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"Value-Added Opportunities in Sericulture through Mulberry Fruit Utilization"

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Abstract

Sericulture has become a leading cottage industry, requiring minimal investment, offering a short gestation period, generating high employment opportunities, and providing highly lucrative returns. Sericulture is the practice of rearing silkworms and extracting silk from their cocoons. During this process, a significant amount of waste by-products is generated. Mulberry foliage is utilized as a nutritious feed for domesticated animals. In China, mulberry leaves have been used for centuries in traditional medicine to treat a range of ailments, including hypertension, hyperglycemia, inflammation, fever, cough, and even certain types of cancer. Mulberry wood is highly suitable for house construction and is widely used in manufacturing agricultural implements, furniture, and sports goods. Mulberries are packed with nutrients, though many people are unaware of their health benefits. Mulberry fruites are high in water content, low in calories, and rich in essential nutrients, particularly iron and vitamin C along with good amounts of potassium, vitamin E, and vitamin K. Due to their high sugar content, mulberries can be extensively utilized in the fruit and vegetable industry for producing marmalades, fondant jams, jellies, cakes, breads, parathas, fruit teas, fruit drink pulp, fruit wine, fruit sauces, fruit powders, and even chocolates. Among all mulberry by-products, the effective utilization of mulberry fruits holds greater medicinal value and offers immense potential for generating additional income and employment within the silk-based cottage industry. However, sericulturists have yet to fully utilize these by-products. Therefore, based on existing literature on mulberries, it would be worthwhile to study the value addition potential for sericulturists and to promote the involvement of the pharmaceutical, cosmetic, and beverage industries through the utilization of mulberry fruit as a by-product in the sericulture industry or enterprise.

Keywords: Sericulture, By- products, Mulberry fruits, Nutritional value, Income Generation.

Introduction

Sericulture holds cultural and historical significance, with centuries-old practices and craftsmanship passed down through generations. With growing global interest in eco-friendly, biodegradable materials, sericulture is gaining renewed importance not only in the textile sector but also in emerging fields such as cosmetics, pharmaceuticals, and biomedical engineering. In general, waste can be considered a by-product. However, in mulberry cultivation, silkworm rearing, or silk reeling, many such by-products help reduce the net cost of production and increase the economic benefits for producers. These by-products also lead to the creation of a variety of appealing products for consumers. Since all these materials have market value and practical uses, they are referred to as by-products rather than waste. In India, the mulberry tree is revered as the *'Kalpa Vruksha'* because all its parts are used in the traditional Ayurvedic system of medicine. Every component of the plant finds application in the preparation of various products in the food, beverage, and healthcare industries, leading to its growing industrial exploitation. Globally, mulberry is recognized for its wealth of biologically active biomolecules such as phenols, alkaloids, terpenoids, amino sugars, and stilbenoids, which contribute to its wide range of therapeutic and commercial uses. Mulberry is widely valued for its economic significance, primarily as the essential feed for silkworm (*Bombyx mori*) larvae, which produce the highly prized mulberry silk. Among the various by-products of mulberry, the fruits stand out for their high medicinal value and significant potential to generate supplementary income and employment within the silk-based cottage industry. However, Indian sericulturists have yet to exploit these resources to their full potential.

Materials and Methods :

The present study was conducted in Andhra Pradesh, Telangana and other states of India. Andhra Pradesh is the second largest raw silk producing state in India after Karnataka. Sericulture is highly concentrated in Anantapur district, is adjoining to Karnataka State which is often called as "Silk State of India". Anantapur district is popularly known for Dharmavaram handloom silk sarees called "Silk City of Andhrapradesh" and occupies the first place in respect of sericulture. Mulberry acreage in Anantapur district is 43,000.acres.(Soure: Department of Sericulture, Governament of Andhra Pradesh). Mulberries are not commonly found in India, but some farmers in Mysore (Karnataka), Anantapur (A.P) and Maharashtra are experimenting with the cultivation of this delicious berry. Mulberry fruits are exported to other states and countries for the production of mulberry food, bevarage products like Jam, candies and jellies (Vestia Agro India..etc).,juice,(Smart juice manufactures, USDA organic), sweets & cake (All famous bakers like Bangalore beaker, warm oven cake and desserts- Hyderabad, India), extract/paste(manufactured by Hollywood secretes and marketed by Morrilfox, Goa,(India), dry fruit powder(Tirupati Balaji Entreprise, Gujarat, India), Mulberry wine (Donelli vini S.P.A- 42043 Gattatico(Italy), imported

by Danish FNB, Mumbai (India).etc., and Mulberry pigments (Vedic natural care Pvt, Ltd, Gautambudh nagar, Uttar Pradesh, India).

