A Study on the Phytochemical Investigation, Nutritional Values, Elemental Analysis and Antimicrobial Activity of *Dendrocalamus longispathus* Kurz (Bamboo) Leaves

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Abstract

Bamboo is one of the fastest growing woody plants in the world and it is also a potential source of bioactive substances. This research evaluated the preliminary phytochemical investigation, nutritional values, elemental analysis and antimicrobial activity of *Dendrocalamus longispathus* Kurz leaves. Preliminary phytochemical investigation indicated the presence of alkaloids, α-amino acids, carbohydrates, glycosides, flavonoids, phenolic compounds, reducing sugars, saponins, tannins, terpenoids, and starch. The nutritional values such as moisture, ash, fats, proteins, carbohydrates and fibers of the sample were determined by AOAC method. It was observed that carbohydrates (33.35 %), proteins (12.92 %), moisture (8.52 %), fibers (22.85 %), ash (21.54 %) and fats (2.82 %) were present in the sample. According to elemental analysis, the sample was found with organic material as major content and the essential minerals such as Si, K, Ca, S, P, Mn and Fe. The sample was found with Rb, Zn, Cu, Br, Cr and Ni as trace elements. Moreover, antimicrobial activity assay against the microorganisms (*Bacillus subtilis, Staphylococcus aureus, Pesudomonas aeruginosa, Bacillus pumilus*, *Candida albicans and Escherichia coli*) was carried out by agar well diffusion method and ethanol extract showed highest activity.

Keywords: *Dendrocalamus longispathus* Kurz , phytochemicals, nutritional value,elemental content, antimicrobial activity

1. Introduction

1.1 Bamboo (*Dendrocalamus longispathus* Kurz)

Bamboos grow in the tropical and subtropical regions of Asia, Africa and Latin America, extending as far north as the southern United States or Central china, and as far south as Patagonia. They also grow in northern Australia (Flint, 2008). Almost all parts of the bamboo tree can be used. Part of bamboo leaf tree can be used for home materials, home furniture, handicrafts, and various types of art (Helen, 2016). The buds or more commonly referred to as bamboo shoots can be delicious dishes and rich with content of a range of nutrients (Rottke, 2002).

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(a) (b)

Figure 1.1 Photographs of (a) Bamboo Leaves and (b) Bamboo tree

1.2. Scientific Classification of *Dendrocalamus longispathus* Kurz

Family	–	Poaceae
Genus	–	*Dendrocalamus*
Species	–	*D. longispathus*
Scienific name	–	*Dendrocalamus longispathus* Kurz
English name	–	Bamboo
Myanmar name	–	Wa-net, Wa-ya

1.3 Uses of Bamboo (*Dendrocalamus longispathus* Kurz)

Bamboo is found in Asia and is used extensively in Asian cooking, especially Chinese food. The most edible part of the plant is the shoots, and they are found in the market in various forms-fresh, canned, dried, and frozen. Several varieties of bamboo shoots are edible and available for consumption, depending on the region in which it is grown. People in Asia eat it in various forms, like a vegetable, pickled, or fried. Other than its culinary uses, bamboo is also used as a raw material for building furniture and even houses (Robinson, 1983). Medicinal uses of bamboo have been known and practiced by Asian healers of old. Bamboo leaves have antioxidant properties. Antioxidants help to keep the balance of free radicals and ward off any excess amount that can cause a large variety of problems like heart disease and even cancer. It is also great for healthy skin. Bamboo is a low calorie product that is high in dietary fiber (Frazier, 1967).

1.4 Benefits of Bamboo (*Dendrocalamus longispathus* Kurz)

Bamboo can help to ease labor pain in the last stage of pregnancy. Health benefits of bamboo include treating wounds and ulcers due to its antibacterial properties. Bamboo juice is particularly helpful for ulcers. Bamboo shoots are good for the stomach and can cure mild symptoms like indigestion and diarrhea. Studies have indicated that consuming bamboo shoots can reduce cholesterol and thus, ensure a healthier life (Raymond, 1982). Advantages of bamboo include its ability to control blood pressure due to the abundance of potassium. Potassium helps to lower blood pressure and keep the body healthy. A lot of cosmetic products integrate bamboo ingredients for facial and hair care. In addition, uses of bamboo plants are not only limited to dietary benefits. (Soltys, 1963).

