FERMENTATION DYNAMIC OF TARAP (*Artocarpus odoratissimus*) PULP

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ABSTRAK

Artocarpus odoratissimus atau nama tempatannya 'tarap' cukup terkenal di Sabah. Kajian terhadap penapaian tarap kurang dijalankan dan maklumat terperinci mengenai penyelidikan tarap kurang diperolehi sebelum ini. Analisa biokimia terhadap kandungan nutrisi isi tarap telah dijalankan untuk membentuk data rujukan. Jumlah keseluruhan gula tarap mengandungi 46.76 mg/ml, gula penurun sebanyak 6.10 mg/ml, 8.34 mg/ml protein, 1.67 % lipid, 99.45 % abu dan 75.36% nilai kelembapan. *High Performance Liquid Chromatoghraphy* (HPLC) dijalankan terhadap gula menunjukkan tarap mengandungi glukosa, fruktosa dan sukrosa. Analisa HPLC terhadap asid organik menunjukkan kehadiran asid fumarik, maleik, oxalic dan malonik. Tiga jenis penapaian diselidik; penapaian asid laktik bakteria (LAB) menggunakan probiotik *Lactobacillus casei* (*L. casei*), penapaian yis menggunakan *Saccharomyces cerevisiae* (*S. cerevisiae*), dan penapaian laktik bersama susu menggunakan *L. casei*. Bilangan bacteria dikira, nilai pH diambil dan analisa biokimia dijalankan (protein, gala keseluruhan and gula penurunan) serta HPLC untuk gula serta asid organik dianalisis. Pertumbuhan bakteria dan nilai pH yang tidak sekata terhadap semua penapaian menunjukkan paten yang serupa; jumlah tertinggi pada hari ketiga dicapai bersama dan penurunan nilai pH yang mendadak, serta penurunan secara berperingkat sehingga hari ke-15. Di akhir penapaian nilai pH yang diperolehi adalah kurang dari empat bagi penapaian LAB serta penapaian laktik bersama susu, dan penapaian yis adalah kurang dari lima. Kuantiti penjumlahan bakteria direkodkan paling tinggi mencapai log 1 cfu/ml bagi penapaian laktik dengan susu, 10^9 cfu/ml dalam penapaian LAB dan 10^7 cfu/ml bagi penapaian yis. Corak transformasi biokimia untuk semua jenis penapaian semasa proses penapaian adalah hampir serupa; gula keseluruhan dan gula penurun berkurangan sehingga proses penapaian berakhir dan nilai turun naik protein berkadaran dengan nilai turun naik jumlah bakteria. Asid laktik dikesan pada hasil akhir dari dua penapaian yang dijalankan melibatkan *L. casei*. Hasil penapaian yis menunjukkan kehadiran asid malik, suksinik dan maleik.

ABSTRACT

Artocarpus odoratissimus or known by the local as 'tarap' is a well known fruit in Sabah. Fermentation in tarap is least known and studied before. Biochemical analyses for tarap pulp nutritional properties were carried out to construct a baseline data. Tarap contained 46.76 mg/ml of total sugar, 6.10 mg/ml reducing sugar, 8.34 mg/ml protein, 1.67 % lipid, 99.45 % ash and 75.36% moisture. High Performance Liquid Chromatography (HPLC) for sugar performed revealed that sugars in tarap were glucose, fructose and sucrose. HPLC analysis for organic acid revealed that organic acids in tarap were fumaric, maleic oxalic and malonic acid. Fermentation investigated; (lactic acid bacteria) LAB fermentation using probiotic *Lactobacillus casei* (*L. casei*), yeast fermentation using *Saccharomyces cerevisiae* (*S. cerevisiae*), and lactic fermentation with milk using probiotic *L. casei*. Bacteria were enumerated, pH and biochemical analyses were carried out (protein, total sugar and reducing sugar), and HPLC for sugar and organic acid were performed. Bacteria growth and pH fluctuation for all the fermentations performed the same pattern; reached highest value in day three together with rapid dropped in pH, and slowly declining until day 15. pH at the end of the fermentation were less than four for LAB fermentation and lactic fermentation of milk, and less than five for yeast fermentation. Bacteria enumeration highest quantity reached log 1 cfu/ml in lactic fermentation of milk, 10^9 cfu/ml in LAB fermentation and 10^7 cfu/ml for yeast fermentation. Patterns of biochemical transformation for all the fermentation types during fermentation process were almost the same; total and reducing sugar content declining until the end of fermentation process and protein fluctuated in synchronized with bacteria fluctuation. Lactic acid detected in the end of fermentation product for the two fermentation of tarap engaged with *L. casei*. Yeast fermentation products detected malic, succinic and maleic acid.

