, jam, syrup and squash. Fruits contain high amount of pectin and is suitable for jelly making (Kumar et al., 2007). The varieties of karonda include Pant Manohar, Pant Suvarna and Pant Sudarshan released by GBPUA&T, Pantnagar; Thar Komal released by CIAH, Ghodhra (Singh *et al*., 2013); Maru Gaurav released by ICAR-CAZRI, Jodhpur (Singh & Nigam., 2022). Table 6 & 7 indicates the medicinal properties of karonda and extraction methods.

Table 6: Medicinal properties of karonda

Parts of Karonda	**Bio active compounds**	**Medicinal properties and therapeutic properties**	**Reference**
Root	Carrissone and caridone	Antibacterial property	Lindsay et al., 2000 *Panda et al.,* 2014
	Urosolic acid and methyl ester	Anticancer activity and cardioprotective compund	Liobikas et al., 2011; Pathak et al., 2007; Shishodia et al., 2003 *Panda et al.,* 2014
Leaf	Oleanolic acid	Anti-inflammatory and anti hyperlipidemic property	Liu, 1995, *Panda et al.,* 2014

Wood and bark	Carindone	Antibacterial activity	Lindsay et al., 2000
Fruit	Linalool	Antimicrobial effect	Park et al., 2012
	Coumarin	Anti-HIC, Anti-tumor, Anti-hypertension and Anti-inflammatory	Pino et al., 2004; Singh and Rastogi,1972; Reisch et al., 1990, Liu, 2011, Pal et al., 1975;

Table 7: Extraction methods of bioactive compounds in karonda (Muhammad Arif *et al., 2016)*

Part used	**Bio active compounds extraction method**	**Medicinal property**	**Reference**
Karonda leaves	Methanolic extraction	Anti- inflammatory and anti-pyretic	Hati et al., 2014; Anupama et al., 2014
Fruit	Chloroform, n- hexane and methanol	Anti- cancer property	Sulaiman., 2014
Fruit	Solvent petroleum ether extract	Anthelmintic activity	Mishra., 2012
Fruits	Ethanolic extract	Antiviral activity and antimicrobial activity	Taylor., 1996
Leaves	Aqueous extract	Anti- diabetic property	Jigna et al., 2005
Roots	Ethanolic extract	Hepatoprotective activity and cardiovascular activity	Hedge and Joshi., 2009
Leaf, stem, bark and fruits	Methanolic and aqueous extract	Anti- malarial activity	Bapna et al., 2013

Conclusion

In summary, the fruits bael, woodapple, aonla, ber, and karonda epitomize nature's wealth, offering a diverse range of nutraceutical value and therapeutic applications. Their extensive nutritional composition and bioactive constituents, such as phenolics, flavonoids, and alkaloids, underscore their profound significance in preventive and holistic healthcare. As ongoing scientific investigations continue to unveil their latent potentials, integrating these fruits into dietary and wellness practices holds promise for fostering robust health and vitality. Embracing and harnessing the nutraceutical and therapeutic attributes of these fruits can significantly contribute to the advancement of comprehensive health and well-being on both individual and societal scales.

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