NUTRITIONAL CHARACTERISTICS EVALUATION OF MALAYSIAN COMMERCIAL PINEAPPLE CULTIVARS

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NUTRITIONAL CHARACTERISTICS EVALUATION OF MALAYSIAN COMMERCIAL PINEAPPLE CULTIVARS

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To my beloved parents and friends.

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ABSTRACT

Pineapple industry is one of the important agricultural sectors in Malaysia with 76 cultivars planted throughout the country. This study aims to generate useful nutritional information as well as evaluating physicochemical, biochemical and organoleptic properties of 'Josapine', 'Morris', 'Sarawak', 'MD2' and 'Crystal' pineapple (*Ananas comosus*). The pineapple varieties were collected at commercial maturity stage (20-40% yellowish of fruit peel) and the edible portion of the fruit was used as sample for evaluation. From the results obtained, 'MD2' showed highest sweetness and lowest astringency index in terms of physicochemical properties and also had highest content of bioactive compounds, antioxidant capacities and bromelain activity with respect to biochemical properties compared to other cultivars. Furthermore, the highest scores for overall sensory attributes also confirmed the preference of 'MD2' over all the other cultivars. Hence, 'MD2' compared very well with other pineapple cultivars and has great potential in the commercial market. The bioactive compounds were highly and significantly correlated with antioxidant capacities and bromelain activity suggests that these bioactive compounds have contributed to the antioxidant and enzymatic activities of pineapples. All the mean differences observed between the cultivars were statistically significant.

ABSTRAK

Industri nanas merupakan salah satu sector pertanian yang penting di Malaysia dengan 76 kultivar yang ditanam di seluruh negara. Kajian ini bertujuan untuk menghasilkan maklumat nutrisi yang berguna serta menilai sifat fizikokimia, biokimia dan organolepsis nanas 'Josapine', 'Morris', 'Sarawak', 'MD2' dan 'Crystal' (*Ananas comosus*). Kepelbagaian nanas telah dikumpulkan pada peringkat kematangan komersil (20-40% kekuningan kulit buah) dan bahagian buah yang boleh dimakan digunakan sebagai sampel untuk penilaian. Daripada keputusan yang diperolehi, 'MD2' menunjukkan indeks kemanisan tertinggi dan indeks astringen terendah dari segi sifat fizikokimia dan juga mempunyai kandungan sebatian bioaktif, kapasiti antioksidan dan aktiviti enzim bromelin yang tertinggi dengan berkenaan kepada sifat biokimia berbanding kultivar lain. Tambahan pula, markah tertinggi bagi sifat-sifat keseluruhan deria juga megesahkan keutamaan 'MD2' ke atas semua kultivar lain. Oleh itu, 'MD2' berbanding sangat baik dengan kultivar nanas yang lain dan mempunyai potensi besar di pasaran komersial. Sebatian bioaktif korelasi tinggi dan signifikan dengan kapasiti antioksidan dan aktiviti enzim bromelin mencadangkan bahawa sebatian bioaktif memberi sumbangan kepada aktiviti antioksidan dan enzim nanas. Semua perbezaan min yang diperhatikan di antara kultivar adalah statistik yang signifikan.

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LIST OF ABBREVIATIONS AND SYMBOLS

AAE	:	Ascorbic Acid Equivalents
AE	:	Albumin Equivalents
AI	:	Astringency Index
ANOVA	:	Analysis of Variance
ATC	:	Automatic Temperature Compensation
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
FAMA	:	Federal Agricultural Marketing Authority
FRAP	:	Ferric Reducing Ability of Plasma
g	:	Gram
GAE	:	Gallic Acid Equivalents
h	:	Hours
H_2O_2	:	Hydrogen Peroxide
HAT	:	Hydrogen Atom Transfer
HIV	:	Human Immunodeficiency Virus
$HO_2\cdot$	:	Hydroperoxyl Radicals
HOCl	:	Hypochlorous Acid
HOBr	:	Hypobromous Acid
IC_{50}	:	Concentration providing 50% Inhibition or 0.5 of Absorbance
kg	:	Kilogram
l	:	Litre
lbs	:	Pound
M	:	Molar
mg	:	Milligram

