UNIVERSITI PUTRA MALAYSIA

ANTIHYPERGLYCEMIC AND ANTIOXIDATIVE POTENTIALS OF MALAYSIAN BANANA (*Musa sp.*) FLOWER EXTRACTS

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ABSTRACT

Banana (*Musa* sp.) is one of the important agricultural products in Malaysia. Its flower commonly referring as 'banana heart' is a blossom which is usually red or dark red in color attached at the end of the bunch of banana fruits. Banana flower consumption is popular among the countries of Southeast Asia such as Malaysia, Philippines, Indonesia, and Si Lanka. In Malaysia, banana flowers are served as vegetables in preparing different types of cuisines. Previously, several studies were conducted to analyze the antioxidant capacity of different part of banana such as pulp, peel, leaves, pseudostem and flower. However, the antioxidant and antihyperglycemic properties of the Malaysian banana flowers have not been reported previously. In this study, six different cultivars of banana flower (Abu, Berangan, Nipah, Susu, Mas and Rastali) were investigated. The objectives of this study were to evaluate the antihyperglycemic and antioxidant properties of the Malaysian banana flowers. The potential of banana flowers as a dietary antihyperglyceamic agent was studied through screening of their anti-amylase and anti-glucosidase activity (%) at the concentration of 200.0 µg / ml. Overall, the anti-amylase and anti-glucosidase activity of the Malaysian banana flowers was found in the range of 47.31 - 62.58 % and 74.98 - 91.62 %, respectively. All banana flower extracts inhibited the activity of α-glucosidase better than α-amylase at the same concentration. The total phenolic and flavonoid contents were evaluated through Folin-Ciocalteu colorimetric method and aluminium chloride method, respectively. The reducing power of the banana flower was determined by ferric reducing antioxidant power (FRAP) assay. The antioxidant capacity of the banana flower was measured through the scavenging activities of the $ABTS^{+}$ and DPPH radical. The Susu cultivar with the highest amount of phenolic compounds (80.13 ± 4.64 mg of Gallic acid equivalent / g of extract) was found to possess the highest and DPPH radical scavenging activity (24.73 ± 0.04 and 25.10 ± 0.15 µmole of Trolox equivalent [TE] / g of extract). This study concluded that the Malaysian banana flower was a potential postprandial hyperglycemia regulator and a good natural source of antioxidant.

Key Words: Antioxidant activity, total phenolic content, antihyperglycemic, banana flower

ABSTRAK

Pisang (*Musa* sp.) adalah salah satu produk pertanian yang penting di Malaysia. Bunganya ataupun biasa dikenali sebagai 'jantung pisang' adalah bunga berwarna merah atau merah gelap bercantung pada akhir tandan buah pisang. Penggunaan bunga pisang adalah popular di kalangan negara-negara Asia Tenggara seperti Malaysia, Filipina, Indonesia, dan Si Lanka. Di Malaysia, bunga pisang dihidangkan sebagai sayur-sayuran dalam penyediaan pelbagai jenis masakan. Sebelum ini, beberapa kajian telah dijalankan untuk menganalisis kapasiti antioksidan bahagian yang berbeza daripada pokok pisang seperti pulpa, kulit, daun, batang semu dan bunga. Walau bagaimanapun, sifat-sifat antioksidan dan antihyperglycemic bunga pisang yang terdapat di Malaysia belum dikaji sebelum ini. Dalam kajian ini, enam kultivar bunga pisang yang berbeza (Abu, Berangan, Nipah, Susu, Mas dan Rastali) telah dikaji. Objektif kajian ini adalah untuk menilai dan menganalisis sifat-sifat antihiperglisemia dan antioksidan bunga pisang yang terdapat di Malaysia. Potensi bunga pisang sebagai ejen antihiperglisemia dikaji melalui saringan aktiviti anti-amilase dan anti-glucosidase (%) pada kepekatan 200.0 µg / ml. Secara keseluruhan, aktiviti anti-amilase dan anti-glucosidase bunga pisang Malaysia didapati dalam lingkungan 47.31 – 62.58 % dan 74.98 – 91.62 % masing-masing. Ekstrak bunga pisang Malaysia menghalang aktiviti α-glucosidase lebih efektif daripada α-amilase pada kepekatan yang sama. Kandungan fenol telah dinilai melalui kaedah Folin-Ciocalteu manakala kandungan flavonoid dinilai dengan kaedah aluminium klorida. Kuasa penurunan ekstrak bunga pisang telah diuji dengan kaedah ferric reducing antioxidant power (FRAP). Kapasiti antioksidan bunga pisang dianalisis dengan mengukur aktiviti pemerangkapan radikal bebas $ABTS^{+}$ dan DPPH. Bunga pisang Susu mengandungi kandungan fenol yang tertinggi (80.13 ± 4.64 mg GAE / g ekstrak) telah didapati memiliki aktiviti pemerangkapan radikal bebas 2,2'-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid) diammonium salt (ABTS) dan 1,1-diphenyl-2-picrylhydrazine (DPPH) yang tertinggi (24.73 ± 0.04 dan 25.10 ± 0.15 µmole daripada Trolox equivalent [TE] / g ekstrak). Kajian ini menyimpulkan bahawa bunga pisang yang terdapat di Malaysia adalah satu ejen yang berpotensi untuk mengawal gula darah dan juga sumber antioksidan baik yang boleh didapati daripada makanan.

