Effective Diversified Uses of Tapioca (*Manihot esculenta* Crantz.) and Borkesseru (*Ailanthus excelsa* Roxb.): The Promising Secondary Host Plants of Eri Silkworm

ABSTRACT

Eri culture is an age old traditional activity associated with the socio-economic life of the rural population of the country. Eri silkworm (*Samia ricini* Donovan) is a multivoltine silkworm which is polyphagous in nature. It feeds on number of primary, secondary and tertiary host plants. Tapioca (*Manihot esculenta* Crantz.) and borkesseru (*Ailanthus excelsa* Roxb.) are regarded as the secondary host plants of eri silkworm and these plants species have enormous potentialities due to having certain properties for utilization in multiple purposes. Besides utilization as a host plant for silkworm rearing, the various parts of the plants can be exploited commercially. The plant parts can be used for human consumption, industrial as well as medicinal purposes. Moreover, they can also be utilized as a fodder, pesticides, fuel etc. Huge potentialities of product diversification of these plants will give a new dimension to eri industry. Hence, popularization of diversified uses of tapioca and borkesseru is very necessary to uplift the rural economy of the country. This review mainly focuses on the importance of tapioca and borkesseru not only as host plants of eri silkworm but also its utility in numerous purposes.

Keywords: Samia ricini; Manihot esculenta; Ailanthus excelsa; potentialities, product diversification, economy

1. INTRODUCTION

Sericulture is an important branch of agricultural science mainly concerned with the mass scale rearing of silkworms for production of silk. It is an agro-based industry that plays a notable role in the rural economy. Four types of silkworms are commercially produced in the world *viz;* mulberry, eri, muga and tasar. Eri, muga and tasar are commonly known as vanya or non-mulberry silkworms. In global scenario, India is the second largest producer of raw silk after China. Due to its favorable climatic condition, India is blessed to have all these four types of silkworms. Among the vanya silk, the production of eri silk is highest in India. In India, eri silkworms are reared in many parts particularly in the north-eastern region. The Brahmaputra valley of Assam and its adjoining foot hills is believed to be the original home of eri silkworm [1]. The eri silkworm rearing is a means of

employment and income source for a wider section of rural population in eri culture concentrated regions as it provides engagement through food and eri silk production and weaving activities [2].

The eri silkworm (*Samia ricini* Donovan) is a polyphagous and multivoltine insect and 5-6 crops can be raised in a year [3]. The larvae feed on various host plants of which castor (*Ricinus communis* L.) and kesseru (*Heteropanax fragrans* Seem) are the primary food plants [4]. Besides these, it also feeds on variety of plants and these are regarded as secondary and tertiary host plants of eri silkworm. Tapioca (*Manihot esculenta* Crantz), commonly known as cassava and borkesseru (*Ailanthus excelsa* Roxb.), the tree of heaven are considered as secondary host plants of eri silkworm and are gaining popularity due to having potential characteristics for diversification of their various parts. This review mainly focuses on potential utilization of tapioca and borkesseru not only as food plants but also for varied commercial purposes

2. TAPIOCA (*Manihot esculenta* Crantz.)

Tapioca belongs to the family Euphorbiaceae under the order Euphorbiales and class Magnoliopsida. It is a perennial shrub and is the most important starchy root crop originated from North Eastern Brazil. In India, it is cultivated about 0.22 million hectares with a total production of 4.65 million tonnes (MT) and productivity of 20.39 tonnes per hectare [5]. It is mostly grown in the north-eastern and southern region of India contributing 93% of area and 98% of production in the country. Tapioca produces 5-10 tubers per plant which is cylindrical in shape. It is a monoecious plant mainly propagated by vegetative means. Propagation of tapioca by stem cuttings develops into numerous adventitious roots of which some develop into tubers. The stem of tapioca is woody and it has diverge branches whereas, leaves are palmately lobed having 5-9 lobes in it.

2.1 Diversified uses of tapioca

Tapioca is a secondary host plant of eri silkworm and is generally used during the period of shortage of primary food plants. It can be utilized as potential host plant of eri silkworm [6]. Apart from castor, the larval period become shorter as the silkworms feed on tapioca leaves along with higher shell ratio, shell weight, single cocoon weight, fecundity are obtained. Moreover, the incidence of diseases also becomes lower as compared to other host plants of eri silkworm [7].

In north-east India, tapioca (cassava) is grown abundantly in the hilly regions [8]. But, commercial utilization of tapioca for income generation is very less in the region. Besides, systematic plantation of castor, the primary food plant of eri, is not available at farmers' level and castors being annual in nature, the farmers usually face major problems of non availability of leaves. In such a situation, tapioca can be utilized judiciously for eri silkworm rearing as it is practiced widely in north-eastern regions for tuber production. Therefore, it has a vast potential to enhance eri silkworm production the region.

