

# Mulberry and its waste utilization an important socio-economic status in sericulture

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## ABSTRACT

Mulberry plant is an extremely versatile plant that can fulfill a number of roles in smallholder agricultural production. Mulberry has been used as silkworm feed also in traditional oriental medicine as a anti-oxidative, anti-inflammatory, anti-cancer, anti-diabetic, anti-obesity and also to treat cardiovascular problems. Mulberry fruits are used as a foodstuff to enhance the cattle milk production. Mulberry stem and root barks can be used in the paper making industry. Dried wastes of mulberry are utilized in poultry rations which improve the nutritional content *i.e.*, vitamin A, finally increasing their egg production. Mulberry wastes such as stem, leaves, branches etc. are used in biofuel and biogas production which can inflates a notable avenue to seri-farmers. Its high thickness stems are applied in manufacturing of hockey sticks and various agricultural implements. Their biomass waste is an valuable raw material for the pharmaceutical industry due to its high flavones and phenol content. Hence whole mulberry plant have a specific value and if proper utilization of such raw material takes place it can open new vista in industrial exploitation which may help to uplift standard of living and socio- economic status of seri-farmers.

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## INTRODUCTION

Adoption of package of cultivation practices for raising of mulberry plants is known as Moriculture, which is a soul cuisine to silkworms for its natural fibre production. There are over 20 species of mulberry of which four are common *i.e.*, *Morus alba*, *M. indica*, *M. serrata* and *M. latifolia*. Central Sericultural Germplasm Resources Centre is actively involved in

conservation and strengthening of mulberry germplasm in India as 1,109 diverse accessions including 845 indigenous and 264 exotic accessions have been conserved (Khurana and Checker, 2011). In a present scenario of moriculture, it is estimated that 20,000 to 25,000 kg of leaves can be harvested per hectare per year under optimum conditions. In India about 350-400 kg of leaves are required to rear 20,000 eggs which finally produces natural silk fibre. It shows an empirical evidence

in obtaining phytotechnology of some products with higher commercial value being part of natural silk production system.

Mulberry trees can flourish in deep, porous, and fertile soil and also grow in barren soil with poor nutrients (Han, 2007). Mulberry trees are anti-erosive which prevents soil erosion as per studies conducted by Shi *et al.* (2005). As well as has the potential to remediate heavy metals like Pb, Cadmium etc. in contaminated soils (Zhou, *et al.*, 2015). Mulberry is a fast growing perennial woody plant rich in cellulose (57.45%), hemicellulose (16.3%), and lignin (24.6%) as per studies of Sharma and Madan (1994). The plants of mulberry utilized for Phyto-regenerable activity, Phyto-pharmaceutical, Agro-alimentary production are some aspects on which abundant research are going on now-a-days.

Mulberry trees are good carbon sink plants *i.e.*, 1 $\mu$ m and are able to absorb about 4162 kg of CO<sub>2</sub> and release 3064 kg of O<sub>2</sub> in each year. They also have high absorption capacity to assimilate certain air pollutants like chlorine, hydrogen, fluoride and sulphur dioxide etc. (Ghosh *et al.*, 2017). Mulberry plants are useful in extraction of chemical “flavonics” a component used against as a anti-cancer action (Zhang *et al.*, 2009). Mulberry latex applied as a good target for pesticides because of its toxic nature and defensive mechanism against herbivory (Iyengar, 2007b).