Kata kunci : Aktiviti antioksidan, kandungan fenol, bunga pisang

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LIST OF SYMBOLS AND ABBREVIATIONS

ABTS	2,2'-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid) diammonium salt
$AlCl_3$	Aluminium trichloride
α-amylase	Alpha amylase
α-glucosidase	Alpha glucosidase
OD	Absorbance value
et al	And others
BRG	Banana cultivar Berangan
AB	Banana cultivar Abu
NPH	Banana cultivar Nipah
SS	Banana cultivar Susu
MS	Banana cultivar Mas
RAS	Banana cultivar Rastali
DPPH	1,1-diphenyl-2-picrylhydrazine
°C	Degree of Celcius
FRAP	Ferric reducing antioxidant power
g	Gram
GAE	Gallic acid equivalents
Trolox	6-hydroxy-2,5,7,8-tetramethylchroman-2 carboxylic acid
L	Liter
µ	Micro
mg	Miligram
µg	Microgram
mM	Milimolar
µM	Micromolar
ml	Mililiter
µl	Microliter
nm	Nanometer
%	Percentage
QE	Quercetin equivalents
R2	R-square
ROS	Reactive oxygen species
NAOH	Sodium hydroxide
Na2CO3	Sodium bicarbonate
NaNo2	Sodium nitrite
w:w	Weight over weight ratio
w:v	Weight over volume ratio

CHAPTER 1

INTRODUCTION

1.1 Research Background

It cannot be denied that agricultural sector plays an important role in boosting the economic and GDP growth of Malaysia. Since Malaysia is located on the peninsula of Southeast Asia, it has an ideal climate and condition to nourish various types of tropical fruits such as papayas, bananas, guavas, pineapples and so on. Meanwhile, the antioxidant properties of pineapples (Yuris & Siow, 2014), papaya (Maisarah *et al*., 2013), guava (Siow & Hui, 2013) and banana (Sulaiman *et al*., 2011) has been studied. Banana (*Musa* sp.) plant belongs to the genus of *Musa* fom the family of *Musaceae*. The banana plant is a large, perennial monocotyledonous herb. It can grow from 2 meter up to 9 meter tall at maturity (Nelson *et al*., 2006). There are various cultivars of banana plant can be found in Malaysia. Most of these cultivars are derived from the two wild species, namely *Musa acuminata* and *Musa balbisiana*. The *Musa* species can be classified as edible and ornamental banana. Up to date, there is more than 50 edible banana cultivars available in Malaysia (Sulaiman *et al*., 2011).

