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VALUE ADDITION OF MULBERRY (*Morus spp*)

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Abstract: Mulberry belongs to the genus *Morus*, of family Moraceae. It is reported that mulberry consists of more than 20 species and several subspecies or varieties. Mulberry has been cultivated in many countries for a very long time with the sole purpose of feeding the monophagous silkworm *Bombyx mori* L. In addition to the major utilization of mulberry leaves as silkworm feed, it is being used for many other purposes, for which it is called as Kalpavriksha. The modern interest on the cultivation and use of mulberry for animal feed and medicinal uses has been started due to search for alternative uses of mulberry once the sericulture decayed due to competition from foreign countries in case of Japan and Italy (Machii 2000, Cappellozza 2000). In addition to the major utilization of leaves as silkworm feed, they have many excellent and beneficial functions to do. This has opened a new vista to think about other uses of mulberry apart from silkworm feed. The other uses of mulberry in addition to the utilization of leaves as silkworm feed are discussed in the paper.

Key words: Mulberry, Sericulture, Silkworm, Other uses

I. INTRODUCTION

Mulberry belongs to the genus *Morus*, of family Moraceae. It is reported that mulberry consists of more than 20 species and several subspecies or varieties. Mulberry has been cultivated in many countries for a very long time with the sole purpose of feeding the monophagous silkworm *Bombyx mori* L. In addition to the major utilization of mulberry leaves as silkworm feed, it is being used for many other purposes, for which it is called as **Kalpavriksha**. The modern interest on the cultivation and use of mulberry for animal feed and medicinal uses has been started due to search for alternative uses of mulberry once the sericulture decayed due to competition from foreign countries in case of Japan and Italy (Machii 2000, Cappellozza 2000). In addition to the major utilization of leaves as silkworm feed, they have many excellent and beneficial functions to do. This has opened a new vista to think about other uses of mulberry apart from silkworm feed

A. MULBERRY AS ANIMAL FEED

In recent times cultivated area is getting decreased in developing countries due to many reasons like increase in population and industrialization etc, So farmers are facing a problem with short of area to grow grasses as a mono crop to feed the cattle. It is a known fact that mulberry is being used as animal feed since long, since farmers are well aware of the nutritional value of the mulberry as a feed. In silkworm rearing, the tender leaves are used in first and second instars and mature leaves are used for the rest of the instars. In this process lot of residual leaves are left with, which are excellent feed for sheep and other lives stock. Mulberry can be grown along the grasses or it can be grown along agricultural fields, roadside, canals and marginal land while under cut and carry systems it is very well suited for small farmers livestock. In all traditional Sericultural countries like China, India and Korea feeding of leftovers of silkworm feeding and plant residues to domestic animals is a common practice. Till today, majority of fodder plants for cattle were grass species. There are many advantages when grasses are cultivated in combination with fodder trees, like grass under shade is fresher than grass

exposed to strong sun out of shade, when grasses are fed in combination with tree leaves animals have become healthy due to balanced mineral intake and high protein content in mulberry and most important feature of mulberry as feed is its high digestibility and high palatability by all domestic animals. Normally digestibility values vary between 70-90% for leaves, 37-44% for the stem, 60% for the bark and 58-79% for the whole plant (Sanchez 2001).

Many reports say that mulberry increases milk yield and reduces feed cost. Liu *et al* (2000) have reported on the supplementation of treated straw based diets with mulberry have significant implications for livestock production in countries where cereal residues are the basis for live stock feeding. Although mulberry is valuable resource in many conditions, it has been particularly beneficial in tropical climates, where grasses have been the customary basis of production. It is reported by Sanchez (2001) that mulberry is 80-100% better than grasses and 40-50% better than tropical legumes for small ruminants. Deshmukh *et al*, (1993) have obtained promising results when rabbits were fed with mulberry as the main feedstuff in the diet. Some of the earlier experiments have shown that rabbits eat better, grow faster and the quantity and quality of flush was better, if mulberry leaves were used as the feed (Li, 2001). Lea and Lee (2001) reported that in Korea mulberry is used as a feed for deer and it is very good for deer feeding which makes deer horns grow faster and bigger with shiny rich furs, due to its high nutritional value. Ye and Ye (2001) reported that farmers of Hubei province, China traditionally use refusal mulberry leaves and silkworm feces as pig feed resulted in getting faster growth and saving feed. Compared with the control group, pigs fed mulberry leaves and silkworm feces saved 2.52 kg feed per kg weight gain, reducing the cost by 8.6 percent and increasing profits by 19.6 percent.