Being an Entomologist and working in the field of mulberry sericulture since last 10 years always was astonished when I got closely related with mulberry plant. It created more interest to know different parameters and resources about mulberry plant which can help to enhance the socio-economic status of sericulturists. Due to which with the help of few mulberry sericulture module students of Ratnai College of Agriculture, Akulj started researching about the utilization of mulberry plant leaving apart its major importance as silkworm feed. When we went in the depth of our studies amazing works were known which highlighted that all the mulberry plants parts such as leaves, stems, barks, roots, fruits alongwith its wastes if been utilized in proper way can surely be an primitive helping hand for increasing extra employment and economic for sericulturists. After this research we truly came to know why mulberry plant is known as “Kalpavruksh”. From our studies we have tried to highlight certain unseen utilizations and resources about mulberry plant which are prescribed below:

### Utilization of mulberry leaves:

The leaves of mulberry are rich in proteins, carbohydrates, sugars, starch, crude fibre, amino acids, vitamin A, B and C, minerals like Ca, Mg, Fe, Zn been ample for human nutrition and hence offered as juice a common hospitality in the villages of China (Angadi, *et al.*, 2013). Also mulberry leaves had less caffeine which lowers blood pressure. So, in India Central Sericulture Research and Training Institute, Central Silk Board, Mysore was licensed to produce mulberry tea “SPOORTHI” (Iyengar, 2007a). Also finding of deoxynojirimycin present in mulberry leaf inhibits the enzymatic property of sugar breaking which can be used to control AIDS and also provide viable treatment for Alzheimers disease as showed by Suryanarayan (2002). Mulberry leaves having protein source and neuro protective functions can be used against neuro degenerative disorders such as Alzheimers and Parkinson (Buhroo *et al.*, 2018).

A new galactose binding lectin was also purified from *Morus alba* leaves with cytotoxic activity on human breast cancer (IC<sub>50</sub> – 8.5 $\mu$ g) and colon cancer cells (IC<sub>50</sub> – 16  $\mu$ g) as per the work of Deepa and Priya (2012). Mulberry leaf juice can be used as febrifuge in curing diarrhoea, cold, endemic malaria and amoebiasis (Venkatesh and Chauhan, 2008). Mulberry leaves owing to their high carotene content can form a valuable source of vitamin A for the health of poultry birds and increase their egg production (Buhroo *et al.*, 2018). Mulberry leaves are relished by sheep and goats have a high nutritive value with a protein content of about 20% of DM (FAO, 1998). The degeneration of biogas showed that potential biogas production in young mulberry leaves was 60.6 ml/ 200 mg while the rate of degradation was 0.0703 similarly in mature leaves were 35.4 ml and 0.0624, respectively (Tanase *et al.*, 2008).

### Utilization of stem, twigs/branches of mulberry tree:

Mulberry twig branches and wood stem are applied in cosmetics for hair lotions, skin moisture products, wood processing for furniture; as fuel in the food industry; for natural colouring or dye, alcohol ennobling and in the paper industry with textile industry for making So, called “Artificial Cotton”. High thickness of mulberry stems are used for preparation pens as well as fuel wood in rural areas alongwith antiseptic properties and also used for making sports goods, agricultural implements,

furniture and household articles. Mulberry wood owing to its strength, elasticity, flexibility and durability are used in preparation of hockey sticks, tennis, badminton, and squash rackets along with low grade plywood for carving, turnery and also for construction of small boats and large ships (Buhroo *et al.*, 2018).

In China and Europe digested and bleached bark of mulberry used to extract a soft and white fibre which is used in textile industries as well as young and small pruned branches used in paper industries respectively (Angadi *et al.*, 2013). Extraction of cotton like fibres from mulberry shoots of phloem applied as a supplementary for making ropes and nets (Angadi *et al.*, 2018). Also tannin extraction from mulberry wood is considered for tanning and colouring purpose (Singhal, *et al.*, 2001). The phytochemical investigation of mulberry stem bark led to the isolation and identification of cathayanin and various cathayanons (Ni *et al.*, 2010). The aggregates of sugar, phytosterols, cheryl fatty acids and phosphoric acids of stem bark used as parzitive and hermitage.

