



MULBERRY-THE TREASURE TREE



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Mulberry belongs to the *Morus* genus of the Moraceae family. So far, 24 species and 100 varieties have been identified under this genus. Mulberry is native to China and has been cultivated widely in Asia, Africa, America and Europe in tropical to temperate regions with diverse topographical and meteorological conditions. Mulberry is a multipurpose fast growing tree species which grows faster compared to other woody plants. It is one of the earliest woody plants under cultivation. Traditionally, mulberry was planted for raising silkworms, making agricultural tools and later on, for making sports goods. Apart from these earlier uses, mulberry has gained an eco-economic importance due to its nutraceutical values, fodder and forage uses and ecological services.

Food and Medicine

Fruits and vegetables are essential components of a healthy human diet. They provide essential nutrients, such as vitamins, fibers, minerals, and have many health benefits. Based on nutraceutical values, mulberry tea is considered as a health food. A special edible carbon is made by carbonization of mulberry root and stem. The edible carbon is used widely as food additive. The baked or fried mulberry tea powder is rich in protein and carbohydrates having distinctive fragrance. The tea powder is used as food additive in steam bun, bread, cake, biscuit, etc. Mulberry fruit is listed as third generation fruit. The fresh fruit is used for making jams, marmalades, squashes, juices, vinegar and beverage (mulberry wine).

Mulberry has been used as herbal medicine from ancient times, specifically in Chinese Medicine. According to the old Chinese Pharmacopeia the mulberry fruit has beneficial effects on kidney (nephritis- inflammation of the kidneys), liver, blood and constipation. It gives relief against rheumatism and promotes saliva generation and consequently reduces thirst. The root bark has been used as an herbal medicine due to its properties to reduce high blood pressure. Moreover, the root bark is used as purgative and vermifuge (an anthelmintic medicine) and febrifuge (a medicine used to reduce fever). The bark is also effective against pneumonia and hemoptysis (airway bleeding). The roots are used as an astringent too. The milky root latex is plastered on sores and used also in dermal creams. Different parts of mulberry are also used to prepare different cosmetic products.

The mulberry leaf tea is used for hyperlipidemia and diabetes. Crude protein in mulberry leaf tea contains 17 amino acids among which 15 are essential for human body. Moreover, the tea contains carbohydrates, fat, vitamins, chlorophyll and rutin. These compounds are readily absorbed by human body. The dry leaf tea is rich in gamma (γ)-aminobutyric acid. On an average γ -aminobutyric acid of 266 mg/100 g dry matter is found in mulberry leaf that is about 10 times higher compared to green tea. The γ -aminobutyric acid lowers the blood pressure and help in the nerve transmission. The tea is also rich in alanine which is very effective against hangover. This is helpful in calming liver, improving eyesight and evacuating wind heat. The leaves also contain abundant deoxynojirimycin. Deoxynojirimycin is said to lower the blood-sugar level closely related to diabetes. Leaf decoction is used as a gargle to get relief from throat inflammation. The mulberry leaf has diaphoretic (having power to increase sweating) and emollient (moisturizer) effects. The mulberry twigs are used in special skin care creams.

The drying of mulberry leaf for making tea is very simple. Mature healthy leaves are plucked in the morning or late afternoon. The leaves are washed and dried under shadow. Then leaves are chopped, steamed and rubbed gently. The steamed leaves are baked, dried again and sieved. The dried leaves can be stored at room temperature. The mulberry leaf tea is prepared just like green tea.

