Sugar Palm Tree: Potential and Future Prospect in Malaysian Traditional Cuisines

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Abstract: The use of palm sugar in Malay traditional cuisines is popular among the Malay and it has natural sweetness which can create a difference in the taste of food. Sugar palm seeds can be used to make juices and sweets. This plant also has high economic value and potential as a substitute for brown sugar. Its fermented juice or *nira* can be used as a beverage and have potential as biofuel. However, not all traders use palm sugar in the preparation of their dishes because it is expensive and difficult to obtain. Palm tree is not commercially planted due to the difficulty of seeds to germinate. Many sugar makers get material from trees that grow around the village. So, it leads to a lack of continuous supply of sugar caused by limited number of trees for tapping. The difficulty of this plant to grow is because of the dormancy of the seeds which may take more than a year to germinate. Typically, many methods can be practiced to overcome seed dormancy, either by mechanical or chemical techniques. The use of biotechnology such as tissue culture also is a promising technique in production of higher number of plantlets in short time. Thus, the main purposes of this article are to discuss the potential and future prospects for palm trees in Malaysian cuisines and to identify various methods to overcome dormancy of sugar palm seed.

Keywords: *Arenga Pinnata*, Malaysian Traditional Cuisines, Sugar Palm

1. Introduction

Sugar palm or scientifically called *Arenga pinnata* is a multipurpose palm tree belongs to the family *Arecaceae*. Generally, sugar palm takes about 4 to 20 months to develop from seed to seedlings. This palm tree can be found in every part of Malaysia, especially in the middle and northern parts of Peninsular Malaysia such as Pahang and Kedah. Almost all parts of sugar palm tree can be used to make variety of products. Palm trees can be profitable and useful to humans. The sugar of *Arenga pinnata* is well-known for its unique taste and widely used as ingredients in many local Asian cuisines such as cakes, traditional *kuih muih* dessert, drink and many more. Further fermentation process of sugar palm juice can produce bioethanol that can be used as raw material for the production of chemical products, cosmetics, pharmaceuticals, and solvents. Besides that, sugar palm also can be used as renewable sources energy such as biofuel.

Fruit of sugar palm contains a hard black seed coat which leads to seed dormancy. This thus restricts its commercialization and production in large scale. Moreover, germination of the sugar palm seed is unpredictable and the report on the period of seed germination is also variable. Seed coat dormancy refers to the seed coat that impermeable to oxygen or water. Internal dormancy is caused by a number of physiological conditions which delay the germination process. There are many methods that can be carried out to overcome seed dormancy, mechanically or chemically. Mechanical method includes scarification or rubbing of seed surfaces using the knife, sandpapering or soaking in cold and hot water while chemical method involves chemical solution such as hydrochloric acid, sulphuric acid, and sodium hydroxide or hormones such as gibberellin.

To date, most of the farmers or sugar makers either utilize sugar palm from the forest or those which are grown in their surrounding where the productivity is relatively low. Previous study stated that palm that is not tapped can form up to 250,000 fruits and seeds. The palm also will die in two years after the formation of the first inflorescence or when the fruits in the

inflorescence near the top of the palm have matured. However, by proper handling and carefully developed tapping scheme, the productive life of the palm tree can be extended. Some report stated that in order to keep the palm alive, a number of female flowers need to be maintained and should not be cut off. Thus, the main purposes of this article are to discuss the potential and future prospects for palm trees in Malaysian cuisines and to identify various methods to overcome dormancy of sugar palm seed.

2. Literature Review

2.1 General Description of Sugar Palm

Sugar palm is one of the multipurpose trees that grows in Malaysia and is available across the nation of Malaysia, Indonesia and other South-East Asia. In Malaysia, sugar palm trees are widely found along the rivers in the rural areas of Beruas-Parit (Perak), Raub (Pahang), Jasin (Melaka) and Kuala Pilah (Negeri Sembilan). Sugar palm is reported to have more than 150 local names which are commonly used by local people. The local names include *Arenga pinnata*, Areng palm, black fibre palm, gomuti palm, *aren, irok, bagot*, and *kaong*. In Malaysia, it is known as either *enau* or *kabung*. The plantation area of sugar palm in Malaysia is smaller compared to oil palm and coconut palm. There are about 892 hectares of sugar palm plantation area while for oil palm and coconut palm 1 359 691 hectares and 182 776 hectares respectively (Sahari et al., 2012).

