SCREENING OF NUTRITIONAL VALUES AND SOME PHARMACOLOGICAL ACTIVITIES OF *HYLOCEREUS UNDATUS* (HAW.) BRITTON & ROSEFRUIT

Nyein Nyein Htwe[1]

Abstract

The present study is aimed at evaluating the mineral content, nutritional composition and some pharmacological activities such as antimicrobial and antioxidant activities from the pulp of *Hylocereus undatus* fruit (dragon fruit). Firstly, phytochemical screening was carried out according to standard procedures. Test results revealed the presence of alkaloids, -amino acids, carbohydrates, glycosides, phenolic compounds, saponins, reducing sugars, flavonoids and starch in this fruit. Semi-quantitative elemental analysis was determined by EDXRF method. According to the results, potassium, sulphur, calcium, iron, copper, manganese, zinc, bromine and rubidium were observed in the sample. In the examination of nutritional composition, the fruit possessed highest moisture content and lowest fat content. The antimicrobial activity of ethanol and water extracts was screened on selected microorganisms such as *Bacillus subtilis*, *Bacillus pumalis*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Candida albicans* and *E-coli* by agar well diffusion method. Both extracts showed antimicrobial activity against all selected microorganisms. In the screening of antioxidant activity by DPPH free radical scavenging assay, ethanol extract exhibited higher antioxidant activity than water extract. Since *H. undatus* fruit possesses many bioactive chemical constituents, minerals, nutrients, antimicrobial and antioxidant activities, it may be used not only for consumption but also for medicinal formulation in human health.

Keywords: Antimicrobial activity, Antioxidant activity, *Hylocereus undatus*, Nutritional composition

INTRODUCTION

Human life cycle largely depends on plants. The fruits, bark and leaves of a large number of plants are valuable as drugs. They are powdered and used as important ingredients in medicine. Medicinal plants are currently in considerable significant view due to their special attributes as a large source of therapeutic phytochemicals that may lead to the development of novel drugs (Venugopal and Liu, 2012). The evaluation of all the drugs is based on phytochemical and pharmacological approaches which lead to the drug discovery referred as natural product screening (Foye *et al.*, 2008).

Nutritionally, fruits and vegetables are energy dense foods containing vitamins, minerals, fiber and other bioactive compounds (Agudo, 2004). They are components of a healthy diet which help in preventing major diseases. Fruits are important sources of nutrients. Other than vitamins, fiber, minerals and polyphenolic compounds, the most abundant antioxidants are found in fruits particularly in the tropical fruits (Rufino *et al.*, 2010). Dragon fruit (pitaya or pitahaya) is the fruit of several cactus species, most importantly of the genus Hylocereus. It is native to South and Central America and it belongs to perennial epiphytic plant. The benefits of dragon fruit for human health can be explained by its essential nutrients such as vitamins, minerals, complex carbohydrates, dietary fibers and antioxidants (Liaotrakoon, 2013). Eating fruit is considered beneficial for carbohydrate metabolism, strengthening bones and teethes, heart tissues, healthy blood and tissue formation, strengthening immune system, faster healing of bruises and wounds,

[1] Lecturer, Dr, Department of Chemistry, Sagaing University of Education

respiratory tract infections and even as a mild laxative due to substantial fibre content. The fruit pulp is rich in antioxidants and vitamin C, polyunsaturated fatty acids, vitamins, carotene, protein and minerals like calcium, iron, potassium, sodium, etc.(Rahmawati and Mahajoeno, 2009). Three varieties of dragon fruit are white pulp with yellow peel, white pulp with red peel and red pulp with red peel. In this study, the fruit with white pulp and red peel was chosen to investigate the chemical constituents, mineral content, nutrient composition, antimicrobial and antioxidant activities. Botanical descriptions are as follow:

Botanical name	:	*Hylocereus undatus* (Haw.) Britton & Rose
Family	:	Cactaceae
Myanmar name	:	Nagar Mauk
English name	:	dragon fruit, strawberry pear
Part used	:	pulp (white)

(a) Fruits (b) Whole plant

Figure 1 Photographs of *H. undatus*

MATERIALS AND METHODS

Sample Collection and Preparation

The fruit sample was collected from Yangon region in Myanmar. The sample was authenticated at Department of Botany, Yangon University. The fruit was washed with distilled water and peeled in order to separate the peel from the pulp. Then, the pulp was cut into small pieces and then shade was dried at room temperature.