#### Utilization of mulberry root bark:

Mulberry root system efficiently improve shear strength of purple soil and inflates anti-erosion capacity of soil (Nan *et al.*, 2011). Root system of mulberry absorb soil nutrients to certain extent along with certain heavy metals like Pb, Cd, Cu (Jothimani *et al.*, 2018). Root bark of *Morus alba* contain isolated glycosides, 5-2'- dihydroxi flavanone-7, 4'-di-o-D-Glucose prevents proliferation of human ovarian cancer cell HO-8910 (Zhang *et al.*, 2009). The root bark of *Morus alba* contain sanggenon alkaloid which inhibited plaque formation along with one drug named "Glucosidase" which is used in high blood pressure (Buhroo *et al.*, 2018). The root bark of *Morus* spp used to treat cough, wheezing, edema and to promote urination as well as in traditional medicine in Asian countries which exhibits antibacterial activity against food poisoning micro-organisms (Shaikh, *et al.*, 2012).

Albanol A isolated from root bark of *Morus alba* induced potent cytotoxicity (IC<sub>50</sub> 1.7 µg) in HL<sub>60</sub> (*Human leukaemia*) by inhibiting topoisomerase- II and activity (IC<sub>50</sub> 22.8 µg) (Priya, 2012). The cudraflavone B found in large amounts in the mulberry roots inhibit activity of inflammatory mediators. Morusinal extracted from *Morus alba* root bark inhibited collagen and

arachidonic acid induce platlet aggregation which effectively inhibits arterial thrombosis and exerts beneficial effects on transient stroke (Lee *et al.*, 2012). Moracin, a novel compound extracted assessed through use of hydrogen peroxide induced stress in skin fibroblast cell (AH927) as studied by Khayade *et al.* (2018). The ethanolic extract from the bark displayed activity against HIV which contains flavanoids like morusin, mulberrofuran D, G, K and kuwanon G, H, of which morusin and kuwanon H showed positive activity against HIV (Shi *et al.*, 2001). The mulberry root juice has catharatic property which can kill roundworm, tapeworms, and hook worms (Ramesh *et al.*, 2003).

#### Utilization of mulberry fruits :

Mulberry fruits are commonly used in preparation of jams, jellies, ice-creams, fruit tea, in cosmetic and medicinal industries for curing liver-kidney deficiency, ringing in ears, dizziness, rheumatic pain, premature grey hair, constipation, diabetes etc. A synthetic food colours are unsafe and dangerous to general health. The mulberry fruits can produce nearly fifteen tons of mulberry drink and red or purple coloured anthocyanins used as coloring and flavouring agents (Malsiamani *et al.*, 2008). Over ripened and sour fruits can be converted into mulberry wine hence said that a glass of mulberry wine a day helps to get rid the impurities, reduces cholesterol creates slim with graceful human bodylines which enhances general health (Sinha, 2008). The fruit of *Morus nigra* are one of the constituent of unani medicine named "Tut-i-aswad" which is said to be used against cancer (Ahmed *et al.*, 1985). Mulberry plants useful in extraction of chemical "flavanics" a component used against as a anti-cancer action (Zhang *et al.*, 2009).

Mulberry fruits have major polyphenol competition such as flavanois, anthocyanins, flavanoids, benzoic acid, hydroxycinnamic acid, showing potential for anti-diabetic, anti-oxidative and anti-obesity effects (Yang *et al.*, 2016). Dried mulberry fruits can be used as a fruit powder containing resveratrol inhibits the mutation of healthy normal cells into cancerous cells which prevents chronic heart disease, inflammation etc. (Hou, 2003). Mulberry fruit juice has a anti-aging property and contain dietary fibre provides 10% of your daily requirements in a single serving (Rutuja *et al.*, 2019). Mulberry wastes as fruits, A new UK fruit juice company "Fair Juice" launched a super fruit drink from mulberry fruits as a source of

resveratrol beneficial to heart health and anti-obesic juice (Fairjuice, 2008). Mulberry fruits seed extracted oil is useful in ayurvedic medicine and its fruit juice used as natural alcoholic extract additive for food and pharmaceutical industries. Habib (2004) has reported that a multi nutrient feed block prepared from mulberry fruits has increased milk production from 30 per cent to 50 per cent in livestock with low disease incidence.