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LIST OF SYMBOLS AND ABBREVIATIONS

°C	degree Celsius
%	percent
ml	milliliter
mm	millimeter
cm	centimeter
µm	micrometer
nm	nanometer
mg	milligram
g	gram
kg	kilogram
µl	micro litre
min	minute
L	litre
M	molarity
N	normality
UV	ultraviolet
H_2SO_4	sulfuric acid
$K_2S_2O_8$	potassium persulfate
NaOH	sodium hyroxide
MeOH	methanol
$CHCl_3$	chloroform
Na_2SO_4	anhydrous sodium sulphate
Hex	hexane
H_2O	water
EtOAc	ethyl acetate
MeCN	acetonitrile
HPLC	High Performance Liqiud Chromatography
cfu	colony forming unit

LAB	Lactic Acid Bacteria
MRS	de Man, Rogosa, and Sharpe
DNS	dinitrosalicylic acid
AOAC	Association of Official Analytical Chemists

CHAPTER 1

INTRODUCTION

1.1 Overview

Food is vital in human community despite geographical regions and their daily lifestyle. Moreover, food reflects the uniqueness of each community present. Different geographic region exploits different resource as food, usually indigenous sources that exist in their surrounding. Furthermore, although few different communities that exist in the same place utilize the same food resource, each of the community may alter the resource into distinctive food. This is how food resembles the uniqueness of community. Fermentation is one of the food preservation technique where the same raw material may be manipulate to undergo different type of fermentation in different region that will produce different taste and flavor as well as the nutritional properties. It is one of the oldest food process technologies which can be traced back thousands of years ago (Ross, 2002).

Food can be in the form of ready-to-eat fresh or processed product from the raw material. Processed foods from raw material whether the resource come from vegetation or animal are to enhance the usage of the raw material or to add value that is by improve flavor and nutritional value. One of the fruit processing technique that are common since the earlier times practiced by most culture in human communities in the world are food fermentations. Universality of this practiced can be seen worldwide through huge range of traditional foods exist until nowadays (Fallon, 2000). In Mediterranean country such as Spain, olives fermentation is common since the crops were abundance, Germany fermented wheat to make sour bread and rice and fish fermentation is traditionally practice by the people in Asian country and cereal, root crops and milk where fermented in Africa (Lee, 1997; Oyewole, 1997).

Fermentation utilizes different chemical composition in raw material, and turns original material into various types of fermentations products that may differ in taste, original appearance and the quality from the original form. Fruit sugar, when fermented with yeast will produce ethanol where this is common in brewery and wine production in western countries such as in Europe. In the existence of lactic acid bacteria, the fruits sugar will be converted into lactic acid as the end product. Examples of lactic acid fermented food are Korean kimchi and sikhae while Germany popular with sauerkraut. (Lee, 1997). Part from that, fermentations produced acetic acid, citric acid and other organic acid through favorable conditions provided during fermentation process.

For example in Malaysia, one of the most popular fermented fruit is tempoyak. Tempoyak is fermented durian (*Durio zybethinus*) pulp. This fermented fruit pulp is common in Peninsular Malaysia and have been used widely in cooking varieties of local delicacies. This method not only preserves durian pulp and prolongs the life span, in the same time given additional value to durian itself (Leisner *et al.*, 2001).

