

Nutraceutical Properties of Mulberry Fruits

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Introduction

Mulberry is cultivated in an area of 2,39,000 hectares in India and distributed in Jammu and Kashmir, Uttar Pradesh, Karnataka, Tamil Nadu, West Bengal and Kerala. It belongs to the family Moraceae and the genus *Morus* and is native of Eastern and Central China. In India, there are many species of *Morus* includes *Morus alba*, *M. indica*, *M. serrata* and *M. laevigata* and most of the Indian varieties of mulberry belong to *M. indica*.

Mulberry is a multipurpose tree and has huge potential economic value owing to its several unique and special features. Apart from being the sole food plant of mulberry silkworm (*Bombyx mori*), it can also be utilized for catering diversified needs such as food, fodder, fuel and fibre. Mostly in mulberry growing countries, mulberry fruit is commonly eaten fresh, dried, or processed into wine, fruit juice, and jam for its delicious taste, pleasing colour, low calorie content, and high nutrient content.

Mulberry fruit is an aggregate fruit composed of many smaller fruits called drupes. The skin of the fruit is smooth and fragile, and its colour changes as it matures. Fruits of different mulberry species are long, ovoid or cylindrical which are variable in colour like white, lavender, pink or purple and deep red to black. The colour of the fruit does not identify the species. *Morus alba* (white mulberry) produce white, lavender or black fruits which are usually deep red, almost black and its best clones have a flavour that equals that of the black mulberry. *M. nigra* (black mulberry) fruits are large and juicy with a good balance of sweetness and tartness that make them the best flavoured species of mulberry. In south India, fruits are observed in two seasons in a year during October to November and March to May. However, whenever mulberry is pruned, flowering takes place with sprouting of axillary buds and followed by fruit formation.



Variation in Colour and Shape of Mulberry fruits

Fruit Composition

Fruits are white to pinkish white, purple or dark purple to black in colour. The nutritive value and composition may vary with varieties of mulberry.

Constituents	Content (%)
Water	85 - 88
Carbohydrate (Sugars, mainly glucose & fructose)	7.8 – 9.2
Protein	0.4 – 1.5
Fat (mainly fatty acids, such as linoleic, stearic and oleic acids in the seeds)	0.4 – 0.5
Free acids (mainly malic acid)	1.1 – 1.9
Fibre	0.9 – 1.4
Minerals	0.7 – 0.9



Stages of mulberry fruits

Nutraceuticals

The consumption of mulberry fruit contributes for the improvement of human health as they are a rich source of nutraceuticals including amino acids, carbohydrates, fats, vitamins, minerals and phytochemicals. Nutraceuticals present in the mulberry fruits can treat many chronic diseases.

Amino acids

Mulberries contain non-essential amino acids, namely, alanine, arginine, aspartic acid, glutamic acid, glycine, proline, serine, and essential amino acids (EAA) namely isoleucine, leucine, lysine, methionine, cysteine, phenylalanine, tyrosine, threonine, tryptophan, valine, and histidine. Amino acids such as morusimic acid A, morusimic acid B, morusimic acid C, morusimic acid D, morusimic acid are present in white mulberry.

Carbohydrates

One cup of mulberries fruit contains 14 g of total carbohydrates. Of those carbohydrates 83 per cent are sugars and the other 17 per cent are dietary fibre. Carbohydrates (monosaccharide: fructose and glucose) and adequate amount of total phenolic content is present in mulberry fruits and it is suggested that mulberry fruits can be used as dietary food due to the presence of polysaccharide called insulin. The percentage of the sugar composition of black (*M. nigra*) and red mulberries (*M. rubra*) were detected as 52 % of glucose followed by 48 % fructose.

Fat

One serving of mulberries contains less than one gram of fats. The predominant fat in that one gram is polyunsaturated fatty acids, followed by monounsaturated and saturated fatty acids. Mulberry naturally contains no cholesterol and no trans fats. Eighteen types of unsaturated fatty acids including linoleic acid and few saturated fatty acids such as palmitic acid (C18:2n6), myristic acid, stearic acid have been reported in mulberry fruits.

Vitamins and minerals

Mulberry fruits are rich source of Vitamins such as A, C, E and K, electrolytes being sodium and potassium. They also contain moderate amounts of vitamin E, vitamin K, vitamin A and vitamin B2. These fruits are also low in vitamin B3, folate or vitamin B9, vitamins B6 and B1. Mulberries completely lack vitamin D, B12 and the folic form of vitamin B9.

It is also rich in minerals like calcium and iron. They contain moderate to low levels of potassium, magnesium, copper, phosphorus, choline, selenium and zinc.

Phytochemicals

Mulberries are rich in phytochemicals, such as alkaloids, polyphenols, flavonoids and anthocyanins which play a major role in beneficial effects on human health. Kang and co-workers isolated cyanidin-3-O- β -D-glucopyranoside (C3G) from 1 %HCl-MeOH mulberry fruit extracts using Amberlite IRC-50 ion exchange chromatography. Isabelle and co-workers reported the presence of 3-caffeoyl quinic acid, 5-caffeoyl quinic acid, cyanidin-3-glucoside, 4-caffeoyl quinic acid, cyanidin-3-rutinoside, pelargonidin-3-glucoside, rutin, quercetin and kaempferol-3-rutinoside in the Chinese mulberry fruit cultivar Guo-2. Mature fruits are rich in anthocyanins, which are excellent antioxidant agents with stronger free radical scavenging activity than vitamin C. Anthocyanins are responsible for the attractive colours of fresh plant foods, including orange, red, purple, black, and blue. These colours are water-soluble and easily extractable, yielding natural food colorants. Anthocyanins from mulberry fruit could be used as a fabric dye or food colorant of high colour value (above 100).

The high phenol present in black mulberry fruit (*Morus nigra* L), attributes great potential for antibacterial and antioxidant activity. Krishna and co-workers investigated the phytochemical and antioxidant activity of mulberry species. The ascorbic acid content varied from 6.8 to 27.1 mg 100 g⁻¹, total polyphenols from 0.51 to 1.58 mg g⁻¹, total flavonoids from 0.37 to 1.26 mg g⁻¹ and O-dihydric phenol from 0.14 to 0.33 mg g⁻¹ fresh weight. High levels of antioxidants are present in a mulberry which acts as an excellent source to fight against infection.

Nutritional benefits of mulberry fruits

Mulberry fruit is used to treat weakness, dizziness, tinnitus, fatigue, anaemia, sore throat, depression and urinary incontinence. Fruit juices are able to slow down the reducing the risk of bone fragility due to high calcium content, promoting the metabolism of alcohol, and immunity enrichment. For women who are experiencing symptoms such as anaemia, paleness, nausea especially after childbirth, may take mulberry juice regularly to reduce symptoms. It can also help irregular menstrual periods and also reduce pain during menstruation.

Conclusion

Mulberry is a multipurpose tree and has huge potential economic value owing to its several unique and special features. Nutraceuticals present in the mulberry fruits includes amino acids, carbohydrates, fats, vitamins, minerals and phytochemicals give many health benefits fight against many chronic diseases. This tremendous bioactivity of mulberry fruit extract may open up a new dimension in the food and medicine industry.