B. MULBERRY FOR POULTRY REARING

Tateno *et al* (1999a & b) and Sudo *et al* (2000) have observed that with feeds containing up to 9% mulberry leaf meal, egg size and production were similar to the commercial feed control. Further they noticed the improvement in the yolk color, increase of vitamin K and beta-carotene in the eggs produced from the poultry birds fed with mulberry. Machii (2000) reviewed the beneficial effects of the integration of poultry rearing into mulberry gardens from the point of view of weeding, additional organic fertilizer, quantity of poultry products and cost.

II. MUSHROOM PRODUCTION:

Mulberry stem and stem powder are found to be good source of media for mushroom production (Machii 2001).

A. MULBERRY AS A MEDICINE

Mulberry leaves; roots and stems are very well used in pharmaceutical industry. Mulberry is investigated for its plentiful medicinal values and being used in Korea (Lee and Lea, 2001) and China (Zhu and Lu 2001) extensively. As far back in oriental history as 2200 years ago, medicinal effects of mulberry leaf and root-inner bark are recorded in Chinese medicine books. Lee and Lea (2001) reported that by 1500s in both China and Korea, it is recorded with elaborate prescriptions that most parts of mulberry plant and also silkworms were utilized for their medicinal effects in various human illness; mainly for beriberi, external swelling. Diabetics, stroke, snake-bite, insect-bite, sweating, boils, open wounds, burns etc, Mulberry which is rich in vitamin B and C can be used for maintenance of normal or expedited activities of systems for immune, anti-oxidation and metabolic turn over of fats and carbohydrates. Mulberry leaf also contains rutin for active capillary system, GABA for lowering blood pressure and DNJ for lowering blood sugar level. In addition in mulberry leaf there are sito sterol for lowering blood cholesterol levels. Based on preliminary experimental results with mice and much publicized awareness better health in later ages, mulberry leaf powder is already available in Korean markets, as supplementary health food in the form of tablets or capsules, along with mulberry leaf extract added to beverages. Various ways of utilization of mulberry for human are very popular presently in Korea with

considerable demands at a commercial level, as scientific knowledge and technology of mulberry as excelled health food are becoming available to the public (Lee and Lea 2001). It is reported (Zhu and Lu 2001) that every part of mulberry tree is being used in Chinese medicine. Mulberry leaves can be used to treat nose bleeding, night sweating, eye illness, acne and so on (Yi *et al* 1997). It is very well proved in animals that mulberry leaves had significant effects on lowering blood sugar content (Fujun *et al* 1995, Noda 1998, Mengzhao, 1989, Youye *et al* 2000). Research also found that mulberry leaf amylase could improve the capability of resisting blood sugar in alloxan-induced hyperglycemic mice and accelerate the excretion of insulin. Antherogenic rats were used to verify the function of mulberry leaves on lowering cholesterol and blood pressure. When rats fed mulberry leaves (1g/Kg), total –cholesterol decreased as much as 49 percent (Mingde 1999) phytosterols could constrain the assimilation of cholesterol in the intestine (Xiao *et al* 1999). Yong and Jingzhi (1999) stated that mulberry lower blood pressure might be due to the existence of high contents of GABA. The high GABA could lower blood pressure and resist arteriosclerosis. High SOD and flavonoid in mulberry leaves can eliminate free radicals (Fujun 1989) and therefore defer caducity (Fujun *et al* 1996). Muscle injection of extract from dry mulberry leaves can cure filariasis (Peiyi and Zhenhai 1990). In a clinical therapy of 1500 cases, the success muscle injection reached as high as 95 percent without side effects (Lianchu and Lihua 1996). According to traditional Chinese medicine mulberry fruit have many functions, enriching the blood, invigorating liver and kidney, fighting senility, preventing chronic hepatitis, curing insomnia, increasing the longevity of the life and neurasthenia (Chu *et al* 2001). Ye and Ye (2001) reported that mulberry leaf has many biological functions such as anti-aging, enhancing body resistance, lowering blood glucose, reducing cholesterol, anti neoplastic, prevention and cure of constipation in the clinical tests. Li (2001) reported that the leaves are used in preparation of mulberry-chrysanthemum cold tablet. Shiva Kumar *et al* (1997) from India reported that mulberry juice can be used as a moisturizer to keep the skin fresh, to prevent throat infection, irritation and inflammation fruit juice is used to prevent high fever, diarrhea and cold, root juice has the capacity to reduce blood sugar and blood pressure. Mulberry is proved in protecting liver, improving eyesight, facilitating discharge of urine, lowering of blood pressure, anti-diabetic and controlling weight in humans as well as animal models (Saurabh Bajpa (2012). The medicinal value of mulberry leaves has opened up a new approach in sericulture production. For the last 20 years, plethora of compounds encompassing almost all major classes of antioxidants have been reported from mulberry. It includes all flavonoids like flavones, iso-flavones, flavonolls, anthocyanins, isoprenylated piperidine and pyrrolidine glycosides, low molecular weight redox compounds like glutathione and various natural amines(Soumen Chattopadhyay *et al*, 2013).