With these in mind I have collect data from various sericulturist (Cultivated mulberry fruits)in Anantapur district and also food and beverage Industries in Andhra Pradesh and Telangana states in India through personal & Oral interview, mail and Google.com. Drawing from existing literature on mulberries, there is considerable scope to explore value addition in sericulture by promoting the use of mulberry fruits as by-products. Such initiatives could attract interest from the pharmaceutical, cosmetic, and beverage industries, fostering innovation and economic growth in the sector. With this background, the present study was designed with the following objectives:

1. To study the nutritional composition, medicinal properties (health benefits), economic significance, and value addition potential of sericulture through the extent of mulberry fruit utilization as a by-product by sericulturists.
2. To promote value addition and stimulate the growth of the food and beverage industry through the effective utilization of mulberry fruit as a by-product.
3. To recommend strategies for encouraging greater adoption of mulberry fruit processing among sericulturists, with support from relevant industries and government bodies.

Fig: 1. Mulberry fruits/Mulberries collected for study

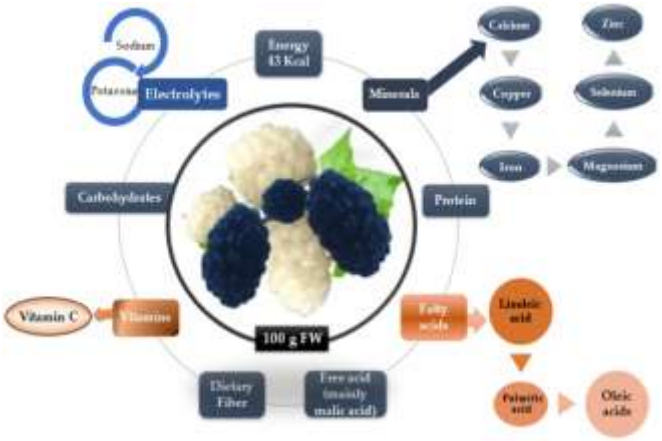
Result and Discussion :

The result and discussion of the present study are presented under the following headings

1. Mulberry fruits/Mulberries and composition : Mulberries are delicious and nutritious; people all over the world enjoy it. Mulberry (*Morus., spp*) is the prime source of food to the mulberry silkworm *Bombyx mori* L.,. They are fleshy, delicious, succulent, mild and sweet flavor. Mulberries can be consumed both in fresh and dried forms. Though there are more than hundreds of species three species are mostly recognized- white mulberry (*Morus alba*), red mulberry (*Morus rubra)* and black mulberry (*Morus nigra*).

Mulberry fruits/Mulberries

These berries are less in calories (43 calories per 100 grams). Mulberry fruit is well known as esteemed dessert fruit. Mulberries contain proteins, fiber, Vitamins and minerals. Fresh mulberries contain 88% water , 9.8% carbohydrates, 1.7% fiber, 1.4% protein, 0.4% fat and 60 calories per cup (140 grams). But When dried, they contain 70% carbohydrates, 14% fiber, 12% protein and 3% fat. They are composed of health enhancing phytonutrient compounds which include polyphenol pigment antioxidants, minerals, vitamins, lipids, protein, dietary fibre , high water content etc. Nutritional profiles of various mulberries are pretty much same. Mulberries are rich source of Iron, Vitamin A,C,K&E. They also contain Riboflavin, resveratrol and zeaxanthin.. They are good source of minerals like potassium, manganese, magnesium, phosphorus, sodium and zinc. They have significantly high amounts of anthocyanins. A well ripened fruit has a mouth watering sweet taste with a pleasant flavor. In black mulberry (M. nigra) fruits, there is malic acid in the range of 35.4-198.5 mg/g followed by citric acid (5.5-23.4 mg/g). Tartaric acid, oxalic acid and fumaric acid were at a level of 4.16, 0.62 and 0.019 mg/g,respectively (Koyuncu, 2004).



