PHYSICOCHEMICAL, BIOCHEMICAL AND ORGANOLEPTIC ANALYSIS OF PINEAPPLE CULTIVARS MD2 AND MORRIS

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To my much-loved parents and friends.

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ABSTRACT

According to Malaysian Pineapple Industry Board (MPIB), pineapple industry is one of the important agricultural sectors in Malaysia thus plays a role in national earnings as one of the world top pineapple suppliers. In Malaysia, pineapple cultivars include Maspine, Morris, Morris Gajah, Gandul, Sarawak, Josapine, N36, Yankee and MD2. Each cultivar has its own physical and phytochemical uniqueness. Before 'MD2' was introduced, 'Morris' was one of the popular cultivars for fresh consumption. This study was geared toward comparing physicochemical, biochemical and organoleptic evaluations of two commercial pineapple cultivars 'MD2' and 'Morris'. Six fruits of each cultivars were purchased at commercial maturity stage which is about 20-40% yellowing of fruit peel and flesh of fruits were used for evaluations. Results of physicochemical analysis showed that 'MD2' is the sweeter and less astringent variety compared to 'Morris' and the same was also observed biochemically where antioxidant capacity, protein content and bromelain enzymatic activity were higher in 'MD2'. For organic acids, 'MD2' had a slightly lower content of oxalic and malic than 'Morris'. Sensory analysis had also supported 'MD2' as the most preferred among the two cultivars where all the attributes such as aroma, flavor, sweetness, off-taste, texture and overall preference scored higher compared to 'Morris'. As a conclusion, 'MD2' compares very well against 'Morris', hence its cultivation in Malaysia for potential local and international market should be encouraged not only due to their higher consumers' preference but nutritional benefits. All the mean differences observed between the cultivars were statistically significant except for protein content and organic acids quantification.

ABSTRAK

Menurut Lembaga Perindustrian Nanas Malaysia (MPIB), industri nanas merupakan salah satu sektor pertanian yang penting di Malaysia dan memainkan peranan penting dalam pendapatan negara sebagai salah satu pembekal nanas terbesar di dunia. Kultivar nanas di Malaysia termasuk 'Maspine', 'Morris', 'Morris Gajah', 'Gandul', 'Sarawak', 'Josapine', 'N36', 'Yankee' dan 'MD2'. Setiap kultivar mempunyai keunikan tersendiri secara fizikal dan fitokimia. Sebelum 'MD2' diperkenalkan, 'Morris' adalah salah satu daripada kultivar yang popular untuk kegunaan segar. Kajian ini menjurus ke arah membandingkan fizikokimia, biokimia dan nilai penilaian deria dua kultivar nanas yang komersial iaitu 'MD2' dan 'Morris'. Enam biji buah bagi setiap kultivar telah dibeli pada peringkat kematangan komersial iaitu kira-kira 20-40% kekuningan kulit buah-buahan dan isi buah-buahan telah digunakan untuk penilaian. Keputusan analisis fizikokimia menunjukkan bahawa 'MD2' adalah lebih manis dan kurang masam berbanding 'Morris' dan yang sama juga diperhatikan secara biokimia dimana kapasiti antioksidan, kandungan protein dan aktiviti enzim bromelain adalah lebih tinggi dalam 'MD2'. Bagi asid organik, 'MD2' mempunyai kandungan oxalic dan malic yang rendah daripada 'Morris'. Analisis deria juga telah menyokong 'MD2' sebagai yang paling digemari di mana semua sifat-sifat seperti aroma, rasa, kemanisan, off-taste, tekstur dan kesukaan secara keseluruhan menjaringkan lebih tinggi berbanding dengan 'Morris'. Kesimpulannya, 'MD2' berbanding dengan baik terhadap 'Morris', oleh itu penanaman 'MD2' di Malaysia untuk potensi pasaran tempatan dan antarabangsa perlu digalakkan bukan sahaja kerana tahap kesukaan pengguna yang lebih tinggi malah faedah pemakanan yang berkhasiat. Semua perbezaan min antara kultivar secara statistik adalah signifikan kecuali kandungan protein dan kandungan asid organik.