Qualitative Phytochemical Analysis

A few grams of dried sample were subjected to the tests of alkaloids, -amino acids, carbohydrates, glycosides, phenolic compounds, saponins, tannins, reducing sugars, flavonoids and starch according to the standard procedures (Marini-Bettolo *et al*., 1981). After the addition of specific reagents to the test solutions, the tests were detected by visual observation of color change or by precipitate formation.

Investigation of Mineral Element

In the elemental determination, the relative abundance of elements present in the sample was determined by EDXRF spectrometer (Shimadzu EDX-8000). This spectrometer can analyze the elements from Na to U under vacuum condition.

Determination of Nutritional Composition

The values of nutrients such as moisture, ash, fiber, protein, fat and carbohydrate from fruit sample were determined by AOAC official method (AOAC, 1965).

Screening of Antimicrobial Activity

For the investigation of antimicrobial activity, ethanol and water extracts were tested with agar well diffusion assay. This experiment was carried out at Pharmaceutical Research Department, Insein, Yangon, Myanmar. Selected microorganisms were *Bacillus subtilis, Bacillus pumalis, Staphylococcus aureus, Pseudomonas aeruginosa, Candida albicans* and *E-coli.*

Determination of antibacterial activity

Nutrient agar (4.6 g) and agar (1 g) were dissolved in 20 mL of distilled water. The resulting nutrient agar medium was autoclaved at 121 °C for 20 min and cooled in water bath at 60 °C. After cooling, bacteria suspension of each bacterial strain (0.02 mL) was added and poured into petri dishes. The seeded plates were allowed to dry in room temperature for 20 min. A standard cork borner was used to cut uniform wells (10 mm diameter) on the surface of the solid medium. Each of the different crude extracts (0.15 mL) was filled into each of the wells and incubated at 37 °C for 24 h. The antibacterial activity was evaluated by measuring zone diameter (mm) of the clear inhibitory zone formed around the well (Lawrence *et al*., 2009)

Determination of antifungal activity

Potatoes (20 g) in 100 mL of distilled water were heated on hotplate until boiling and filtered. Potato infusion was obtained. Dextrose (2 g) and agar (1.5 g) were added to potato infusion to obtain the potato dextrose agar medium. The resulting potato dextrose agar medium was autoclaved at 121 °C for 20 min and cooled in water bath at 60 °C. After cooling, fungal suspension of each fungal strain (0.1 mL) was added and poured into petri dishes. The seeded plates were allowed to dry in room temperature for 20 min. A standard cork borner of 10 mm diameter was used to cut uniform wells on the surface of the solid medium. Each of the different crude extracts (0.15 mL) was filled into each of the wells and incubated at 37 °C for 72 h. Antifungal activity in terms of zones of inhibition was recorded (Ibrahim *et al*., 2011).

Evaluation of Antioxidant Activity

The antioxidant activity of ethanol and water extracts was determined by DPPH free radical scavenging assay (Lee *et al.*, 2004). This test was performed at Medical Biotechnology Laboratory, Biotechnology Research Department (BRD), Kyaukse, Mandalay Division, Myanmar. Each extract was dissolved in 10 mg/ mL of DMSO (dimethyl sulfoxide) and diluted with 50 % ethanol for various concentrations (62.5 μg/ mL, 125 μg/ mL, 250 μg/ mL, 500 μg/ mL and 1000 μg/ mL). Briefly, the reaction mixture containing 50 μL of diluted test sample of various concentrations and 50 μL of DPPH (0.3 mM) dissolved in ethanol was taken in a 96-well micro-titer plate and kept standing at 37 °C for 30 min. The absorbance was measured at 515 nm by using 96 well microplate reader (Spectrostar Nano, BMG Labtech Microplate reader). Ascorbic acid was used as a standard. 50 % ethanol was used as the control and added to the 96-well plate instead of the sample. Percent Radical Scavenging Activity (% RSA) was calculated by using the following formula:

$$\% \text{ RSA} = [1 - (\text{OD test compound} / \text{OD control})] 100$$

RESULTS AND DISCUSSION

The phytochemical analysis was performed in order to know the different types of compound present in the fruit sample. According to the results, it was found that the presence of alkaloids, -amino acids, carbohydrates, glycosides, phenolic compounds, saponins, reducing sugars, flavonoids and starch but absence of tannins in this fruit.

Mineral elements present in fruit pulp were determined by EDXRF spectrometer. From the investigation, it was found that organic compounds were predominant and other elements. K was present in reasonable composition but S, Ca, Fe, Cu, Mn, Zn, Br and Rb were present in very little amounts based on the relative abundance of elements. Moreover, it was found that there was no contamination of toxic metals such as Cd, As, Pb and Hg in fruit sample. The results are mentioned in Table 1 and Figure 2.