Composition of mulberry fruits of 100 gms

Mulberry fruit products:

1.1 Mulberry Jam, Jellies and Candies

1.2 Mulberry juice

1.3 Mulberry wine

1.4 Mulberry sweets and cake

1.5 Mulberry / paste

1.6 Mulberry dry fruit powder

1.7 Mulberry Pigments

1.1 Mulberry Jam , jelly and candies : It is commercially valuable for getting income by preparing as jam, jelly and candies. They also good source of minerals like iron, potassium, manganese, and magnesium. It is to handle easily and pile well on bread/waffies/etc. Unlike other fruit jams, It's really a matter of taste, so, kids are very much interested to eat jam, candies and jellies. It helps to increases memory power also. Based on the highly satisfactory performance, Mulberry jam & Syrup was marketed by the state Agro Industries Department during 2010 under the name SNOWKIST at Jammu & Kashmir and Vistevia Agro India at Kolkata (West Bengal), India. These findings was supported by Yuan and Zhao, 2017.

Mulberry Jam (Home made & Industrial) **Jelly** **Candy**

1.2 Mulberries juice/syrup : Mulberry fruit juice it is also used as natural alcoholic additive for food and pharmaceutical industries. The juice obtained from mulberry fruit has delicious taste and smell. Mulberry has the function of nourishing blood. If the person who has anemia, pallor, dizziness, insomnia, and heart-palpitations regularly takes mulberry juice, they will experience good effects. The mulberry juice can also be applied topically to the head to promote healthy hair growth. The person who has dry eyes and uses their eyes a lot during work can drink mulberry juice, which can nourish the body fluid and strengthen sight. Smart juice manufactures(USDA) launched Organic Black Berry Juice, which is good source of Iron. A new UK fruit juice company "Fairjuice" has launched a super fruit drink prepared from pure fresh pressed mulberry fruits which is full of antioxidants. It is also a source of resveratrol which is considered to be beneficial for heart health. It also suppresses the appetite, which is whyit has been reported as a useful drink against obesity. Theses findings was supported by Vojkan M. *et al*., 2014; Brij Kishor e Singha ,2010;Fairjuice 2008.

Mulberries Juice/syrup

1.3. Mulberry wine: The high concentration of mulberries have unique sweetness and flavor are used in beverage industry which gives high income and also having in good health benefits. Wine can be obtained from mulberry fruit, it is sweet, sour and non alcohol is used for purification of blood. Many believe that one glass of this wine per day improves health by cleaning the organism from impurities and enables the ejection of fecal residues in the intestines http://www.eckraus.com. Like many other berries, mulberries are rich in anti-oxidants, which can help boost our physical immune system. In addition, mulberries have blood restorative effects, making this beverage a healthy companion to any meal.[45]. Mulberry wine manufactured by Donelli vini S.P.A- 42043 Gattatico(Italy), imported by Danish FNB, Mumbai (India).

Mulberry wine

1.4. Mulberry sweets and cake: Mulberry dried powder is used in the preparation of various sweets and cakes in food industry. The passion behind Mulberries Cake Shop is to create beautiful cakes made with mulberry fruit derivatives which translate the feel of your party into an edible form since,2000, Denver, U.S. state of Colorado (http://www.yelp.com/biz/mulberries-cake-shop, and also now all famous beakers like Bangalore beaker, warm oven cake and desserts- Hyderabad, India) made mulberry cake.

Mulberry cake

1.5. Mulberry fruit extract/paste: In Chinese markets, mulberry is often provided in the form of a paste called "sangshengao". The paste is mixed in hot water to make make a tea to improve the liver and kidney and sharpen the hearing and brighten the eyes. For this application, it can be combined with the traditional formula *Yiqi Congming Tang*, which is used for deficiencies in hearing and vision, particularly in the elderly who suffer from deficiency of yin with deficient heat(N. Vijaya Kumari,2014 and Vojkan M. *et al*., 2014).In India mulberry fruit

extract/paste used as dietary supplement to improve skin brightness- manufactured by Hollywood secretes and marketed by Morrilfox, Goa,(India).

