



Faculty of Resource Science and Technology

**EFFECTS OF STERILISATION METHODS ON STORAGE OF
LIQUID NIPAH SUGAR**

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**Bachelor of Science with Honours
(Resource Biotechnology)
2018**



Borang PTA4

**Borang Pengesahan
Laporan Projek Tahun Akhir (STF3015)**

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**Effects of Sterilisation Methods on Storage of
Liquid Nipah Sugar**

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A report submitted
In partial fulfilment for the Degree of Bachelor Science with Honours
(Resource Biotechnology)

Faculty of Resource Science and Technology
Universiti Malaysia Sarawak

2018

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Final Year Project Report



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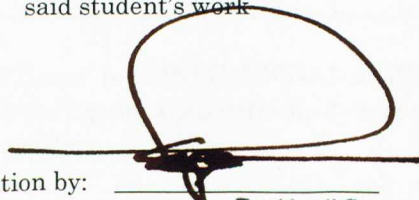
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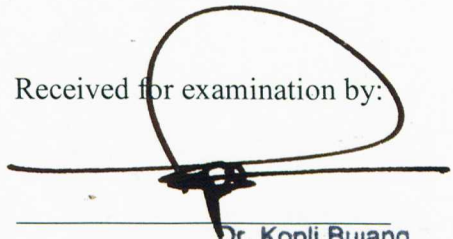
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ACKNOWLEDGEMENT

I would like to express my sincere gratitude to my advisor Professor Dr. Kopli bin Bujang for the continuous support of my research, for his patience, motivation, immense knowledge, the one who gave access to the laboratory and research facilities. Without his precious support it would not be possible to conduct this project. His guidance helped me in all the time of research and writing of this thesis.

I would like to thank the rest of my laboratory mates, Ms. Ilyana, Ms. Amirah Asyiqin, Ms. Afza Nazifa, and Mr. Ng Jek Yin for the stimulating discussions, encouragement, and for all the fun we have had in the last three years. I also would like to acknowledge individuals who have directly or indirectly, lent their helping hands in this venture.

Last but not the least, I would like to thank my family: my parents and to my brother and sisters for supporting me spiritually throughout the writing.

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LIST OF ABBREVIATIONS

BNS	Brown Nipah Sugar
CO ₂	Carbon Dioxide
CR	Cold Room
<i>et al.</i>	<i>et alii</i> (and others)
g	Gram
g/L	Gram per litre
GB	Glass Bottle
GI	Glycemic Index
ha	Hectare
HPLC	High Performance Liquid Chromatography
kg	Kilogram
L	Litre
LBNS	Liquid Brown Nipah Sugar
ml	Milliliter
pH	Potential of hydrogen
PP	Polypropylene
RT	Room Temperature
<i>S.cerevisiae</i>	<i>Saccharomyces cerevisiae</i>
UHT	Ultra High Temperature
UV	Ultraviolet
W	Watt
WNS	White Nipah Sugar
°C	Degree Celsius
°F	Degree Fahrenheit

Effect of Sterilisation Methods on Storage of Liquid Nipah Sugar

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ABSTRACT

Nypa fruticans is a species of palm native that grows in the soft mud and riverbanks. Brown Nipah Sugar (BNS) or commonly known as *Gula Apong* is a product produced from the nipah sap of *Nypa fruticans* where the nipah sap was boiled for 5-6 hours to produce BNS. They were collected from Kg Pinggan Jaya and Pusa, Sarawak. BNS was diluted with sterilized distilled water at ratio of 1:10 to produce Liquid Brown Nipah Sugar (LBNS). The LBNS was stored in different conditions after given different sterilization treatments to determine the storage analysis of LBNS. The pH, reducing sugar, ethanol contents and microbial contents over storage time was studied where the LBNS that stored in cold room, 4°C have a longer shelf life if compared to room temperature, ±25°C. Treatment of autoclave was more efficient compared to untreated, microwave and boiling as the LBNS that being autoclaved and stored in cold room, 4°C have constant concentration of glucose which is 30 g/L throughout the storage time. An autoclaved LBNS also have a suitable pH which is 5.0 where the condition is not favorable for the microbes to grow as the microbial contents for treatment autoclave is lower than the untreated LBNS, microwave and boiled LBNS. Then, as the concentration of glucose in autoclaved LBNS stored in cold room is constant, the ethanol contents also remain low which is 1.215 g/L over the 5 days of storage time.