Table 1 Relative Abundance of Elements in *H. undatus* Fruit

Element	Relative Abundance (%)
K	1.060
S	0.049
Ca	0.037
Fe	0.005
Cu	0.002
Mn	0.002
Zn	0.002
Br	0.001
Rb	0.001
C H	98.843

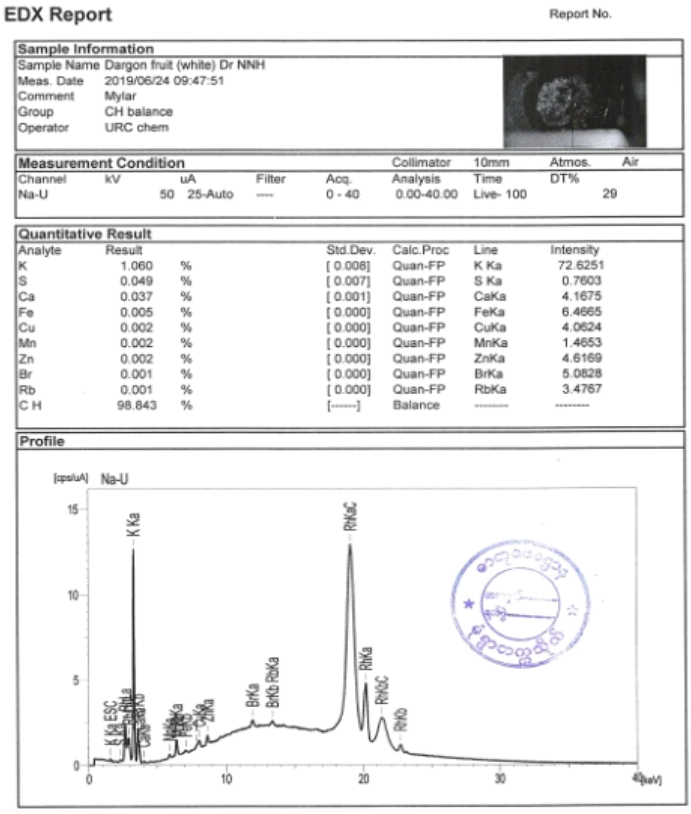

Figure 2 EDXRF spectrum of *H. undatus* fruit

In the investigation of nutrient composition by using AOAC method, the fruit indicated high moisture content (88.47 %) and the other parameters, carbohydrate

(9.68 %), fiber (0.25 %), protein (0.68 %), ash (0.84 %) and fat (0.08 %) were found in the fruit as depicted in Figure 3.

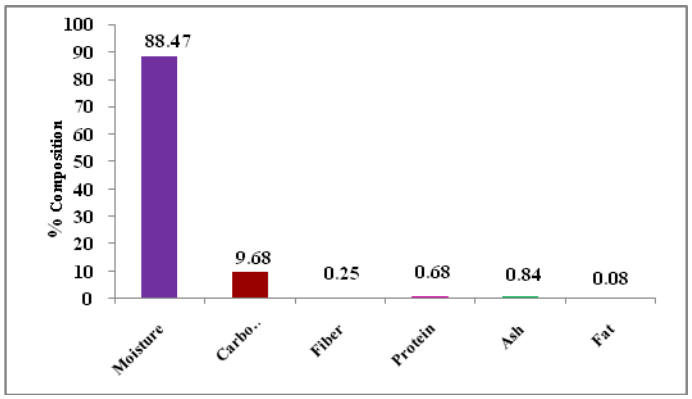

Figure 3 Nutritional composition of *H. undatus* fruit

The antimicrobial activity of ethanol and water extracts was investigated by agar well diffusion method. From the determination, both extracts showed antimicrobial activity against all selected microorganisms. Ethanol and water extracts exhibited activities with inhibition zone diameter between 12 mm ~ 20 mm and 14 mm ~ 20 mm respectively. In addition, it was found that both extracts possessed the highest activity against *E.coli* microorganism. The result of this assay is summarized in Table 2 and Figure 4.