B. MULBERRY AS A FOODSTUFF

Mulberry fruits are edible and well known for its delicious taste. They can be consumed directly or can be used in the preparation of Wine, Jam or Soft drinks. “Da 10” is the most popular fruit mulberry variety, which is planted in Zhejiang, Guangdong and Jiangsu provinces of China (Ye 2001). Mulberry fruit research has become more active in the Sericulture Research Institute of Yunna province, China utilizing many species in cross breeding for fruit production, the result of which is DL-number 1 (Chu *et al* 2001). Mulberry fruits have many excellent characters like nice taste, large size, attractive color and high nutritive and medicinal values. Fresh mulberry fruits are rich in amino acids, vitamins and mineral, such as Zn, Mn, Fe, Ca that are indispensable for the human body, in addition mulberry fruits also rich in pectin and fibrin. Ascorbic acid content is as high as 20mg/100g in fresh fruit (Chu *et al* 2001). Fruits can be used as coloring and flavoring agent (Shiva Kumar *et al* 1996). In Japan, mulberry leaves are used to make a dish called “Tian-Fu-La” and mulberry leaf powder can be added to flour for pastries and cakes (Li 2001). The leaves that silkworms love contain agents that can significantly improve our health (Will Block, 2004). Sarita *et al* (1997) from India discussed about preparation method of Paratha, Pakoda, Saag, Dhokla, Steamed product with mulberry leaves noticed that the products

prepared from mulberry leaves were acceptable and tasty. Mulberry leaves can be used as green vegetable. Dried mulberry leaves can also be used as tea. In addition, mulberry leaf and fruits are also eaten as fresh or dried vegetable or are mixed in such food or confectionery stuff as noodle, soybean curd, cakes, ice-cream, yogurt, beverage, wine, rice-cake etc.,

C. IN FISH REARING

The use of silkworm waste to rear fish has long history in China. The mulberry dike and fishpond system in Guangdong province, China was famous in the world for its high productivity and sustainable recycling with in a natural ecosystem (Li 2001). Ye (2001) reported that in Zhujiang valley; the mulberry dyke-fish pond model had been well developed. The mulberry is planted in the dyke around the fishpond. The pond mud is dredged for the mulberry, mulberry leaves feed the silkworm and silkworm waste goes as fish food. The agricultural ecological model combining sericulture with animal husbandry can increase economic value and recycling of waste resources.

D. MULBERRY WOOD

The mulberry branches are to use to make baskets, toys and sport goods. Mulberry shoots after using leaves for silkworm rearing are being used as firewood in the rural areas. Bark is used for paper production and mulberry tree is also used for forest protection against wind and sand.

The merits of growing mulberry in India are many like high density planting, fast growing, availability of many high yielding varieties, easy vegetative propagation, suitable for shoot harvest etc. In addition to all these, mulberry leaves are rich in nutrients. Hence besides using as a sole food for the silkworm, it is quite feasible to utilize all the parts of mulberry for various valuable purposes.

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