Study on Antimicrobial and Antioxidant Activities of *Musa acuminata* C. Peel (Phee-Gyan Banana)

Mya Mya sainn, Jar Kyi Kyaw[2], Ni Ni Than[3]

ABSTRACT

This study was designed to examine the nutritional composition, antioxidant activity, antimicrobial activity and total phenol content of *M. acuminata* C. peel (Phee-Gyan Banana). In the present work, the preliminary phytochemical tests revealed that saponins, carbohydrates, glycosides, phenolic compound, α-amino acids, flavonoids, steroids, alkaloids, cyanogenic glycosides, reducing sugar, starch, tannins and terpenoids were present in *M. acuminata* C. (Phee-Gyan Banana). Determination of nutritional values of *Musa acuminata* C. have been carried out by AOAC method. The antimicrobial activities of the various crude extracts (PE, EtOAc, EtOH and watery extracts) from *M. acuminata* C. peel sample were determined against six strains of microorganisms by agar well diffusion method at Pharmaceutical Research Department (PRDThe total phenolic content was determined by Folin-Ciocalteu assay.. The total phenolic content of ethanol extract was higher than that of watery extract**.** In addition, the antioxidant activities of the peel of *M. acuminata* C. extracts were determined by 2,2-diphenyl-1- picrylhydrazyl (DPPH) assay method.

Keywords- *M. acuminata* C., AOAC, microorganisms, Folin-Ciocalteu assay

INTRODUCTION

Medicinal plants have been the mainstay of traditional herbal medicine amongst rural dwellers worldwide since antiquity to date. According to the World Health Organization, a medicinal plant is any which, in one or more of its organs, contains substances that can be used for therapeutic purposes, or which are precursors for chemo-pharmaceutical semi synthesis. Such a plant will have its part including leaves, roots, rhizomes, stems, barks, flowers, fruits, grains or seeds, employed in the control or treatment of a disease condition and therefore contains chemical components that are medically active. Medicinal plants are increasingly gaining acceptance even among the literates in urban settlements, probably due to the increasing inefficacy of many modern drugs used for the control of many infections such as typhoid fever, gonorrhea and tuberculosis as well as increase in resistance by several bacteria to various antibiotics and the increasing cost of prescription drugs, for the maintenance of personal health (Levy 1998, Van den bogaard *et al* ., 2000).

Myanmar is one of the nations blessed with a rich heritage of traditional medicinal systems and rich biodiversity to complement the herbal needs of the treatment administered by this traditional medical system. Musa is agenus from zingiberales and family Musaceae; it includes bananas and plantains. There are around 70 species of Musa with a broad variety of uses. The common name was banana scientifically known as Musa sapientum. There are many composition of banana peel like enzymes such as polyphenol oxidase, pectin as gelling agent and that the banana peel extract is used alone or combined with a cream or ointment, medicinal benefits of the extract include relief of pain, swelling and itching. Additionally, flavonoids, tannins, phlobatannins, alkaloids, glycosides and terpenoid were found to be present in the peels of genus Musa. These phytochemicals have been reported to exert multiple biological and pharmacological effects.

Moreover, banana peel contains vitamin A, vitamin C, gallocatechin, dopamine, vitamin E, vitamin B6, asitosterol, malic caid ,succinic acid, magnesium, phosphorous, potassium, fiber and iron. The fatty acids present in the banana peels are responsible for their antimicrobial activity (Chabuck *et al* ., 2013). Ripe and delicious banana are one of the most popular fruits that are easily available all year around .Banana peel possessed not only many bioactive substances but also cheapest and edible source. The aim of present research was studying about the phytochemical constituents, nutritional composition, antimicrobial activity, total phenol contents, antioxidant activity and alkaloids contents of Musa acuminate C. peel.

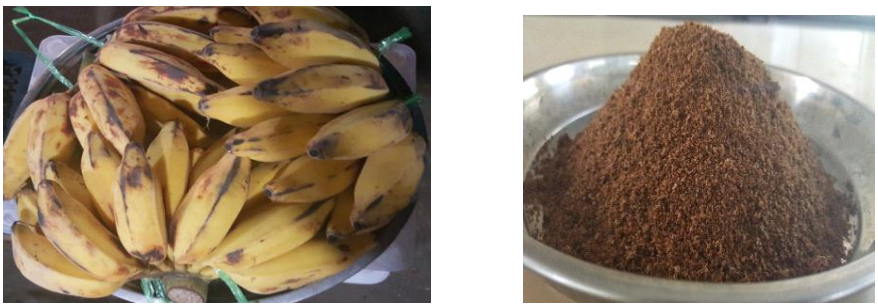


Figure 1. *Musa acuminate* C. peel (Phee-Gyan Banana) and the dry powder sample

MATERIAL AND METHODES

Collection and Preparation of Sample

The sample was collected from North Okkalapa Township, Yangon Region, Myanmar.The sample was identified at the Department of Botany, University of Yangon. The collected sample was washed with water and dried in an oven at 50 °C. The dried pieces were made into powder by using grinding machine. The powdered sample was stored in air-tight container to prevent moisture changes and other contaminations. The dried powdered sample was used for chemical and biological investigations.