Sugar palm is a medium size plant and can grow up to 20m tall. The crown has 12 to 20 leaves that are made up of more than 150 smaller leaflets. The flowers are arranged in large bunch, up to 2m long and generally consist of 4 to 8 bunches of female flowers in the axils of the upper leaves and about 7 to 15 bunch of male flowers at the end. Fruits of sugar palm have hard black seed with a size of 5 to 8 cm long. Three to five years after germination, the palm forms a rosette of leaves without a stem. Approximately 50 leaves are developed in the following 5 to 10 years. The trunk serves as starch storage which then converted into sugars for the production of seeds (Wolter and Leo, 2010).

Palm sap derived from sap of palm tree is consumed freshly or processed as a refreshing alcoholic beverage by people in some parts of Africa, Asia and South America. Palm sap is a term commonly used by most of these countries and the name is given according to the origin of the sap. For example, a sap obtained from oil palm or *Arenga* palm is called palm sap or *air nira* while coconut sap or neera is a sap obtained from coconut palm (Ho et al., 2007). Sugar palm sap can be processed to produce sugar. Sugar palm tree can produce 25 tons of sugar per ha per year and it is the highest as compared to other agricultural plants. In contrast, sugar cane and cassava can produce only 14 ton and 20 tons of sugars per ha per year respectively. Sugar palm cannot grow in rows over acres of cleared land. It can grow at complex rainforest ecosystems and can be intercropped with other crops such as vanilla, bamboo, bananas, and figs. The tree has deep roots that make it well suited to very sloped and disturbed land (Chris, 2011).

2.2 Potential uses of sugar palm in Malaysian traditional cuisines

Almost all parts of the sugar palm tree can be used to make variety of products. The sap of sugar palm can be used to produce sugar, wine and vinegar. The cut stalk of sugar palm can produce sugary juice of about 10 to 50 litres a day with an average of 20 litres a day. The juice, containing about 12 to 16% with an average of 14% sucrose (Pontoh, 2007), is boiled until it becomes thick juice then moulded into a pike of bamboo or a coconut shell to produce a block of brown sugar or the thick juice is continually stirred to produce granulated brown sugar (Pontoh and Roeroe, 2015). Brown sugar is a natural sweetener because of its natural raw materials and the way of processing it is valuable for health (Abdullah et al., 2015).

In Malaysia, palm sugar is widely used in cuisines especially in the making of traditional *kuih muih* such as *lepat pisang, tepung bungkus, buah Melaka* and *dodol*. The use of

palm sugar can enhance the taste of the cuisines. Furthermore, palm sugar is gaining popularity because of its natural and minimal process as well as its health benefits due to its low glycaemic index (GI). The GI is the indexing of the glycaemic response of a fixed amount of available carbohydrate from a test food to the same amount of available carbohydrate from a standard food consumed by the same subject (Srikaeo and Thongta, 2015). According to Jenkins et al., 2002, GI values can be categorized into three main groups that are low (GI of 55 or less), moderate (GI of 56 – 69) and high (GI of 70 or higher) and the low GI is important to the dietary management of peak sport, diabetes, weight reduction, performance and the reduction of risks associated with heart disease and hypertension. Okpala (2015) stated that as compared to white sugar or sweeteners such as stevia, palm sugar is not refined thus retains all the nutrients and vitamins. Palm sugar comprises an excellent source of minerals and vitamins such as vitamin B1, B2, B3, B6, B12, zinc, potassium, iron and amino acids. It also contains fructose, sucrose and glucose.

Currently, sugar or sucrose derived from sugarcane is widely used as sweetener but it can contribute to health problem. Due to health concern, demand of reduced-sugar foods, low-calorie sugars such as acesulfame K, aspartame, neotame, saccharin, sucralose and varieties of polyols (sugar alcohols) such as sorbitol, mannitol, xylitol and other sweeteners is increasing (Kroger et. al., 2006). Nevertheless, all these kinds of sweeteners are costly and highly processed ingredients (Srikaeo and Thongta, 2015).

Sweeteners such as stevia and palm sugar in the manufacture of traditional Malay cakes not only improve the taste palatability, it is also good for health. Various attempts have been made by researchers in exploring new sources of sweeteners while preserving the treasures of nature. The Federation of Malaysian Consumers Associations (FOMCA) group communications director Mohd Yusof Abdul Rahman said that the rapid economic development over the last 20 years brought significant changes in the lifestyle of Malaysians community. The intake of fatty foods, oily foods and refined carbohydrates such as white bread, white rice and sugar is ever increasing. In 1970s, Malaysians consumed about 17 teaspoons of sugar a day and this figure rose to 21 teaspoons a day in the 1980s. In the 1990s, the Malaysian used an average of 24 teaspoons of sugar a day, but now the figure has raised to 26 teaspoons a day. Sugar is also associated with more than 60 diseases, including cancer, diabetes, obesity, heart problems, osteoporosis, kidney problems, asthma and allergies. According to statistics from Ministry of Health, 11.6 million of the 16 million adults nationwide suffer from non-communicable diseases (NCDs), such as diabetes, high blood pressure or cancer (Yusliza, 2015).

