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Chemical Composition and Biological Activity of *Momordica charantia* (Bitter Melon)

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***Abstract*— Phytochemical analysis and biological activities of *Momordica charantia* have been studied. Two parts of plant were used in this study such as fruit and seed. Plant sample has been extracted by using three different polarity of solvents such as *n*-hexane, chloroform and methanol through the cool extraction method. The result has shown that the highest percentage yield was methanol fruit extract with 15.29%. The phytochemical analysis has revealed there are many secondary metabolites in *M. charantia* fruit and seed such as alkaloid, flavonoid, saponin, phenol, tannin, terpenoid, steroid and glycoside while for seed part saponin was absence. Antibacterial study has been conducted by using disc diffusion method on *Bacillus subtilis*, *Staphylococcus aureus*, *Salmonella typhimurium* and *Escherichia coli*. In addition, the result has shown that the highest inhibition zone for fruit and seed was on *Staphylococcus aureus* in the range of 16 to 17 mm. Meanwhile, the antioxidant study revealed that the fruit and seed of *M. charantia* do not have antioxidant activity with percentage inhibition less than 50%. The results of this study conclude that *M. charantia* extract contains medicinally important bioactive compounds with efficient biological activities.**

Keywords*— *Momordica charantia, Chemical composition, Antibacterial, Antioxidant

I. INTRODUCTION

Natural product is substances that origin from animals, plants and microorganism. New therapeutic compounds have been comes from nature due to the tremendous chemical diversity found in various species of plants. Since the beginning of the 20th century, extraction or powder of medicinal plant has been used as the main active ingredient in medicinal products because they are considered as a powerful source of drugs that has no side effects when applied to patients [1]. *Momordica charantia* which belongs to Cucurbitaceae family is known as bitter melon, balsam pear or karela is commonly used in Indian subcontinent [2]. *Momordica* is the Latin names which means "to-bite" (referring to the jagged edges of the leaf that has been appeared as if they have been bitten). The taste of fruit very bitter because it contains a bitter compound called momordicin which has believed to have a stomachic effect [3]. These species are widely used as medicinal remedy for many disease, specifically for diabetes [4]. *M. charantia* has known as 'peria katak' in Malaysia is an excellent source of vitamins and minerals that made it extensively good and nutritious [5]. In this study, the phytochemical screening was done on *M. charantia* extracts in order to detect the presence of secondary metabolites such alkaloids, saponins, flavonoids, terpenoids, phenols and steroids. The screening of antibacterial and antioxidant activity of *M. charantia* extracts were also done.

II. MATERIALS

A. Raw Materials

The fruits of *Momordica charantia* were purchased at a local market located in Tampin, Negeri Sembilan.

B. Chemical and Instruments

Methanol, ethyl acetate, *n*-hexane, dimethyl sulfoxide (DMSO), chloroform, acetone, ammonia, vanillin, nutrient agar (NA), nutrient broth (NB), sulphuric acid (H_2SO_4), acetic anhydride, sodium hydroxide (NaOH), hydrochloric acid (HCl), ferric chloride ($FeCl_3$), Wagner's reagent (iodine in potassium iodide). Ultraviolet visible (UV-Vis) spectrophotometer, ultraviolet (UV) lamp, digital rotary evaporator, autoclave, incubator, hot plate and oven

III. METHODS

A. Plant Extraction

The seeds were separated from the fresh fruits and cleaned. The fruits then were cut into small pieces. Both fruits and seeds were dried and grinded into finely powder. The powder of the fruits and seeds have been weighed accurately and were extracted sequentially with *n*-hexane, chloroform and methanol. The extracts were filtered through a filter paper and concentrated using rotary evaporator to obtained the crude extract.

B. Phytochemical Screening

Chemical tests for the screening and identification of bioactive chemical constituent such as alkaloids, flavonoids, phenols, saponins, terpenoids, glycosides, steroids and tannins on M.charantia extracts were carried out by using standard procedure in [6].

C. Antibacteria Assay

The antibacterial activity of the crude extracts of M.charantia was determined using disc diffusion method with slightly modification [6]. The activity was tested against two Gram-positive bacteria, B. subtilis and S. aureus as well as two Gram-negative bacteria, E. coli and S. typhimurium.