Preliminary Phytochemical Investigation of *Musa acuminate C. peel*

Phytochemical tests for the sample was carried out according to the reported methods to investigate the presence and absence of phytochemical constituents such as alkaloids, α-amino acids, carbohydrates, cyanogenic glycosides, organic acids, flavonoids, glycosides, organic acids, phenolic compounds, reducing sugars, saponins, starch, steroids, tannins and terpenoids. (M-Tin Wa, 1972). (Harbone, 1984).

Determination of Nutritional Values in *Musa acuminate C. peel*

The nutritional values such as moisture, fiber, fat, ash, protein, carbohydrate and energy value of the sample were determined by AOAC method (AOAC, 2002) at Ministry of Agriculture, Livestock and Irrigation, Small scale Industries Department in Thudma Main Road, North Oakkalapa, 137 (A), Yangon, Myanmar.

Determination of Total Phenol Content as Gallic Acid Equivalent in Sample

The total phenol content (TPC) in each crude extract was estimated by Folin-Ciocalteu reagent method according to the procedure described by Song *et al.*, 2010. First, 1 mL of prepared extract solution was mixed with 5 mL of FCR reagent (1:10) and incubated for 5 minutes. 4 mL of 1 M sodium carbonate solution was added to each tube and the tubes were kept at room temperature for 2 hours and the UV absorbance of reaction mixture was read at λ_{max} 765 nm. The blank solution was prepared as the above procedure by using distilled water instead of sample solution. Total phenolic content was estimated as microgram Gallic acid equivalents per milligram of different extract (g GAE/ mg).

Determination of Antioxidant Activity of Crude Extract from the *Musa acuminate C.* Peel by DPPH Free Radical Scavenging Assay

The free radical scavenging activity of crude extracts from the peel of banana as measured using DPPH free radical scavenging assay. DPPH radical scavenging activity of watery and ethanol extracts from the peel of banana was determined by UV-visible spectrophotometer (Marinova and Batchvarov, 2011). The control solution was prepared by mixing 1.5 mL of 0.002 % DPPH solution and 1.5 mL of ethanol in the brown bottle. The blank solution was prepared by mixing 1.5 mL of sample solution and 1.5 mL of ethanol in the brown bottle. The sample solution was also prepared by mixing 1.5 mL of 0.002% DPPH solution and 1.5 mL of test sample solution. These bottles were incubated at room temperature and were shaken on shaker for 30 min. After 30 min, the absorbance of different concentrations (6.25, 12.5, 25, 50, 100 and 200 µg/mL) of tested sample was measured at 517 nm using UV-spectrophotometer. Absorbance measurements were done in three times for each concentration and the mean value so obtained were used to calculate percentage of radical scavenging activity (%RSA) by the following equation.

% RSA = [ADPPH - (A Sample – A Blank)/ DPPH]× 100

Where;

% RSA = % radical scavenging activity of test sample

DPPH = absorbance of DPPH in EtOH solution

A Sample = absorbance of sample + DPPH solution

A Blank = absorbance of sample + EtOH solution

Screening of Antimicrobial Activity of the *Musa acuminate C.* Peel

The antimicrobial activity of four crude extracts such as petroleum ether, ethyl acetate, ethanol and water of sample were determined against six strains of microorganisms such as *Bacillus subtilis, Staphylococcus aureus, Pseudomonas aerugrinosa, Bacillus Pumilus, Candida albicans* and *Escherichia coli* by employing agar well diffusion method (Madigan and Mattinko, 2005). The tests were screened at Myanma Pharamaceutical Industrial Enterprise Research Department**,** on Yangon-Insein Road, West- Gyogone, Insein Township, Yangon, Lower Myanmar.

RESULTS AND DISCUSSION

Preliminary Phytochemical Investigation of *Musa acuminate C.* Peel

The phytochemicals constituents present in the peel of banana were investigated by test tube method. The phytochemical tests revealed that alkaloids, α-amino acids, carbohydrates, flavonoids, glycosides, organic acids, phenolic compounds, reducing sugars, saponins, starch, steroids, tannins and terpenoids were present in sample. However, cyanogenic glycosides were not detected in banana peel.