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LIST OF ABBREVIATIONS AND SYMBOLS

AE	:	Albumin Equivalents
AI	:	Astringency Index
cv.	:	Cultivar
DNA	:	Deoxyribonucleic Acid
DPPH	:	2,2-Diphenyl-1-Picrylhydrazyl
EC	:	Enzyme Commission
e.g.	:	exempli gratia
EDTA	:	Ethylenediaminetetraacetic Acid
ET	:	Electron Transfer
et al.	:	and Others
etc.	:	et cetera
g	:	Gram
h	:	Hours
H_2O_2	:	Hydrogen Peroxide
HAT	:	Hydrogen Atom Transfer
IC50	:	Concentration providing 50% Inhibition or 0.5 of Absorbance
kg	:	Kilogram
L	:	Litre
M	:	Molar
mg	:	Milligram
ml	:	Millilitre
mM	:	Millimolar
MARDI	:	Malaysian Agricultural Research and Development Institute
min	:	Minute

n	:	Sample size
nm	:	Nanometer
ROS	:	Reactive oxygen species
rpm	:	Revolutions per Minute
SEM	:	Standard Error of Mean
SI	:	Sweetness Index
SPSS	:	Statistical Package for the Social Sciences
TA	:	Titratable Acidity
TSS	:	Total Soluble Solids
UV-VIS	:	Ultraviolet–Visible
v	:	Volume
var.	:	Variety
w	:	Weight
WW	:	Wet weight
µg	:	Microgram
µl	:	Microlitre
℃	:	Degree Celsius
%	:	Percent

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CHAPTER 1

INTRODUCTION

1.1 Research Background

Agriculture and agro-based industry is one of the main contributors to the national economy growth and development and is considered Malaysia's third machine of economic growth. World pineapple trade has shown increasing trend for the past three decades. According to Malaysian Pineapple Industry Board (MPIB), pineapple industry is one of the important agricultural sectors in Malaysia thus plays a role in national earnings as one of the world top pineapple suppliers. Conferring to Economic and Technology Management Review (e-ETMR), Malaysia is listed as top 15 in fresh pineapple exporter and number 9 for canned. Statistics of fresh pineapple production and canned pineapple in Malaysia for 2011 was 96957 metric tonnes and 17165 metric tonnes, respectively (MPIB).

Pineapple (*Ananas comosus)* is a tropical plant with edible multiple fruit and named after its similarity to the pine cone. It is the most economically important fruit in the *Bromeliaceae* family. Rangan (1984) stated that the palatable percentage of the fruit constitutes about sixty percent of their weight and contains approximately eighty five percent water, 0.4% protein, 14% sugar, 0.1% fat and 0.5% fibre. Pineapple is sweet, flavorful, aromatic and has several beneficial properties including an antioxidant property. This fruit contains sugar, vitamin C, and bromelain, a

proteolytic enzyme that breaks down protein that helps fight infections by dissolving layers of slough and bacteria-rich surfaces. Bromelain has proven medicinal uses such as anti-inflammatory effects and subsiding swelling of inflammation such as acute sinusitis, sore throat, arthritis and provide faster recovery from wounds and surgery (Maurer, 2001). Due to its attractive sweet flavor, pineapple is widely consumed as fresh fruit, fruit juice, canned fruit, and as an element in desserts. World production and commercial applications of selected fruits based on Hui (1991) states that pineapple is ranked 8th in the largest 1998 world production (106 ton/year) compared to many other fruits.

Preference of fruits are mainly determined by general composition that greatly influence its flavor and nutritional properties. Since amount and concentration of sugar, organic acid and phenolic compounds greatly influences taste of the commodity (Kelebek *et al.*, 2009), physicochemical and biochemical tests were conducted to improve better knowledge and understanding of consumer's preference. Many sensory characters such as aroma (retronasal sensation observed when chewing and then swallowing), tenderness vs. firmness, saccharinity, astringency and sweetness to acidity ratio are of great importance in terms of preference. However, consumers are now more concerned with the nutritional qualities and benefits of their diet in addition to these general sensory characteristics. Fruit nutrients which are considered important are vitamins, minerals, phenolics, and carotenoids (responsible for the yellow to orange color of fruits). Phenolic compounds contribute toward some useful biological actions for example antioxidative (Larrauri *et al*., 1997), anti-browning (Chaisakdanugull *et al.*, 2007) and anti-inflammatory (Hale *et al.*, 2005) properties.