This study is to look at indigenous food fermentation of the local resource. Tarap (*Artocarpus odoratissimus*), fruit native to Sabah was chosen as study material to see the biotransformation that took place when fermentation was carried out by looking the flavor, appearance, quality and the composition of the end product so thus the nutritional properties of unfermented and fermented fruit pulp.

1.2 Tarap (*Artocarpus odoratissimus*)

Artocarpus odoratissimus (A. odoratissimus) fruit, which is by local name known as *tarap* fruit is a local fruit in Sabah. Tarap distribution can be found in the South East Asia region. This fruit are common in Sabah, Sarawak, Philippine and Brunei (Serudin & Tinggal, 1992). Different place may have different local name of the fruit. These plant species belong in the order *Urticales* under the family *Moraceae* and the genus *Artocarpus*, the same genera as jackfruit (*A. heterophyllus*) and breadfruit (*A. altilis*) so thus the chempedak (*A. polyphema*).

In Sabah and Sarawak, *A. odoratissimus, A. heterophyllus, A. altilis* and *A. polyphema* is common fruits and contributes as food resources to the local but in Peninsular Malaysia, *A. odoratissimus* is least known to the local. To be compare with the jackfruit and chempedak, tarap is least known in the market and the fruit product is not well-developed as the two mentioned species' are. The pulp (mesocarp) is ready-to-eat fresh. The seed (endocarp) are eaten boiled (Serudin & Tinggal, 1992). The tarap fruit skin turns green-yellow when ripe. The internal formation of the fruit pulp is similar as *A. heterophyllus*. The tarap pulp is usually smaller than the fruit pulp of jackfruit or the chempedak in size.

The pulp of the fruit when ripened has fragranced aroma, succulent and sweet in taste beside the nutrition it holds. Thus, the properties stated make the tarap pulp to be potentially developed into food product to give additional value to the fruit itself (Serudin & Tinggal, 1992).

1.3 Scope of Study

Tarap (*A. odoratissimus*) is subjected to fermentation with probiotic microbes. The ripened pulp or the mesocarp is the only part of the fruit that will be subjected to be analyzed. The fermented and unfermented tarap will be analyzed using certain biochemical analyses. The biochemical transformation during the fermentation process will be examined.

1.4 Importance of Study

Tarap is a local fruit and indigenous to Sabah. This fruit can be found extensively in Sabah and affordable. The fruit should be consumed within a few hours after opened that is by removed the skin, this is due to that once the pulp exposed to air, the pulp loses flavor quickly and fruit darkens (over-ripened). Sugar content of the tarap pulp that was about 20% indicate high sugar content that ideal for fermentation. As a result, further development can be studied regarding tarap fermentation that hold the potential to be developed into value added product.

1.5 Aim of Study

The study was to performed fermentation procedure to tarap fruit pulp and examined the end product from the fermentation process.

1.6 Objective

The objectives of my study are;

I. To determine base-line value of Tarap nutritional properties.

II. To optimized fermentation dynamic on Tarap (*Artocarpus odoratissimus*) pulp using probiotic microbes.

III. To study microbial dynamic and pH fluctuation.

IV. To study the biochemical transformation during the fermentation process.

CHAPTER 2

LITERATURE REVIEW

2.1 Tarap Fruit

Unique fruits and indigenous to Borneo are still exist in the wild, including in Sabah, Malaysia. One of the fruit is tarap *(Artocarpus odoratissimus)* where the pulp flesh usually eaten fresh.

Tarap have many parts of the tree that can be investigated (young leaves, seeds, tarap fruit skin, latex) and tarap fruit and seeds have great potential to be developed into food product. The fruit of tarap have nutritional properties including vitamin C and carbohydrate. Beside the edible pulp, the seed and skin of tarap fruit were also valued. The seed recorded in Brunei have medicinal properties while the skin was given to livestock as food feeding. Different parts of tarap trees were used for different purpose that benefits the peoples. Tarap is high in sugar content that is about 20 % which stated to

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