Determination of Nutritional Values in *Musa acuminate C.* Peel

The nutritional values of sample were investigated by A.O.A.C method. The moisture content was determined by oven drying method and found to be 8.94 % of sample. Protein content was measured by micro-Kjedahl's method and found to be 6.98 % .Kjedahl method has been almost universally applied to determine nitrogen content (AOAC, 1970). The ash contents was measured by ashing in the muffle furnace and found to be 9.49 %. Fiber is determined by acid- base treatment and found to be11.36 %. Fat contents were measured by Sohxlet extraction method using PE (b.pt. 60-80 ºC) and found to be 23.70%. *Musa acuminate C. peel* was found to be 39.23 % of carbohydrate by subtraction method.

Determination of Total Phenol Content as Gallic Acid Equivalent in Sample

In this study, a significant linear correlation was observed between the values for the total phenol content and antioxidant activity. The high contents of phenolic compounds indicated that these compounds contribute to the antioxidant activity. The total phenol contents of watery and ethanol extracts from the peel of *Musa acuminate C.* were found to be 10.77 μg GAE/mg and 12.04 μg GAE/mg. According to the results, the higher TPC (μg GAE/mg) was detected in ethanol extract (12.04 μg GAE/mg) than watery extract (10.77 μg GAE/mg). This means that phenolic compounds were more soluble in ethanol.

Figuer3 A bar graph of total phenol content of watery and ethanol extracts of *Musa acuminate C.* peel

Determination of Antioxidant Activity of Crude Extract from the *Musa acuminate C.* Peel by DPPH Free Radical Scavenging Assay

From the experimental results, the peels of banana were found to have antioxidant activity. IC_{50} values of ethanol and water extracts are 46.44and 116.05

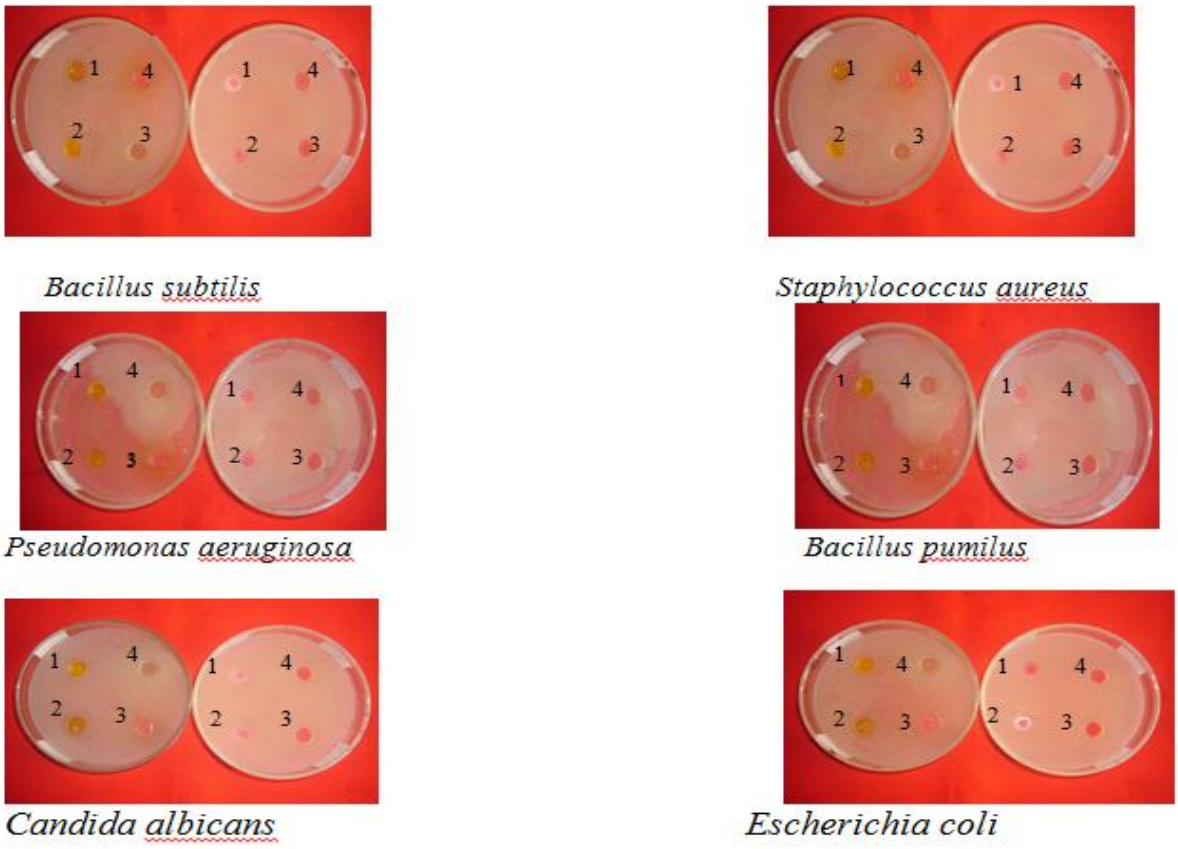
g/mL respectively. Among these extracts, since the lower the IC_{50} showed the higher the free radical scavenging activity, the 95 % ethanol extract was found to be more effective than watery extract in free radical scavenging activity. However, it was observed that these two extracts have the lower antioxidant activity than standard BHT (IC_{50} = 15.32 µg/mL) under conditions. The antioxidant potential of crude extracts was different may be due to the difference in chemical structure of their phenolic compounds.