### **Mulberry waste utilization:**

Mulberry wastes serves as a secondary proponent which inflates generating a great revenue to seri-farmers. Present days in the world several corporate industries aimed to collect mulberry wastes from seri-farmers and utilized for commercial production of by products. It is estimated that 15MT of wastes (including both the rearing and other farm waste) is generated from one hectare of mulberry farm annually (Ghosh *et al.*, 2017). Mulberry waste such as stem, leaves, branches used as a biofuel and biogas production which helps as a income to seri-farmers. Mulberry waste can be applied in vermi-compost preparation and been an ideal substrate in bioprocess through micro-organism for extraction of industrial enzymes like proteases, lipases, glycosidase, glucose isomerase, top-isomerase and invertase (Angadi, *et al.*, 2013). It acts as an alternative source to feed cattle enhancing milk yield. Hence popularly saying “Silk and Milk” which creates complementary relationship between sericulture and livestock (Bharathi, 2019). Also acts as a stimulant for lactation in the cattle (Singhal *et al.*, 2001). The heat potential of mulberry wastes (branches) is much superior over other agricultural residues and tree species indicating the scope of its exploitation as fuel wood.

The mulberry wood ash reported effective against Nuclear polyhedrovirus, flacherie disease and denonucleosis with its stable alkaline effect (Kumar *et al.*, 2000). Mulberry sticks can be used as fences or woven into baskets and silkworm rearing trays which results a avenue to seri-farmers. Mulberry wastes widely applied in pharmacological industry which generates a avenue in medicinal industries also pulp extracted from unused mulberry material is of great use in paper industries while the mulberry bark is used in artificial leather preparation (Ramesh *et al.*, 2005).

### **Socio-economic status of mulberry plants and their**

### **waste:**

Mulberry has the potential to play a valuable role in the world of agriculture as well as sericulture. It is an extremely versatile plant that can fulfill a number of roles in small holder agriculture production and contribute to socio-economic status (Buhroo *et al.*, 2018). Mulberry has been cultivated in many countries for a long time with the sole purpose of feeding the monophagous silkworm. In addition to the major utilization of mulberry leaves as silkworm feed, it is being used for many other purposes. Moriculture play main role in economy of small land holder farmer and tribal areas. Not only plant but also their waste contribute in socio-economic status. Their input cost is less and one batch of mulberry plant gives approximate fifteen to twenty years income hence minimizing every year planting input cost of seri-farmers. That way helps the sericulture farmer to generate secondary revenue which can enhance their socio-economic status.

Mulberry leaves has distinct role *i.e.*, in preparing tea, source as feed for silkworm, in animal feed, in making juice and in preparation of medicine as mentioned by Ghosh *et al.* (2017). Also Bharathi (2019) stated that mulberry stem is white in colour, soft, pliable. It has great demand in the manufacture of sports good, agricultural implements and also used as fuel. Automatically it serve as a raw material for many industries and help in upliftment of socio- economic status of country. Family income is the most vital indicator for economic growth and development of country.

In the same way Buhroo (2018) stated that mulberry root contain many substances which act as medicine and have pharmaceutical activity and also the remaining left over material of mulberry leaves are used in biogas production. Ghosh *et al.* (2017) mentioned that it is also used to make vermi-compost as a valuable product. Hence in this way the whole mulberry is an extraordinary multipurpose plant which acts like backbone and contribute in many way to uplift the socio-economic status of rural people in our country.

### **Conclusion:**

The major constraints of utilizing mulberry and its waste into by products is due to lack of traditional and experienced knowledge. Also insufficient research made on the subject as an alternative constraint for utilizing mulberry wastes into by products is another important

lacuna which should be worked so that it may help the sericulture farmers to generate secondary revenue which may enhance their socio-economic status.

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