Table 2 Antimicrobial Activities of *H. undatus* Fruit

Extract	Inhibition Zone Diameter (mm)					
	I	II	III	IV	V	VI
Ethanol	12 (+)	13 (+)	18 (++)	18 (++)	20 (+++)	20 (+++)
Water	16 (++)	14 (+)	20 (+++)	17 (++)	19 (++)	20 (+++)

Disk diameter;

Agar well ~ 10 mm

10 mm ~ 14 mm = (+), low activity

15 mm ~19 mm = (++), medium activity

20 mm above = (+++), high activity

no zone of inhibition = (-), no activity

Organism;

I = *Bacillus subtilis*, II = *Staphylococcus aureus*, III = *Pseudomonas aeruginosa*, IV = *Bacillus pumilus*, V = *Candida albicans*, VI = *E-coli*

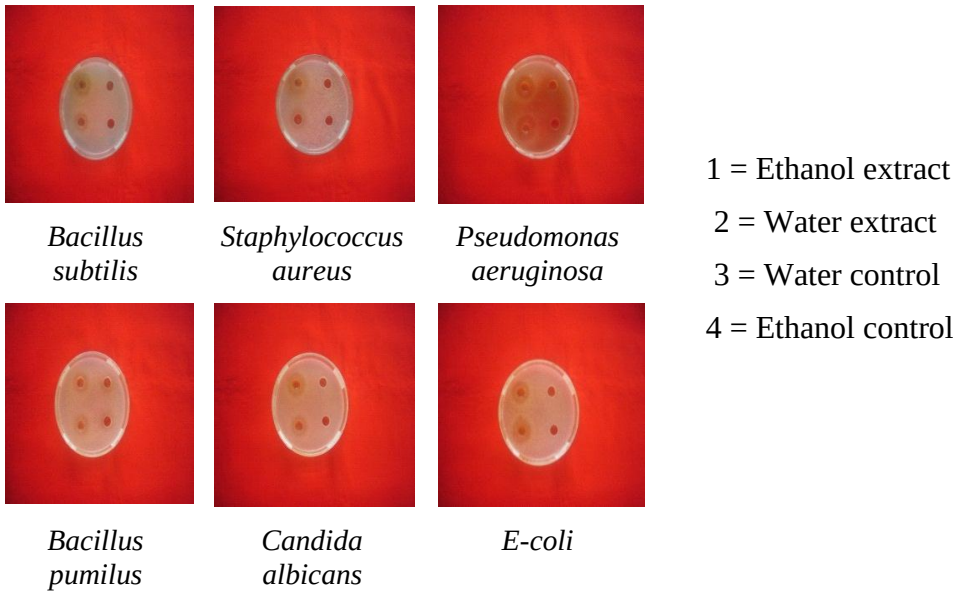

Figure 4 Photographs of antimicrobial activities of *H. undatus* frui

The antioxidant activity of ethanol and water extracts was determined by DPPH free radical scavenging assay. The concentration of DPPH used for this experiment was 0.3 mM. All data were represented as Mean ± SD from the triplicate experiments. In this experiment, ascorbic acid was used as standard. The percent inhibition of ascorbic acid in concentration of 500 µg/ mL was 94.63 % and IC_{50} value was 82.02 µg/ mL. The percent inhibition of ethanol and water extracts in concentration of 500 µg/ mL showed 38.84 % and 23.31 % respectively. IC_{50} value for ethanol extract was 655.08 µg/ mL but water extract did not show both IC_{50} value and activity in concentration of 62.5 µg/ mL. Therefore, ethanol extract showed higher activity than water extract (except standard ascorbic acid). The data is tabulated in Table 3.

Table 3 Antioxidant Activities of *H. undatus* Fruit

Extract / Concentration (µg/ mL)	Antioxidant Activity (%) (Mean ± SD)					IC_{50} (µg/ mL)
	1000	500	250	125	62.5	
Ethanol	74.68 ± 3.06	38.84 ± 2.24	27.44 ± 2.24	17.02 ± 1.74	10.74 ± 2.16	655.08
Water	45.79 ± 2.91	23.31 ± 1.74	14.21 ± 0.86	11.90 ± 1.25	-	-
Ascorbic acid	> 100	94.63 ± 0.34	84.61 ± 0.94	74.35 ± 1.20	36.49 ± 0.88	82.02

CONCLUSION

From the overall assessments of the present study concerning with the evaluation of some phytochemicals, mineral content, nutrient composition and pharmacological activities from fruit pulp of *Hylocereus undatus* (dragon fruit), the following inferences can be deduced. In the preliminary phytochemical tests, the fruit may be used for medicinal purposes due to the presence of bioactive constituents. As the reasonable concentration of potassium by elemental analysis, the fruit may be employed to reduce high blood pressure. The highest amount of moisture by evaluation of nutritional composition makes the fruit with freshness and it is suitable for consumption. In the screening of antimicrobial activity by using agar well diffusion method, both ethanol and water extracts showed activities against all selected microorganisms. From the result, the sample may be used for the formulation of antimicrobial drugs. The antioxidant activity of ethanol and water extracts was determined by DPPH method and both extracts exhibited the antioxidant activity. According to all experimental data, it was found that the fruit possessed rich chemical nutrients, antimicrobial and antioxidant activities. Therefore, *H. undatus* fruit may be used in raw material for drug production and possible application in nutrition and pharmacology.