Besides utilization as a host plant for silkworm rearing, tapioca has a tremendous scope for utilization as a byproduct. The value added products made from tapioca can be used diversely for human consumption, animal feed, industrial use, medicinal, insecticidal purposes etc.

2.1.1 Human consumption

Cassava is a staple food crop cultivated in several developing countries and is known to be the highest producer of carbohydrates among staple crops [5]. The roots and leaves, which constitute

50% and 6% of the mature cassava plant, respectively, are the nutritionally valuable parts of cassava [9]. Cassava is consumed either directly as baked tubers or as the products prepared from Cassava [10]. In southern and north eastern states of India, it is used as baked tubers as well as a culinary item. In north eastern states, it is popularly known as 'simalu alu'. Inspite of these, starch, saga, chips, flour from chips, thippi, peel, sago wafers are the important value added products from cassava [10].

2.1.2 Animal feed:

Raw tubers, flour made from tapioca, dried chips, thippi and peel are the most common forms of tapioca utilized as cattle feed. Inspite of these, tapioca thippi flour is being used as a fish and poultry feed by most of the people [10].

2.1.3 Pesticide

The plant extracts of tapioca leaves in ethyl acetate solvent is highly toxic against adults of *Trilobioum castaneum* [11]. The ethyl acetate extract made from tapioca could be utilized as a potential grain protectant against *Tribolium castaneum*.

2.1.4 Medicinal use

Tapioca contains some medicinal properties and thus plays an important role in improving various conditions within the human body. One of the most valuable mineral contributions of tapioca is iron. Together with copper which tapioca also contains, iron increases the amount of red blood cells in the body, thereby preventing anemia and related conditions [12]. Fiber present in tapioca help in various gastrointestinal tract problems, presence of potassium reduces blood pressure. Besides absence of allergenic protein, gluten makes cassava flour a good substitute for rye, oats, barley and wheat [12]. Persons diagnosed with celiac disease and other gluten based allergies can get relief by consuming foods made from tapioca flour. Although baking cakes, bread and other foods requires gluten to enable them to swell in size, it can be substituted with guar and xanthan gum [13]. Inspite of having toxic cyanide, cassava is remedy for number of ailments if prepared properly; such as digestive disorders (Gastritis, gastroduodenal ulcer, constipation and colitis), liver disease, celiac disease and diabetes [14]. Moreover, having rich source of vitamin K, calcium and iron, tapioca plays an important role in the protection and development of bones. It also has some beneficial effects in controlling diabetes too. The leaves of tapioca are good for measles, small pox and skin rashes, ringworm etc.

2.1.5 Industrial use

Starch is an important value added product produced from tapioca. In textile industry, it is commonly utilized for starching shirts and other garments [15]. Starch is also used in pharmaceuticals, in paper industry, in confectionery industry etc [10]. Besides, tapioca roots can be used in manufacturing biodegradable bags developed from a tapioca resin which is renewable, reusable and recyclable [15]. Other tapioca resin products include gloves [16].

3. BORKESSERU (*Ailanthus excelsa* Roxb.)

Borkesseru (*Ailanthus excelsa* Roxb.) belongs to the family Simaroubaceae, order Sapindales and class Magnoliopsida. It is an indigenous lofty deciduous tree with a straight cylindrical bole and is widely distributed in India. This plant is perennial in nature, tall, grows swiftly and when the trees are grown fully it usually attains up to a height of about 18-25 meters. The wood is soft and whitish in colour which is covered by bark of grey-brown colour [17]. It is fast growing tree, thick branches and develop massively like a spreading crown.

Ailanthus excelsa originated in Moluccus island [18]. It emanated from Europe and in India it is grown in eastern, western and north-eastern region [19]. It is well adapted in arid, semi-arid and semi-moist regions [20]. It is mainly propagated through seeds. The leaves are alternate, pinnately compound, hairy and the leaflets are very coarsely toothed [21]. Leaves have 8-4 pairs of leaflets. The fruit of borkesseru is 1 seeded Samara and ripens in May-June. Borkesseru is suitable for uplifting as a plantation tree in social forestry, agroforestry, avenue plantation, industrial plantation as well as wasteland afforestation. Its quick growth and absolute immunity to grazing gives the species first choice among the soft woods [22].