2.3 Future prospect of sugar palm

Palm sugar is reported rich in nutrient, has low-glycaemic index and pleasant taste, dissolves and melts exactly like sugar and is considered as natural and unrefined sugar. Although stevia has been widely used as natural sweeteners, many people have lately complained about the aftertaste of stevia. Thus, people turn to agave nectar which is made from bulbous roots of agave plant. However, agave plant has also been entangled in a controversy of whether it is truly natural or even low in glycaemic (Adams, 2010). Therefore, it has resulted in the use of brown sugar derived from palm sugar concentrated as an alternative sweetener.

Brown sugar derived from sugar palm tree has a potential as a sugar substitute and it is not only caused by the same function as a sweetener, but also because of the natural, unique flavour and aroma, as well as its nutritional properties. Productivity of sap from the sugar palm tree (*Arenga pinnata* (Wurmb) Merrill) is the highest among the sap of coconut (*Cocos nucifera*), siwalan (*Borassus flabellifer* L). (Weka et al., 2015). The nutritional properties of brown sugar are described in Table 1.

Table 1. Nutritional composition of brown sugar

Macro and micronutrient	Amount (mg/L (ppm) in dry matter
Nitrogen (N)	2.02
Phosphorus (P)	790.00
Potassium (K)	10.30
Calcium (Ca)	60.00
Magnesium (Mg)	290.00
Sodium (Na)	450.00
Chlorin (Cl)	4.70
Sulphur (S)	260.00
Manganese (Mn)	1.30
Boron (B)	0.30
Zinc (Zn)	21.90
Copper (Cu)	2.30

(Source: The Philippine and Nutrition Research Institute, 2000)

Other benefit of sugar palm that is still being explored is its potential to produce bioethanol as a substitute for fossil fuel. The economics important of sugar and bioethanol produced from sugar palm is still not well recognized by many people. Sugar palm may be seen as not so effective and efficient palm because they have a long juvenile phase which is about 10 years before harvesting. However, integrating existing bioethanol production in existing plantation and reducing the juvenile phase could be possible solutions. Jasper et al., 2011 suggested that sugar palm can be very productive as the ethanol yields are exceeding those of sugar cane. Previous study reported that sugar palm tree is capable of producing 19 tons of ethanol per hectare each year. Meanwhile, corn and sugar cane produce 3.3 tons and 4.5 tons respectively (Chris, 2011). According to Vracken (2014), sugar palm tree can produce between 1,600 to 2800 kg of sugar over its productive lifetime of 12-16 years and the yearly productivity is estimated about 105 to 227 kg/year. Thus, this can be used to estimate yield of ethanol for high scale production.

Besides having an important role in the economics of local people, the parts of sugar palm such as string, leaves, and fruits have many uses and by-product such as roofing materials, materials for braiding, wood and starch may contribute to income (Wolter and Leo, 2010). Besides sugar, starch also can be produced by sugar palm which derived from palm trunks, fibre from stem and sap tapped from the inflorescence part of palm tree. The nature of the trees which has very intensive roots near the soil surface and deep into the soil protects the soil itself which gives some advantages for soil conservation (Pontoh and Roeroe, 2015). Sugar palm requires less maintenance and can grow harmonically with other natural forest ecosystem components such as timber trees and food crops (Jasper et al., 2011). During the growth, the tree does not need soil cultivation and the harvesting can be done by only tapping the juice or taking the fibre without destroying the living trees causing the soil to never be disturbed.

Utilization of natural resource such as sugar palm as a new source of sugar and energy is vital. Sugar palm tree is capable of producing 19 tons of ethanol per hectare each year. Meanwhile, corn and sugar cane produce 3.3 tons and 4.5 tons respectively (Chris, 2011). However, continuous supply of sugar palm is needed to achieve this goal. Nowadays, Malaysia has set a target to become an advanced economy by 2020. Malaysia's Prime Minister Datuk Seri Najib Tun Razak said that socioeconomic development is vital in raising the quality of lives of Malaysians, but if limited natural resources are not used efficiently, it will result in irreversible damage and put Malaysia's development at risk. The Tenth Malaysia Plan, 2011-2015, recognised the importance of environmental sustainability as part of a comprehensive socio-economic development plan. Measures to address the issues of climate change, environmental

degradation, and sustainable utilization of Malaysia's natural endowment were therefore featured in the Tenth Malaysia Plan.