Figuer 5 A bar graph IC_{50} values of watery and ethanol crude extracts of sample and standard BHT

Screening of Antimicrobial Activity of the *Musa acuminate C.* Peel

Screening of antibacterial activity of crude extracts such as ethanol, ethyl acetate, pet ether and watery extracts from *Musa acuminate C. peel* was done by agar well diffusion methods. In this investigation, these extracts were tested on six harmful microorganisms including *Bacillus subtilis, Staphylococus aureus, Pseudomonus aeruginosa, Bacillus pumalis, Candida albicans,* and *Escherichia coli.* The diameter of agar well was 10mm.When comparing different antimicrobial agents to know concentration, the inhibitory zone diameter is taken as a measure of antimicrobial activity in figure .The larger the diameter showed the higher the antimicrobial activity of test agents.

From these result, given in table 2, it was observed that ethyl acetate, ethanol and watery extracts inhibited the antimicrobial activity inhibition and zone diameter in the range between 12-13 mm, 12-14 mm and 11 mm. Among these extracts, ethanol extract showed the highest antimicrobial property against *Escherichia coli and Staphylococus aureus* with inhibition zone diameter 14 mm whereas pet ether extract didn't show antimicrobial activity. However watery extract exhibited three species of microorganisms (*Bacillus pumalis, Candida albicans,* and *Escherichia coli)* with the inhibition zone diameter range 11mm. From this investigation, it can be deduced that *Musa acuminate C. peel* may be effective for the treatment of some diseases such as skin rashes, kidney failure or neurologic problem and diarrhea infection by the test microorganisms.



1 .Pet Ether extract, 2.Ethyl acetate extract ,3. Ethanol extract, 4. H_2O extract

Figure 6 Antimicrobial screening of various crude extracts of *Musa acuminata* C. peel (Pheel-Gyan)

Table 2. Inhibition Zone Diameters of Various Crude Extracts of *Musa acuminata* C. Peel (Phee-Gyan Banana)

	Inhibition Zone Diameters of Extracts (mm)			
Organisms	PE	EtOAc	EtOH	H_2O
	Dry peel	Dry peel	Dry peel	Dry peel
B. Subtilis	(-)	13 (+)	12 (+)	(-)
S. aureus	(-)	13 (+)	14 (+)	(-)
P.aeruginosa	(-)	13 (+)	12 (+)	(-)
B. pumilus	(-)	12 (+)	12 (+)	11 (+)
C. albicans	(-)	13 (+)	12 (+)	11 (+)
E. coli	(-)	13 (+)	14 (+)	11 (+)

Diameter of agar well = 10 mm No activity = (-)

CONCLUSION

In the present work, the preliminary phytochemical tests revealed that saponins, carbohydrates, glycosides, phenolic compound, α-amino acids, flavonoids, steroids, alkaloids, cyanogenic glycosides, reducing sugar, starch, tannins and terpenoids were present in *Musa acuminata* C. (Phee-Gyan Banana). The antimicrobial activities of the various crude extracts (PE, EtOAc, EtOH and watery extracts) from *Musa acuminata* C. *peel* sample were determined against six strains of microorganisms by agar well diffusion method. Among the dried banana peel extracts, the highest antimicrobial activity was observed in EtOH extract whereas PE extract didn't show antimicrobial activity. The total phenolic content was determined by Folin-Ciocalteu assay. The total phenolic contents of EtOH and watery extract were found to be (12.04 ± 0.032) and (10.77 ± 0.026) g GAE/mg, respectively. The total phenolic content of ethanol extract was higher than that of watery extract. According to these observations, it could be inferred that ethanol extract of *Musa acuminata* C.peel showed high phenolic content and antioxidant activity so it could be used in the cure of oxidative stress related diseases and some age-related disorders. *Musa acuminata* C. peel rich in phenolic are increasingly being used in the food industry because they retard oxidative degradation of lipids and improve the quality and nutritional value of food.

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