Key words: *Nypa fruticans*, Liquid Brown Nipah Sugar (LBNS), Shelf life, Glucose, Ethanol

ABSTRAK

Nypa fruticans merupakan sejenis pokok palma yang tumbuh di kawasan lumpur dan tebingan sungai. Gula nipah perang (BNS) atau lebih dikenali sebagai gula apong merupakan produk yang dihasilkan daripada air nira di mana air nira tersebut akan dididih selama 5-6 jam untuk menghasilkan BNS. Gula nipah dapat diperolehi dari Kg Pinggan Jaya dan Pusa, Sarawak. Gula apong dilarutkan dengan air suling yang telah disterilkan pada nisbah 1:10 untuk menghasilkan Larutan Gula Nipah Perang (LBNS). LBNS akan disimpan dalam keadaan yang berlainan selepas diberikan rawatan untuk menentukan keadaan yang sesuai untuk menyimpan LBNS. Jumlah glukosa, pH, kandungan etanol dan mikroba dikaji dimana LBNS yang disimpan dalam suhu yang sejuk, 4°C mempunyai jangka hayat yang lebih panjang berbanding dengan suhu bilik, ±25°C. Rawatan autoklaf adalah lebih sesuai berbanding dengan LBNS yang tiada rawatan, ketuhar dan mendidih memandangkan LBNS yang diautoklaf dan disimpan dalam suhu sejuk, 4°C mempunyai kepekatan glukosa yang hampir sekata iaitu 30 g/L sepanjang masa penyimpanan. LBNS yang diautoklaf turut mempunyai nilai pH yang bersesuaian iaitu 5.0 di mana keadaan itu tidak sesuai untuk pertumbuhan mikroba memandangkan pertumbuhan mikoba untuk rawatan autoklaf adalah lebih rendah berbanding LBNS yang tiada diberi rawatan, ketuhar dan LBNS yang dididihkan. Kemudian, kandungan etanol kekal rendah iaitu 1.215 g/L sepanjang tempoh 5 hari masa penyimpanan dengan kandungan glukosa yang hampir sama untuk LBNS yang diautoklaf dan disimpan dalam suhu yang sejuk.

Kata kunci: *Nypa fruticans*, Larutan Gula Nipah Perang (LBNS), Jangka hayat, Glukosa, Etanol

1.0 INTRODUCTION

1.1 Background of study

The world's sugar supply primarily comes from sugar cane and sugar beet, but now there is a new entrant which is nipah palm. Nipah palm or in scientific is known as *Nypa fruticans* is the only species of palm native that adapted to the mangrove areas and it is actually one of the underutilized sugar-yielding palm in Malaysia (Prasad *et al.*, 2013). This special plant grows in soft mud and riverbanks where the river water bring in nutrients and they are typically found in Malaysia, Thailand, Vietnam, Indonesia, Singapore and Philippines. The largest nypa stands are found in Indonesia (700,000 ha), Papua New Guinea (500,000 ha), Malaysia (20 000 ha) and 8000 ha in the Philippines (Tamunaidu *et al.*, 2013).

Nipah palm has some important commercial uses where the sap production from the palm can be used to produce products and the nipah palm also used for multipurpose such as roof thatching, partitioning, sources of fuel wood and for medicinal purposes (Matsui *et al.*, 2014). Nipah sap is the main staple for the villagers especially in Malaysia where the rural community boil the nipah sap to yield a Brown Nipah Sugar (BNS) or commonly known as *gula apong*, they also fermented it into alcoholic drink and also vinegar. The vinegar produced from nipah sap such as the malt vinegar is not only can be used in cooking but also as a health drink as the nipah sap contains a flavonoid contents such as anticancer, antioxidants, anti-stress and anti-microbes which make it has a big potential to produce a health drink from the nipah sap.

Realizing the potential of commercializing nipah industry, the MUDA Agricultural Development Authority takes a bold step forward in the development of this natural plant to boost the local community's economy. The nipah commercialization project in the MUDA area is one of the federal governments' initiatives in developing nipah entrepreneurs. Their main objective is to bring the nipah industry to commercialized level. In 2009, the nipah sap

production had reached up to 287,000 L and the value are approximately 1 million for the year of 2009 itself. The amount of nipah sap that can be collected from each bunch of the nipah tree is between 0.5 to 1 L a day. The demands for nipah sugar is expanded in the household use and the growing recognition by consumers of the health value of palm sugar. The main driving force is the awareness that nipah sugar is much healthier than bleached sugar. It does not cause sugar rush and its glycemic index (GI) of 35 is much lower than glucose which has a GI of 100. This makes nipah sugar fit for modest consumption even for diabetics (Tacio, 2017)

The sugar demand is expected to increase in Malaysia by 3% a year to over 1.9 million tons by the year 2020 despite the higher prices due to the rapid population in Malaysia (The Crop Site, 2011). Therefore, the production of sugar from nipah sugar will give a big impact in Malaysia sugar industry because a large amount of sugar beet and sugarcane need to be imported from other countries while sugar from nipah palm can be obtained from Malaysia for food sugar supply.