ml	:	Millilitre
mM	:	Millimolar
MARDI	:	Malaysian Agricultural Research and Development Institute
min	:	Minutes
ml	:	Millilitre
MPIB	:	Malaysian Pineapple Industry Board
n	:	Sample Size
nm	:	Nanometer
$^1O_2$	:	Singlet Oxygen
O_2	:	Molecular Oxygen
$O_2^{\cdot -}$	:	Superoxide Anion
O_3	:	Ozone
$OH\cdot$	:	Hydroxyl Radicals
ORAC	:	Oxygen Radical Absorbance Capacity
RM	:	Ringgit Malaysia
$RO\cdot$	:	Alkoxyl Radicals
$RO_2\cdot$	:	Peroxyl Radicals
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
TAE	:	Tannic Acid Equivalents
TPTZ	:	2, 4, 6-Tri [2-Pyridyl]-S-Triazine)
TRAP	:	Total Radical Trapping Antioxidant Parameter
TSS	:	Total Soluble Solids
UV-VIS	:	Ultraviolet–Visible
v	:	Volume
var.	:	Variety
w	:	Weight
WW	:	Wet Weight
µg	:	Microgram
µl	:	Microlitre
α	:	Alpha
β	:	Beta
γ	:	Gamma
&	:	And
˚C	:	Degree Celsius
%	:	Percent

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CHAPTER 1

INTRODUCTION

1.1 Research Background

Agriculture and agro-based industry has made a significant contribution to the national economy and development of modern Malaysia. According to Malaysian Pineapple Industry Board (MPIB), pineapple industry is one of the important agricultural sectors in Malaysia which play a role in country's earnings as one of the world pineapple suppliers. In 2011, it was reported that the production of fresh fruit and canned pineapple in Malaysia estimated around 96,957 metric tonnes and 17,165 metric tonnes (858,007 standard cases), respectively (MPIB). Furthermore, the export of fresh pineapple, canned pineapple and pineapple juice contributed approximately RM 63.4 millions to the national economy in the same year. The canned pineapple has high market demand in countries include Japan, United States, European countries, Singapore, West Asia and others (MPIB).

Pineapple (*Ananas Comosus*) contains good aroma, flavour, juiciness, sweetness, texture and high nutritional content such as vitamins, phenolics, fibre and minerals (Brat, Thi-Hoang, Soler, Reynes & Brillouet, 2004). The preference and acceptance of consumers are mainly determined by the general composition and nutritional properties of the commodity. The nature and concentration of phenolic compounds, sugar and

organic acid will largely influence the taste and organoleptic characteristics of the fruit (Kelebek, Selli, Canbas & Cabaroglu, 2009). Phenolic compounds in fruits possess numerous biological activities including antioxidant activity, anti-carcinogenic, anti-inflammatory, and anti-atherosclerotic activities (Chung, Wong, Huang & Lin, 1998). On the other hands, sugar content as soluble solids in the juice not just function as sweetener and also play role in appearance, texture, freezing point, fermentation, preservation and antioxidant activity (Clarke, 1995; Phillips, Carlsen & Blomhoff, 2009). The type of organic acid varies in different fruits. The main organic acids of pineapple fruits are citric acid and malic acid (Belitz, Grosch & Schieberle, 2009). Organic acids composition in the fruit can affect the flavour properties and stability of fruit juices, and the organic acids such as ascorbic acid, citric acid and malic acid can also act as natural antioxidant in the fruit (Houlihan & Ho, 1985; Kelebek *et al*., 2009). Moreover, pineapple is the best known source of endopeptidase bromelain among the plants of the plant family Bromeliaceae (Kumar, Hemavathi & Umesh Hebbar, 2011) which has wide range of applications in many industries such as food, medical, pharmaceutical and cosmetics industries, *etc*. (Ketnawa, Chaiwut & Rawdkuen, 2011).