Mulberry fruit extract/paste

1.6. Mulberry dry fruit powder : Mulberry fruits can be dried and stored as a powder, which contain high amount of Iron and Vitamin C and decent amount of Potassiun and Vitamin K&E. About 10 g of dried fruits provides about 100 mg of anthocyanins. [48] As it contains resveratrol, fruit powder works as an anti-mutagen which can inhibit the mutation of healthy normal cells into cancerous cells. It is believed to prevent heart disease, cancer and other diseases associated with chronic inflammation. The fruit powder has an anti-aging effect on cells because it combats free radical damage http://navitasnaturals.com/newsletters/May12.html . Mulberry fruit powder can be used for baking, making ice creams, cookies, baby food etc. Mulberry fruit powder manufactured by Tirupati Balaji Entreprise, Gujarat, India.

Mulberry fruit powder

1.7. Mulberry pigments : Mulberry fruit color derives from anthocyanins, which are under basic research for mechanisms of various diseases (*Wrolstad RE,2001 and Hou DX, 2003).*Anthocyanins are responsible for the attractive colors of fresh plant foods, including orange, red, purple, black, and blue. These colors are water-soluble and easily extractable, yielding natural food colorants. Due to a growing demand for natural food colorants, their significance in the food industry is increasing. A cheap and industrially feasible method has been developed to extract anthocyanins from mulberry fruit which could be used as a fabric tanning agent or food colorant of high color value (above 100). Mulberry is considered to be a wonder skin ingredient that revives and rejuvenate skin in the most natural way (*Liu X, et al., 2004)* . Himalayan organics Bio mulberry cream is a super-light, anti ageing face cream with soothing aroma, It helps prevent melanin synthesis and helps glowing skin while reducing dark spots and hyper pigmentation, there by promoting even skin tone. It was manufactured by Vedic natural care Pvt, Ltd, Gautambudh nagar, Uttar Pradesh, India.

Mulberry Face cream.

Conclusion : Globally, mulberry is utilized not only as a source of leaves for silkworm rearing and animal feed, but also as a raw material for producing a variety of industrial products. In India, particularly in the southern states such as Andhra Pradesh, Telangana, Karnataka, and Tamil Nadu, farmers have traditionally focused almost exclusively on silkworm rearing, with little attention given to seri-byproducts. Although this is a potentially valuable sector for farmers, extension workers and researchers have also shown limited focus on the utilization of these byproducts. Although this sector offers significant value addition for farmers, extension personnel and researchers have not devoted substantial attention to the utilization of seri-byproducts. Value-added products such as jam, jelly, wine, syrup, paste, sweets, cakes, dry powder, pigments, and many others can be produced from *Morus* fruits. This enables industrialists to effectively utilize mulberry fruit byproducts from the sericulture industry, generating substantial income and offering significant potential in the global market. Unlike China, India is still developing technologies and establishing centers for the effective utilization of mulberry fruits. Such initiatives can create employment opportunities, provide additional income for small and marginal rural farmers, and contribute to rural development. Mulberry cultivation generates both direct and indirect employment for farmers. Beyond sericulture, mulberry is utilized in various sectors that contribute to employment creation and revenue generation. Industries such as animal husbandry, food processing, cosmetics, dyeing, and pharmaceuticals use different parts of the plant—including leaves, stems/bark, roots, and fruits—for the production of processed commercial products. Apart from the leaves, mulberry fruits are an important income-generating byproduct for sericulturists. The above findings clearly indicate that mulberries can be effectively utilized in the food, beverage, and cosmetic industries as a valuable raw material, owing to their exceptional antioxidant content and strong nutritional profile. Both central and state governments should support the sericulture industry in establishing market infrastructure for the utilization of byproducts. Promoting small-scale industries based on mulberry fruit byproducts in rural areas can play a significant role in strengthening the Indian economy. This paper presents an overview of the potential and effective applications of mulberry fruit byproducts in sericulture as a value-added activity, with the aim of motivating farmers, researchers, educators, and students to explore these opportunities, which offer considerable future prospects."

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