1.2 Objectives

The objectives of this study are to:

1. Analyse storage period of LNS.
2. Determine the best storage conditions for LNS.
3. Produce Liquid Nipah Sugar (LNS) from solid Brown Nipah Sugar (BNS), as an option in marketing nipah sugar globally.

2.0 LITERATURE REVIEW

2.1 Sugar industry

There are approximately 165.8 million metric tons of sugar that was produced in total worldwide in 2015/2016. The global production of sugar is now at around 180 million tonnes a year. Approximately 80% is produced from sugar cane and 20% is produced from sugar beet. The 10 countries that have a large production of sugar represent roughly 75% of world sugar production where the Brazil alone are almost 25% of world production (International Sugar Organization, 2016).

The total world sugar trade is projected to increase by 8.3% from 45.8 million metric tons to 49.6 million metric tons between 2016 and 2025. Even the Brazil's production is expected to increase by 10.8% from the 2013-2015 average of 36.3 million metric tons to 40.1 million metric tons in 2025 and their consumption is predicted to increase by 17.7% (Taylor, 2016). The world's sugar production is produced from sugar cane which is largely grown in tropical countries and sugar beet which is mostly grown in the country with temperate zones of the northern hemisphere. Sugar cane or scientifically known as *Saccharum officinarum* provide about 75% of world's sugar production. The average sugarcane stalk has about 1.2 kg of juice, which is roughly 11% sugar by weight. Thus, the average stalk contains about 0.3 pounds (0.12 kg) of sugar (Pereira, *et al.*, 2016). Sugar cane and beet sugar are identical in chemistry and quality but the sugar beet only provide about 35% of the world's sugar. Then, the sugar industry in Malaysia is rapidly increasing as the sugar is one of the important recipe in fast growing food industry. The import of sugar have expanded steadily in order to meet the growth in demand. In 1995, imports of raw sugar reached a record 1.0 million tonnes, while exports were 101 000 tonnes. In recent years, sugar have been Malaysia's largest agricultural import, with annual sugar imports valued at

between US\$200 to 300 million. The main suppliers of raw sugar to Malaysia are Australia, Thailand and Fiji which account for 98% of total imports.

2.2 Nipah Palm (*Nypa fruticans*)

Nipah palm is one of the Arecaceae family and a species under genus *Nypa*. It was a special plant which grows wild in a wet and swampy areas especially in the states of Kedah, Perlis, Terengganu and Sarawak. Nipah palm has a large frond which looks almost similar to a palm leaf as shown in **Figure 1**. Nipah palm is special and popular among the rural community. It has a lot of uses and the main one is the liquid produced through the fruit bunches called nipah sap or nipah juice (The Star Online, 2006). It is being developed as a commercialized agricultural downstream product and the demand of nipah sap is increasing day by day. The sweet nipah sap tapped from the stalk of the inflorescence where the tapping normally commences from the nipah palm shoots after four years and continues up to 15 years or more. The shoots of 9 – 12 year old usually can produce a lot of nipah sap where the palm can produce 1500 – 1900 ml of sap per stem. However, the stems of 15 years or more can yield less nipah sap (Hossain & Islam, 2015). In Malaysia, nipah palm is actually became one of the main products in the state of Sarawak. It is growing naturally and abundantly in the mangrove and river areas of Kota Samarahan, Pusa, Asajaya and Betong Sebuyau. Sarawak had a lot of nipah palm which covering about 47 000 hectare of with concentration wetland mostly in Rajang Delta (The Sarawak Tribune, 2014).



Figure 1: *Nypa fruticans* in Pusa, Sarawak.

2.3 Traditional Method on Harvesting Nipah sap from Nipah Palm

The process of harvesting the nipah sap starts by knocking matured palm branches. The action of knocking the branches is known as *mengurut*. The palm fruit is then removed. The end of the branch is sliced and the liquid will flow out (Herbsia, 2017). Specifically, a bunch of ripened nipah fruit will be gently tapped and massaged once in every two days for two months before being cut for the nipah sap. It is believed that massaging the bunch will ensure the active nipah bunches produce more nipah sap (Aimi *et al.*, 2012). There are various other ways that are used by other entrepreneurs to collect nipah sap. In the past, the nipah sap was collected using a bamboo that was smoked for 4 hours in order to produce a fragrant nipah sap. The bamboo is called '*tookie*'. Now, there is a modern method that being practiced today which is using sterile plastic bag or plastic bottle to collect the nipah sap from the palm trees. From the interview session with Mr Mahli bin Ramli and Mr Bujang, the owner of nipah palm in Kg Pinggan Jaya, Kuching Sarawak, the method of using plastic bottle is not really hygienic and efficient as the bottle will become smelly after being used once and