The sugar composition of pineapple fruit plays a significant part in its apparent quality, sweetness level and people's acceptability. Sugar level is influenced by weather and fruit maturity stage or conditions. Total soluble solids content (TSS) test the solids concentration of a sucrose containing solution, which is the typical quality attributing for assessing a fruit's sweetness (Delwiche *et al.*, 2008).

Organic acids are present in different concentrations and varieties in different types of fruits. According to Belitz *et al.* (2009), major organic acids found in

pineapple are citric and malic acid. Organic acids are helpful guide of authenticity in fruit product. The organic acid composition of fruits is of great concern because of its significant impact on the sensory characteristics of fruit juices (Kelebek *et al.*, 2009).

Pineapple in Malaysia are planted all across Peninsular and East Malaysia. The most familiar varieties are 'MD2', 'Sarawak', 'Yankee', 'Josapine' and 'Morris Gajah' for fresh fruit intake. 'Sarawak' is also known as 'Smooth Cayenne' in Spanish or 'Kew' in Thailand. Another variety called 'Gandul' is processed for canning and its juice. Varieties 'N36' and 'Maspine' are used for both fresh and canning processes (MPIB). Several research were carried out previously to study and compare the chemical composition, morphology and bioactives of different pineapple varieties. Bartolomé *et al.* (1995) studied morphological features, chemical constituents and sensory analysis of 'Red Spanish' and 'Smooth Cayenne' cultivars while Brat *et al.* (2004) compared the physicochemical characteristics of a new pineapple hybrid named 'FLHORAN41' with 'Smooth Cayenne'. Hossain *et al.* (2011) worked on total phenolic compounds and antioxidant activity of pineapples. The result from many previous studies proved that different cultivars have different phytochemical characteristics.

1.2 Problem Statement

Pineapples are beneficial and nutritious to human due to its phytochemical compositions. The industry is a big contributor to the agricultural sector in Malaysia. Based on previous research, different pineapple varieties contain different chemical compositions. However, physicochemical and biochemical evaluation and comparison of commercially available pineapple cultivars in Malaysia have yet to be fully accomplished. Thus, this study was geared toward analyzing the differences among two different cultivars 'MD2' and 'Morris' to come up with useful information on nutritional values and beneficial health benefits of the two commercial pineapple

cultivars in Malaysia to create vital data resource for further research of the fruit as a reference for commercial use.

1.3 Objectives

i) To compare physicochemical properties of pineapple cultivars 'MD2' and 'Morris'.
ii) To analyze the biochemical characteristics of pineapple cultivars 'MD2' and 'Morris'.
iii) To evaluate organoleptic characteristics of pineapple cultivars 'MD2' and 'Morris'.

1.4 Scope of Study

For this study, six pineapple fruits of two different cultivars 'MD2' and 'Morris' were purchased at commercial maturity stage, which is about 20%-40% yellowing of fruit peel. The edible portions of the fruit were taken as sample for evaluation. For physicochemical tests, the edible portion of fruit pulp were homogenized and the juice was analyzed for pH, titratable acidity (TA) and total soluble solids (TSS) in degrees Brix at 20°C. Biochemical tests composed of determination of DPPH radical scavenging capacity, protein content, bromelain enzyme specific activity and selected organic acids quantification. Different solvents and methods were used for the extraction of pineapple for different tests. Antioxidant capability of pineapple fruits was determined using DPPH radical scavenging ability. Bromelain enzyme proteolytic activity, protein content and specific activity were determined. Organoleptic test included evaluation of appearance, texture, aroma, off-flavor, sweetness and overall preference involving 30 taste respondents by using 5

point Hedonic scale (1: Dislike Extremely; 2: Dislike; 3: Neither like nor dislike; 4: Like; 5: Like Extremely). Lastly, statistical assessment was performed using IBM SPSS 18 Statistics software.

1.5 Significance of Study

Even though pineapple industry is one of the biggest contributor to Malaysian agricultural sector's gain, the physicochemical, biochemical and organoleptic tests and comparison among commercial cultivars are yet to be fully established. Thus, this study was geared to determine, compare and relate the physicochemical and biochemical components, antioxidant ability, enzymatic activity and organoleptic sensory evaluation of two different commercial pineapple cultivars in Malaysia.

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