Mulberry flowers in February-March and fruit ripens in April-May. Mulberry fruit is appetizing and low in calories. Mulberry fruit, especial the black mulberry (*M. nigra*), has a sour taste with a pH < 3.5. In Pakistan, the fruit is dried both for domestic and commercial purposes in Astore, Chitral, Gilgit, Hunza, Shigar, Skardu, etc. The fresh fruit (Soros-traditional fruit) consists primarily of water contents (80-85%), invert sugar (\approx 9.19%), free acid (1.86%), protein (1.44%), crude fibre (0.91%) and ash (0.66%). The fruit is also rich in carotene (photosynthetic pigments without oxygen atoms that absorb ultraviolet, violet, and blue light and scatter orange or red light). They scatter yellow light in case of low concentration. The main sugar content is glucose. The dry fruit, on an average, contains about 12% sugar contents, while in some varieties fruit contains >20% sugar contents. The main free acid is malic acid. Fresh fruit contains 16 amino acids out of which seven belong to essential amino acids group, vitamins (A, B, C, E & K) and minerals such as calcium, iron, magnesium, potassium, sodium and zinc. Vitamin B₁, B₂, B₃ (niacin) and vitamin C in mulberry fruit are relatively greater compared to apple. The fruit also contains pectin and cellulose. Niacin (nicotinic acid) reduces amount of 'bad' cholesterol and triglycerides made by the liver. The mulberry seed contains fatty oil ranging from 25% to 32%. The fatty acid comprised primarily linoleic acid and oleic acid which are essential for human body. The pure fruit juice can be kept fresh, without adding preservatives, for three months under cold storage. The mulberry beverage can be kept fresh under room temperature for 12 months.

The mulberry fruit is helpful to increase macrophage and phagocytic coefficients. The fruit promotes transformation of lymphocytes and improves T-cell mediated immune function. It helps in the growth of hematopoietic cells. The fruit is used to treat inflammation, tumor, ulcer, filariasis and spasmodic. The fruit is also used for delaying aging effect, preventing premature white hair and obesity effects. Recently it is found that mulberry fruit has a strong antioxidant property which is due primarily to the presence of polyphenols including anthocyanins. The major polyphenols found in mulberry fruit are: anthocyanins, benzoic acids, flavonoids, flavonols and hydroxycinnamic acids. Cyanidin-3-rutinoside and cyanidin-3-glucoside are the major anthocyanins isolated from mulberry fruit. The mulberry fruit contains also resveratrol that stops growth of cancerous cells, check cell mutation and releases hydrolases from lysosomes to disassemble cancerous cells. The syrup made of the black mulberry fruit is an effective remedy against sore throat. Mulberry fruit is also a good laxative.

Mulberry fruit can be dried as a whole. A solution of Potassium Metabisulphate (PMS) also known as Potassium Pyrosulphite is prepared by dissolving about 3-4 g PMS in one litre clean water. The ripened fruit is picked manually from trees and tied in muslin cloth. The cloth along with fruit is dipped in PMS solution for one minute. The sterilized fruit is placed in trays and dried in the Sun. The dried fruit is graded according to size and packed in polythene bags.

Fodder and Forage

Mulberry leaf, on dry matter basis, contains about 17 to 28% crude proteins, 58-60% carbohydrates including 25% soluble carbohydrates, 6.0% crude fats, 10 to 16% minerals and

up to 25% ash. The composition of macronutrients varies with the mulberry variety, age of the leaf and growing conditions. On an average, one acre mulberry plantation produces about 3.4-4.9 tons of dry mulberry leaves. Thus one acre of mulberry produces about 0.67 ton proteins which is equivalent to protein contents of 1.20 ton soybean. Similarly, 100 g dry mulberry leaf contain about 2.7 g calcium and 3.1 g potassium which is greater than the calcium content in the same mass of red shrimp or fish powder. The mulberry leaf also carries 0.47-0.63% magnesium and 0.14-0.24% phosphorus. The young shoots of mulberry contain 0.26-0.35% magnesium and 1.33-1.53% potassium by mass. The mulberry leaf also contains flavonoid, flavonoid glycosides, steroids and volatile components. These components are essential for developing immunity against diseases in livestock and poultry.

Mulberry leaf is nutritionally rich forage for livestock and poultry. The potential of mulberry as high quality fodder and forage plant was discovered by chance in Latin America. A Chinese origin farmer of silkworm in Costa Rica fed mulberry leaves to goats and got fascinated by its palatability, nutritional value and considerable improvement in body weight of the animals.