There is variety of Malaysian pineapple cultivars planted in Peninsula and Borneo of Malaysia. These include the 'Sarawak', 'Yankee', 'MD2', 'Morris', 'Morris Gajah' and 'Josapine' for fresh consumption, 'Gandul' for canning and juicing, 'N36' and 'Maspine' for both fresh consumption and canning purposes (MPIB). Several studies had been carried out previously to investigate and compare the phytochemical properties and bioactivities among different pineapple cultivars. For instance, Brat *et al*. (2004) compared the physicochemical characteristics between the new hybrid 'FLHORAN41' and 'Smooth Cayenne', Kongsuwan, Suthiluk, Theppakorn, Srilaong and Setha (2009) worked on the bioactive compounds and antioxidant capacities of 'Phulae' and 'Nanglae', Zulipeli (2007) investigated the bromelain content of 'Josapine', 'Gandul', 'Maspine' and 'N36', Wardy, Saalia, Stteiner-Asiedu, Budu and Sefa-Dedeh (2009) compared the physical, chemical and sensory properties of 'MD2', 'Smooth Cayenne' and 'Sugarloaf'. The results of these studies showed that different pineapple

cultivars have different phytochemical characteristics and bioactivities from each other (Brat *et al*., 2004; Kongsuwan *et al*., 2009; Zulipeli, 2007, Wardy *et al*., 2009).

1.2 Problem Statement

Pineapples are rich in nutrients and phytochemicals which have multiple benefits to human health. In Malaysia, pineapple industry is one of the important agricultural sectors with 76 cultivars planted throughout this country. According to some previous studies, different pineapple cultivars have different phytochemical characteristics and bioactivities from each other (Brat *et al*., 2004; Kongsuwan *et al*., 2009; Zulipeli, 2007, Wardy *et al*., 2009). However, the physicochemical, biochemical and organoleptic properties evaluation and comparison among the commercial cultivars are yet to be fully accomplished. Hence, this study was performed to analyse the differences among the cultivars with the purpose to generate useful nutritional and health beneficial information of different Malaysian pineapple commercial cultivars in order to provide essential data resource either for future study of the fruit or as reference for commercial activity.

1.3 Objectives

a) To analyse the physicochemical characteristics of the selected Malaysian pineapple cultivars.
b) To analyse the biochemical characteristics of the selected Malaysian pineapple cultivars.
c) To analyse the organoleptic characteristics of the selected Malaysian pineapple cultivars.

d) To evaluate the correlation between physicochemical, biochemical and organoleptic characteristics of pineapples.

1.4 Scope of Study

In this project, pineapple fruits (*Ananas comosus*) of different cultivars were collected at commercial maturity stage (20-40% yellowish of fruit peel) and the edible portion of the fruit was used as sample for evaluation. For physicochemical test, the edible portion of pineapple pulp was homogenized, and then the aliquots of homogenated pulp were analysed for pH and titratable acidity (TA), and total soluble solids (TSS) as degrees Brix at 20˚C. For biochemical test, different solvents were used for the extraction of pineapple for different biochemical assays. The phytochemical or bioactive compounds of the fruit extracts were evaluated using ascorbic acid content, total phenolic content, and tannin content assays. Besides, the antioxidant capacities of pineapple fruits were investigated by DPPH radical scavenging capacity and ferric reducing capacity assay. In addition, the enzymatic activity of pineapple fruit was determined by bromelain proteolytic activity and protein content of the samples. For organoleptic test, the evaluation for appearance, flavour, aroma, texture and overall preference involved 30 untrained taste panellist by using 5 point Hedonic scale: 1: Dislike extremely; 2: Dislike; 3: Neither like nor dislike; 4: Like; 5: Like extremely. Lastly, the statistical evaluation was performed by using Minitab version 15 and IBM SPSS (Statistical Package for the Social Sciences) Statistics version 20.

1.5 Significance of Study

Although pineapple is one of the important commodities to national economy, the physicochemical, biochemical and organoleptic characteristics evaluation and

comparison among the commercial cultivars are yet to be fully accomplished. Hence, this study was carried out to determine and compare the physicochemical characteristics, bioactive compounds, antioxidant capacities, enzymatic activity and sensory properties of different pineapple commercial cultivars in Malaysia. The outcome of this study aims to provide relevant nutritional information of different commercial cultivars to consumers, facilitate the promotion of different pineapple cultivars to market with known fruit characteristics and strength, improve the consumption of pineapple due to its nutritional properties, and provide useful information for further hybridization among the pineapple cultivars.

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