D. Antioxidant Assay

DPPH radical scavenging assay was utilized to determined the antioxidant activity of of M.charantia with some modifications [7]. Each sample (1.0 mg) was dissolved in methanol (1 mL) to obtain a stock solution with concentration of 1000 µg/mL. A series of diluted solution were prepared from the stock solution with methanol starting from 1000, 500, 250, 125, 62.5, 31.3,15.63 and 7.81 µg/mL. The sample solutions with various concentration (0.2 mL) was mixed with 3.8 mL of methanolic DPPH solution (50 µM). The mixture was incubated for 30 minutes at room temperature in the dark. After 30 minutes, the absorbance of reaction mixture was recorded at 517 nm.

IV. RESULTS AND FINDINGS

A. Phytochemical Screening of M.charantia Extracts

M.charantia contains many active compounds such as alkaloids, flavonoids, steroids, phenols, saponins, tannins, glycoside and terpenoids. In this study, phytochemical screening was carried out to detect the presence of secondary metabolites in n-hexane, chloroform and methanol. Table 1 shows the result of the phytochemical analysis of those extracts.

Table 1. Phytochemical screening of *M. charantia*

Test	*n*-Hexane		Chloroform		Methanol		Observation color
	fruit	*seed*	*fruit*	*seed*	*fruit*	*seed*	
Saponin	-	-	+	-	+	-	Frothing
Alkaloid	+	+	+	+	+	+	Reddish brown
Flavonoid	+	-	+	-	+	+	Light yellow
Phenol	-	-	+	-	+	+	Dark green
Tannin	-	-	-	-	+	+	Dark green
Terpenoid	+	+	+	+	+	+	Brown
Steroid	+	-	+	-	+	+	Green
Glycoside	+	+	+	-	+	+	Greenish yellow

Key: presence (+), absence (-)

According to the result, alkaloids and terpenoids can be found in all of the three extracts. Almost of all tests gave positive results in methanol fruit and seed extracts. However, only saponin was gave negative result in methanol seed extract.

B. Antibacterial Activity

The diameter of inhibition zone for each extract were measured. Table 2 showed the highest bacteria activity of fruit and seed extract against *S. aureus* with diameter inhibition in the range of 16.0 to 17.0 mm compared to other extracts. In contrast, there was no inhibition zone observed for n-hexane and chloroform extracts against *B. subtilis*.

Table 2. Antibacterial activity of difference *M. charantia* extracts

Extract	Diameter of Inhibition Zone (mm)			
	B. subtilis	***S. aureus***	***E. coli***	***S. typhimurium***
n-Hexane fruit	6.0	15.0	8.0	13.0
n-Hexane seed	6.0	17.0	7.0	12.0
Chloroform fruit	7.0	11.0	7.0	12.0
Chloroform seed	6.0	17.0	10.0	14.0
Methanol fruit	10.0	16.0	8.0	6.0
Methanol seed	6.0	9.0	6.0	14.0
Streptomycin[a]	23.0	27.0	23.0	22.0

Inhibition zone diameter (mm) including diameter of disc 6 mm; [a]Positive control

C. Antioxidant Activity

Based on the Table 3, all of the fruit and seed extracts have percentage inhibition less than 50% at concentration 1000 µg/mL which were showed inactive DPPH radical scavenging activity. Meanwhile, the result has shown that methanol fruit and seed extracts have the highest percentage inhibition among the other extracts.

Table 3. Percentage inhibition of fruit and seed extracts of *M.charantia*

Samples	Percentage inhibition at 1000 µg/mL (%)
Ascorbic acid	95.80 ± 0.36
Methanol fruit extracts	20.97 ± 0.58
Chloroform fruit extracts	12.53 ± 0.93
n-Hexane fruit extracts	14.33 ± 0.46
Methanol seed extracts	20.48 ± 0.15
Chloroform seed extracts	9.38 ± 0.53
n-Hexane seed extracts	5.23 ± 0.48

V. CONCLUSIONS

The phytochemical screening has revealed there are many secondary metabolites in *M. charantia* fruit and seed such as alkaloid, flavonoid, saponin, phenol, tannin, terpenoid, steroid and glycoside while for seed part saponin was absence. Antibacterial study has been conducted by using disc diffusion method against *B. subtilis*, *S. aureus*, *S. typhimurium* and *E. coli*. In addition, the result has shown that the highest inhibition zone for fruit and seed was on *S. aureus* in the range of 16.0 to 17.0 mm. Meanwhile, the antioxidant study revealed that the fruit and seed of *M. charantia* do not have antioxidant activity with percentage inhibition less than 50%. The results showed that the extract of *M.charantia* have a potential as antibacterial agents for pharmaceutical purpose.

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