The banana fruit is the dominant product of the banana plant. It was ranked as the fourth most important food crops in the diet of millions of people especially in Southeast Asia (Darvari *et al*., 2010). A 100 g of banana fruit provides roughly 116 kCal of energy (Kumar *et al*., 2012). Banana fruit, which is high in nutritional value can be eaten raw or cooked. It is known for its high content of the potassium,

magnesium and various vitamins. According to Kumar *et al*. (2012), a single banana can provide up to 23 % of the potassium that we need on a daily basis. In addition, due the presence of tryptophan (the precursor of serotonin), banana fruit was also known as a good natural source of antidepressant. In facts, several pharmacological properties such as antidiarrhoeal, antiulcerative, antimicrobial, antihypertensive, hypocholesterolaemic and hypoglycemic activities of banana were discussed previously (Imam & Akter, 2011). Apart from the banana fruit, other parts of the banana tree are beneficial to human as well. For example, the leaves are commonly used for wrapping food such as the local food *nasi lemak*. The fiber extracted from the banana pseudostem can be used for different purposes. The plant sap can be applied externally to stings and bites. The roots, leaves and seed mucilage also use for medicinal purposes in certain countries (Kumar *et al*., 2012).

Banana flower or sometime refers as 'banana heart' is a blossom or inflorescence which usually in red or dark red color that is attached to the end of the bunch of banana fruits. In the red or dark red bracts, there are lots of small whitish flowers which would turn into the mature edible banana fruit. Banana flower consumption is popular among the countries in Southeast Asia such as Malaysia, Philippines, Indonesia, and Si Lanka. Its taste is a little starchy and bitter. In Malaysia, banana flowers are served as vegetables in preparing different types of cuisines. In China, banana flower is traditionally used to treat certain illness such as heart pain, diarrhea, asthma and stomach cramps (Sumathy *et al*., 2011). Besides, the cooked banana flower was reported as a great food for diabetic patients and it can be used for the treatment of bronchitis, dysentery and ulcers (Kumar *et al*., 2012). Both *in vivo* and *in vitro* studies have shown the health benefits for consumption of banana

flowers especially of its antioxidant and anti-diabetic properties (Bhaskar *et al*., 2011; China *et al*., 2011; Jamuna & Nandini, 2014; Sheng *et al*., 2010).

Several studies on different parts of Malaysian banana plant were conducted previously. For example, the antioxidant property and mineral contents of several cultivar of banana fruit (Sulaiman *et al*., 2011) and the relationship between extracting solvents and antioxidant properties of three Malysian banana (Berangan, Mas and Raja) (Shian *et al*., 2012). Meanwhile, three cultivars of native banana namely Berangan, Mas and Nipah were also reported to possess antibacterial activity against gram negative bacteria (Fadhilah *et al*., 2014). Apart from the banana fruit, a previous study on animal model also revealed that oral administration of both green and yellow banana peel extract at different dose (200 and 400 mg / kg) can be used to treat depression (Tee & Hassan, 2011). Although Sumathy *et al*. (2011) was done the phytochemical screening of banana flowers and reported the antimicrobial and antioxidant properties (through DPPH radical scavenging activity), there is hardly any study available which discuss the other pharmacological properties of Malaysian banana flowers. Thus, the current study was carried out to compare the antioxidant and hypoglycemic properties of different Malaysian banana flowers.

Figure 1. The picture of banana (*Musa* sp.) flower.

1.2 Research Hypothesis

After adverse effects of synthetic antioxidants on human health reported, the source of naturally occurring antioxidants has been targeted in recent research. Plant based foods, which are known for its phytochemical content, especially phenolic compounds which contribute to the antioxidant activity. Different cultivars of banana flowers commonly found in Malaysia has been selected in this study as they are consumed as vegetable among Malaysians. Due to the different polyphenols content, different Malaysian banana flowers may exert different antioxidant and anti-hyperglycemia properties. Increase consumption of plant based foods rich in phenolic compounds is a good way to enhance anti-oxidative defense system in the living body as well as facilitate the postprandial blood sugar regulation.

1.3 Research Objectives

1. To study the inhibitory effect of ethanolic extracts of banana flower on the enzyme activities of α-amylase and α-glucosidase.
2. To determine the antioxidant activities of ethanolic extract of banana flower with various antioxidant assays.

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