ACKNOWLEDGEMENTS

Author would like to express deep sense of gratitude to Rector, Dr Saw Pyone Naing and Pro Rector, Dr Myat Myat Thaw from Sagaing University of Education, for their permission to contribute this paper in this journal. I should also express my gratitude to Professor Dr Kathy Myint Thu, Head of Department of Chemistry, Sagaing University of Education, for her kind help in writing this paper.

REFERENCES

Agudo, A. (2004). *Measuring Intake of Fruits and Vegetables*.Japan, Background Paper for the Joint FAO/WHO Workshop on Fruit and Vegetables for Health

A.O.A.C. (1965).*Methods of Analysis*.USA,3rd Ed.,Benjamin franlin Station, 123-498

Foye, W.O., Lemke, T.L. and Williams, D.A. (2008). *Foye's Principles of Medicinal Chemistry*. USA, 6th Ed., Lippincott Williams and Wikins Co.,44-45

Ibrahim, T.A., Opawale, B.O. and Oyinloye, J.M.A. (2011). "Antimicrobial Activities of Herbal Extracts Against Multi Drug Resistant Strains of Bacteria from Clinical Origin". *Life Sci. Leaflets*, vol. 15, 490-498

Lawrence, R., Tripathi, P. and Jeyakumar, E. (2009). "Antimicrobial Activity of Yacon Leaves".*Brazilian J. of Microbiology*, India, vol. 40, 906-915

Lee, S., Son, D., Ryu, J., Lee, Y.S., Jung, S.H., Lee, S.Y. and Shin, K.H. (2004). "Antioxidant Activities of *Acanthopanax senticosus*Stems and Their Lignan Components".*J. ofArchives Pharmacal Research*, vol. 27(1), 106-110

Liaotrakoon, W. (2013). *Characterization of Dragon Fruit (Hylocereus spp.) Components with Valorization Potential.* Ph.D Thesis, Ghent University, Belgium

Marini-Bettolo, G.B., Nicolettic, M. and Patamia, M. (1981). "Plant Screening by Chemical and Chromatographic Procedure Under Field Conditions". *J. Chromato.*, vol. 213, 121

Rahmawati, B. and Mahajoeno, E. (2009). "Variation of Morphology, Isozymic and Vitamin C Content of Dragon Fuit Varities". *Bioscience*, vol. 1(3), 131-137

Rufino, M.S.M., Alves, R.E., Brito, E.S, Perez-Jiminez, J., Saura-Calixto, F. and Mancini-Filho, J. (2010)."Bioactive Compounds and Antioxidant Capacities of 18 Non-Traditional Tropical Fruits from Brazil". *Food Chemistry*, vol. 121(4), 996-1002

Venugopal, R. and Liu, R.H. (2012). "Phytochemicals in Diets for Breast Cancer Prevention: The Important of Resveratrol and Ursolic Acid".*Food Sci. Hum Wellness*, vol. 1, 1-13

Marini-Bettolo, G.B., Nicolettic, M. and Patamia, M. (1981). "Plant Screening by Chemical and Chromatographic Procedure Under Field Conditions". *J. Chromato.*, vol. 213, 121

Rahmawati, B. and Mahajoeno, E. (2009). "Variation of Morphology, Isozymic and Vitamin C Content of

Dragon Fuit Varities". *Bioscience*, vol. 1(3), 131-137

Rufino, M.S.M., Alves, R.E., Brito, E.S, Perez-Jiminez, J., Saura-Calixto, F. and Mancini-Filho, J. (2010).

"Bioactive Compounds and Antioxidant Capacities of 18 Non-Traditional Tropical Fruits from Brazil".

Food Chemistry, vol. 121(4), 996-1002

Venugopal, R. and Liu, R.H. (2012). "Phytochemicals in Diets for Breast Cancer Prevention: The Important of

Resveratrol and Ursolic Acid". *Food Sci. Hum Wellness*, vol. 1, 1-13