3.1 Diversified use of borkesseru

Like tapioca, borkesseru can also be used as an alternate host plant to feed the eri silkworms. The leaves of 2-3 years old plant can be used for rearing of silkworms [18]. In north eastern region of India, eri silkworm rearing is widely practiced. Besides utilization as a food plant to feed the silkworms, the farmers can also use this plant for various purposes. Other uses of borkesseru are as follows:

3.1.1 Industrial use

The wood is short fibered, grained straightly and coarsely textured which is easy to saw and work both by hand as well as machines. More than 70% of its wood is used in matches industry to make matchwood boxes and match splints. The wood is used extensively in cottage industries to make wooden toys and cheaper quality cricket bats. The timber being light and perishable is commonly used for packing cases, fishing catamarans, floats and sword sheaths. The timber is also utilized suitably as commercial plywood. It is mainly used as Grade III and Grade IV plywood. The wood is sainty, yellowish white and well suited for cabinet making [23]. The pulp is attained from debarked wood, utilize for manufacturing paper. The pulp is used as an alternate to aspen for printing papers which enhance the surface quality of papers. It is also used for the preparation of pencils [24]. It could be suitable for flooring, boat building, matches, match boxes, and veneer manufacturing [25]. Besides these, from the bark of plant, a bassora or hog gum can be extracted which is inferior in quality. Also, due to the presence of high content of linoleic acid in the the seed oil of borkesseru will make it possible for the use in the cosmetic industry in near future [18].

3.1.2 Animal feed

Leaves of borkesseru along with twigs are found to be very suitable fodder for animals. Leaves are highly nutritious and palatable tree yields an average of about 500-700 kg of green leaves twice a year and also, found to be suitable fodder for cattle, sheep and goats [26]. Leaves are mainly used to augment production of milk.

3.1.3 Pesticide

The extract of *A. excelsa* is found to be effective against *Callosobruchus maculates*, mainly infested on *Phaseolus mungo* in the storage houses and is considered as an environmentally safe agricultural pesticides. 3% concentration of extracts of *Ailanthus excelsa* was lethal to *Callosobruchus maculates* [27].

3.1.4 Medicinal use

The plant being bitter and aromatic, show some medicinal properties. *A. excelsa* is widely used in ayurveda and evidence based phytotherapy. In Ayurveda it is used to remove the bad taste of mouth. The plant is also utilised for antifertility and

rejuvenating purpose by some tribal populations. The plant is used as natural antifertility agent by the Irula women in Mavanahalla region of the Nilgiri district in Tamil Nadu [28]. The fresh juice of stem bark mixed with either honey or sugar is given to pregnant woman during evening for three consecutive days to induce permanent sterility [22]. The bark of the plant is reported to have anthelmintic, antiamoebic as well as anticancer agents. It has marked antispasmodic and cardiac depressant properties [29]. In Chinese system of medicine bark of *A. excelsa* is used to treat diarrhea and dysentery, especially when there is a blood in stool [30]. The bark has been used in Asian and Australian medicine to counteract worms, excessive vaginal discharge, malaria and asthma [31]. In African countries the plant is used for the treatment of cramps, gonorrhea epilepsy, tape warm infestation and high blood pressure. They are used to cure diseases like dyspepsia, bronchitis and asthma Pilex, mostly used ointments for piles and Lukol tablets for leucorrhoea contains *A. excelsa.* Fruits are used in diarrhea, polyurea, piles and fever [32]. Traditionally, the mattress prepared from the leaves of borkesseru is used as a bed for the children suffering from fever. Leaves are also used for the preparation of lotions for scabies. Quassinoids and ailantic acid are also isolated from bark which are considered to be the main therapeutic constituents for dysentery (amebic and bacterial) and diarrhea; intestinal worms and internal parasites; malaria; as an astringent to stop internal bleeding (stomach ulcers, hemorrhages) and externally for wounds and in viral infections [33]. The oil extracted from borkesseru seeds is a good source of essential fatty acids. The seed oil of borkesseru is rich in two unsaturated fatty acids i.e, oleic and linoleic acids which are important from the nutritional point of view as well as for oil stability [34]. Dietary fats rich in linoleic acid, prevent cardiovascular disorders such as coronary heart diseases and high blood pressure and also its derivatives also serve as structural components of the plasma membrane and as precursors of some metabolic regulatory compounds [35]. The bark is used in indigenous veterinary practices too. In Karnataka, India the pest of stem barks along with goat milk and neem oil is utilize to cure nose rope wound in ox.

3.1.5 Use as Fuel

The stem and branches are utilize for the purpose of fuel wood which gives poor quality fuel as it quickly burns and does not retain heat for long [36].

4. CONCLUSION

Tapioca and borkesseru have enormous potentialities and can be utilized extensively as these plants have a great demand in the market due to having multiple properties. They can not only be utilized for silkworm rearing but also for industrial, medicinal and other purposes too. Huge potentiality of product diversification of different plant parts will acquire a good market in both national as well as international level. Therefore, efforts should be taken to popularize the economic utility of these plants in eri potential zones for attracting the farmers to cultivate and take it as a profitable venture. Hence, the farmers should be introduced about the diversified uses of tapioca as well as borkesseru and encourage them to cultivate which will not only cater the needs of farmers but will also give a new dimension in sustainable economic development of the farmers.

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