Therefore, the uses of sugar palm as new source of plant for production of sugar and ethanol can help Malaysia to pursue green growth for sustainability and resilience by strengthening the enabling environment for green growth. Efforts should be taken to maintain continuous supply of sugar palm which is beneficial to human and environment health. The uses of sugar palms are summarized in Table 2.

Table 2. Sugar palm parts and uses

Part of sugar palm	Utilization and application
Fruit	Palm sugar - food sweetener, brown sugar, preparation of Malaysian traditional cuisines, vinegar and fresh drink
Palm sap	Produces alcoholic beverages (bioethanol) by distillation process to fermented sugar sap with yeast to produces toddy that contains over 30% alcohol.
Bioethanol	Can be produce when make advance fermentation process. It is used as raw material for the production of product such as chemical products, solvents, pharmaceuticals, cosmetics and medicine.
Flower	Honey production
Root	Medicinal properties (to cure blader problem) Insect repellent, water pipes, musical instrument (drums), tool handles and erosion control
Stem core	Sago, starch, glue substances
Fibre	Rope, brush, thatching and filters
Pitch of leaf's rachis	Drinking cup
Leaves sheath	Fire ignition
Young leaves	Salads, cigarette paper
Leaflet midrib	Brooms, baskets, meat skewers
Old woody leaf bases	Biofuel
Trunk / Timber	barrels, floor and furniture and boards
Unripe endosperm	*Kolang kaling*

(Source: Sahari et al., 2012)

Due to its important and potential for human use and our economic growth, many researches have been conducted to break the dormancy of sugar palm seeds. Desy et al. (2013) indicated that, sugar palm has characteristic of seed coat dormancy and the rate of germination is very low (of 10% to 65%), taking about four to six months to start germination (Salim, 2004). Sugar palm can be propagated through its seed or biotechnology via tissue culture. Breeding program through biotechnology is an alternative method to provide high yield varieties. Furthermore, application of mechanical scarification such as rubbing with rough surfaces, grinding and scratching with sharp tools can overcome the effect of an impermeable seed coat thus enhances the germination rate (Lam and Adralina, 2011). Seed of *Lupinus parennis* scratching using razor blader gives 100% of germination rate (Bijan et al., 2003).

Besides application of mechanical treatment, the uses of chemical treatment such as acid and hormones are also among efficient method to break seed dormancy. For example, gibberellic acid (GA_3) can enhance seed germination and stimulate early seedling emergence and growth performance of plant (Hopkins and Huner, 2004). Previous study reported that the use of GA_3 at concentration 150ppm increases sugar palm seed germination up to 65% (Oktoviani et al., 2014). Furthermore, Desy et al., 2013 found that sugar palm treated with 0.3% hydrochloric acid fastens germination of sugar palm to 49 days.

In contrast, Micha et al. (2014) conducted a study on induction of somatic embryo from zygotic embryo of sugar palm using various combinations of hormones. They found that all types of medium used could produce embryogenic calluses. However, embryo globular treated with kinetin and 2, 3, 5-Triiodobenzoic acid (TIBA) during induction stage can produce highest amount of matured embryo clumps when treated with 0.1 mg l-1 GA_3 (70.8%). Embryogenic callus is a condition where calluses are able to regenerate into a plantlet through somatic embryogenesis or organogenesis.

3. Conclusion

Sugar palm is known as a multipurpose tree that has potential to provide various products which can give benefit to our economic and environmental sustainability. Sugar palm plays important role in maintaining Malaysian heritage especially in terms of food as well as provide green energy for environmental sustainability. Hence, research on sugar palm tree should be continued so that it can be commercialized on a large scale and generate income for the country. Therefore, Malaysia is able to produce brown sugar as alternative to sugar cane which is healthier for people use. Besides that, if the brown sugar is easily available, the uses of brown sugar in making our traditional cuisines especially in making *kuih muih* also can be expanded and this can enhance the taste and uniqueness of Malaysian cuisines throughout the nation. Generally, Malaysia is a country rich in natural resources and the population consists of multi races with different customs and culture to make it unique. Malay communities in Malaysia dominate the country. Each Malay community in each state in Malaysia has different languages, dress, customs and culture as well as cuisine. Until now, the uniqueness of Malay culture and heritage is still maintained due to the efforts and concerns of various private or government institutions. Conservation of Malay heritage is crucial to spark the growth of knowledge among researchers in promoting the development and progress of the country in many aspects. With an efficient use of sugar palm, Malaysia could preserve its unique food heritage and enhance its green technology.

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