Nutritional composition of mulberry is close to the alfalfa (*Medicago sativa*). The mulberry leaves are more nutritive in terms of crude protein, fat, fibre, nitrogen free extract and calcium contents as compared to fresh corn stalk, corn silage, the Black Locust (*Robinia pseudoacacia*) and Poplar (*Populus* spp.). Similarly, the nutritional value of mulberry leaves is about 80% greater than that of grasses and 40-50% greater as compared to leguminous pastures. The carrying capacity of one hectare mulberry plantation is 25-35 sheep units which is comparable to any well managed rangeland.

One of the main features of mulberry as forage is its high palatability. Livestock have digestion rate of 70-80% of palatability of mulberry leaf. The total digestibility of the mulberry leaf is at par to the most of tropical forages. Small ruminants browse preferably fresh leaves followed by the young shoots even if they have not experienced them earlier. Cattle eat the whole foliage if chopped finely. Mulberry leaves are fed as food supplement to milking cows to increase the milk production. The dry mulberry leaf powder at the rate of 5-10%, 10-15% and 25-30% for chicken, rabbits and cows, respectively give good results. Integrated models have been developed to rear silkworms, poultry and livestock on mulberry.

Ecological Services

In recent past with increasing awareness about ecological deterioration and subsequent implications, role of mulberry plantations has been realized greater than traditional uses. Mulberry has a strong tangled root network (strong vertical and profuse horizontal roots) which is very helpful to stabilize soil and conserve water. It has been found that the mulberry plantation increases aggregation degree and status of top soil by about 25% and 50%, respectively compared to other forest tree species. Mulberry root system also decreases dispersion rate and soil erosion, and increases water stability index when planted on sloppy lands. Mulberry is also useful for controlling desertification and saline-land management. Moreover, it has a good potential for carbon sequestration and mitigating global warming. One hectare of mulberry plantation absorbs about 63 ton Carbon dioxide (CO₂) (equivalent to 17.2 ton of Carbon) and releases about 46 tons of Oxygen in a year. Likewise, one cubic meter mulberry plantation can absorb about 20 ml Sulfur dioxide (SO₂) per day. It has a high resistance against Chlorine pollution. The absorption of CO₂, SO₂ and resistance against Chlorine makes mulberry an ecological tree species. Mulberry is an ideal tree for city landscape due to its beautiful tree form, leaf colour, leaf shape, growth, and tenacity. The

dense crown type canopy and broad leaves of mulberry stabilize microclimate, such as reducing wind speed and temperature, and increasing air humidity.

Mulberry Wood

The mulberry wood is fine, close grained, heavy, tough and moderately durable. The specific wood density of mulberry is 0.69 and a calorific value of 5,100 kcal/kg. The mulberry wood is multi-purpose. The wood is used to manufacture furniture and sports goods (especially tennis rackets and hockey sticks), house building, wall paneling, toys, tea chest, stocks, panels, spokes, poles, stews, shafts of carriages and casts. The wood is also suitable for making plywood and carving. The straight mulberry logs are used as support in shuttering. Mulberry branches are used for weaving baskets and making fine quality paper. The wood of *M. serrata* is especially used for making cabinet-work and carving. It is also used for making boats, turnery, to some extent making buggy shafts, carriages, veneer and plywood. Recombined wood boards and bars made of mulberry branches have several uses including: making floor boards, door jambs, architectural models of buildings, furniture, etc. Mulberry is an excellent raw material for paper manufacturing. One hectare of mulberry plantation yields approximately 12.3 ton of dry mulberry shoots. This biomass can generate about 62,730 Kcal/ha. Moreover, the stem and branches are used as medium for growing mushrooms. The dry stem contains 50, 20, 20 and five percent cellulose, semi-cellulose, lignin and crude protein, respectively. The ratio between carbon and nitrogen is 86:1 which is suitable for culturing mushrooms. The stem powder of mulberry is used for producing mushrooms like Jew's ear (*Auricularia auricular-judae*) and medicinal fungus (*Ganoderma lucidum*), in China. Thus the multifarious economic uses of mulberry warrants its large scale plantation under different horticulture and forestry programmes.

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