require a lot of time to wash the bottles and they prefer to use bamboo to harvest the nipah sap as shown in **Figure 2**. The unopened flower spathe is prepared by tight binding to prevent it from opening; gentle tapping with a mallet; gradual bending; and final cutting. Then, the nipah sap starts to exude from the opening of the cut stalk. This methods also minimizes the exposure of nipah sap to the environment and contaminants which allows the hygienic collection of sap (Tamunaidu *et al.*, 2013). It is also important to eliminate the tedious washing of collection vessels after every use to minimize the inversion and fermentation of nipah sap.



Figure 2: Method on harvesting the nipah sap using (a) bamboo and (b) plastic bottle

2.4 Method on Production of Brown Nipah Sugar from Nipah sap

The nipah sap has a short life span and it takes only about 3 to 4 hours for it to tastes sour after being harvested from the palm and the level of alcohol in nipah sap will increase if it was left for a few hours. The nipah palm sap need to be cool immediately after collection and kept frozen in order to prevent the sweetness of palm sap turn into sour. However, some rural community especially in Sarawak does not have refrigerator or electricity to freezing the nipah sap. Therefore, the villagers have an alternative to make the nipah sap can retain its sweetness where the sap was boiled for 6-8 hours with continuous stirring to evaporate the water content and produce BNS as shown in **Figure 3**. There are about 10 L of sap to produce 1 kg of BNS. The BNS was used in drinks and foods as a sweetener. Currently, there are a few small-scale producers of BNS in small towns in Sarawak, and they produce on demand. As the production of BNS is very time consuming and labor intensive, there are fewer and fewer people are willing to continue the craft. There is a possibility that it will diminish over time as other forms of sugar, honey, and treacle are available and cheaper in the market



Figure 3: Production of BNS Kg Pinggan Jaya, Kuching Sarawak. (a) Nipah sap boiled over a wood fire for about 6 hours until it is dry. (b) BNS produced after the boiling process.

2.5 Commercialization of Nipah Sugar

The PT First Flower is a knowledge based industry which has an objective to develop Nipah palm as a major supplier of sugar in Asia due to the unique configuration of factors such as the availability of species, modern selection and propagation technology, the land and of course the demand. The nipah palm can yields a sap with a sugar content of around 13 to 16%, the highest sugar content of palm trees and also much higher than sugar cane.

According to Borneo Post Online (2014), Sarawak is set to be the hub for the Nipah industry. With SARZ AL-Yahya Corporation Sdn Bhd investing between RM3 billion and RM5 Billion within five years starting the year of 2015 to develop a large scale nipah plantation and Nipah Sap Processing Industry Complex in Belawai, Tanjung Manis. This is because the nipah sap play a role in food industry as the nipah sugar is traditionally used as a tastemaker in spicy food pastes, cakes and bakery products. It is increasingly used as a sweetener for ice-cream, energy drinks, lemonades, soy sauce and bakery products. In Sarawak, the nipah sugar (*Gula Apong*) can be produce about 15 000 – 20 000 packet per day in kg Tambak, Pusa, Sarawak. Besides, according to Utusan Sarawak (2013), Lembaga Pemasaran Pertanian Persekutuan (FAMA) has managed to export 22 tons (21 904.65 kg) of nipah sugar to Brunei and for domestic uses in Sarawak.

2.6 Applications of Nipah Sugar

For the liquid nipah sugar or the fresh nipah sap, the downstream products produced are ice blended nipah, nipah jelly, nipah ice-cream and nipah vinegar. Then, the BNS or *Gula Apong* was traditionally produced and utilized in coastal villages where sugar was not available and expensive due to the limited road accessibility. Therefore, the processed imported white sugar replaced *gula apong* gradually. In Sarawak, the Ibans ethnic using *gula apong* to make rice cakes (*penganan iri*) to serve them to guests during festivals especially during the Gawai

Festival. Currently, the *gula apong* was widely used in Sarawak in order to providing a sweet taste in food products such as in Chendol, Three-layered tea, puddings, kuih talam and the most popular one is the ice-cream *Gula Apong* as shown in **Figure 4**. It is also used as food flavor enhancer and coloring.



Figure 4: (a) Rice cakes and (b) ice-cream *gula apong* made from nipah sugar which are commonly found around Kuching