2. Materials and Methods

Dendrocalamus longispathus Kurz leaves were collected from La Mu Tan Gyi Village, Htantabin Township, Yangon Region. The collected bamboo leaves were washed with distilled water, cut, dried in air, ground into powder and finally stored in air-tight containers for further works. The preliminary phytochemical investigation of sample was carried out by Test Tube method. The nutritional values of sample were determined by AOAC method (AOAC, 2000). Then, semi-quantitative elemental analysis of sample was performed by EDXRF method. Moreover, the antimicrobial activity of *Dendrocalamus longispathus* Kurz was determined by agar well diffusion method.

3. Results and Discussion

3.1 Preliminary Phytochemical Investigation of *Dendrocalamus longispathus* Kurz Leaves

Phytochemical constituents of bamboo leaf sample were studied at Chemistry Laboratory, Department of Chemistry, West Yangon University.

According to phytochemical investigation, the bamboo leaf sample was found that the bioactive compounds such as alkaloids, α-amino acids, carbohydrates, flavonoids, glycosides, phenolic compounds, reducing sugars, saponins, starch, terpenoides and tannins were present. The *Dendrocalamus longispathus* Kurz has an impressive range of medicinal uses with high nutritional value and medicinal benefits. The results obtained are reported in Table 3.1.

3.2 Determination of Nutritional Values of *Dendrocalamus longispathus* Kurz Leaves

The nutritional values of *Dendrocalamus longispathus* Kurz leaf sample were determined by AOAC method. The results obtained are reported in Table 3.2.

The protein content was determined by protein analyser (VELP SCIENTIFICA). The moisture content (8.52 %), the ash content (21.54 %), the fiber content (22.85 %), the fat content (2.82 %), the protein content (12.92 %) and the carbohydrate content (33.35 %) were found in the sample. So, from the nutritional point of view, it may be suggested that *Dendrocalamus longispathus* Kurz Leaf is suitable for human's health.

Table 3.1 Observation of Phytochemical Tests of *Dendrocalamus longispathus* Kurz Leaves

No.	Type of compound	Extracts	Test reagent	Observation	Remark
1	Alkaloids	1% HCl	Dragendorff's reagent Mayer's reagent Sodium picrate sol:	Orange ppt White ppt Yellow ppt	+ + +
2	α –amino acids	H_2O	Ninhydrin reagent	Violet spot	+
3	Carbohydrates	H_2O	10 % α –naphthol, Conc:H_2SO_4	Red ring	+
4	Flavonoids	EtOH	Mg ribbon, Conc:	Pink colour	+

			HCl		
5	Glycosides	H_2O	10 % Lead acetate sol:	White ppt	+
6	Phenolic compounds	H_2O	1 % $FeCl_3$ sol:, $K_3Fe(CN)_6$ sol:	Deep blue Colouration	+
7	Reducing Sugars	H_2O	Benedict's sol;	Brick red ppt	+
8	Saponins	H_2O	Distilled water	Frothing	+
9	Terpenoids	EtOAc	Acetic anhydride, Conc:H_2SO_4	pink colour	+
10	Starch	H_2O	I_2 solution	Blue colour	+
11	Tannins	EtOH	5 % $FeCl_3$ sol:	Blue ppt	+

(+) = present (-) = absent

Table 3.2 Nutritional Values of *Dendrocalamus longispathus* Kurz Leaves

No.	Nutrients	Results (%)
1	Carbohydrates	33.35
2	Fibers	22.85
3	Ash	21.54
4	Proteins	12.92
5	Moisture	8.52
6	Fats	2.82
7	Energy value (kcal/100g)	188.9

3.3 Elemental Analysis of *Dendrocalamus longispathus* Kurz Leaves

The elemental contents of the *Dendrocalamus longispathus* Kurz leaf sample were studied by Energy Dispersive X- ray Fluorescence (EDXRF) spectrometer. The results are reported in Table 3.3.

According to elemental analysis, the sample was found with organic material (93.442 %) as major content and the essential minerals such as Si (3.721 %), K (1.910 %), Ca (0.376 %), S (0.358 %), P (0.091 %), Mn (0.055 %) and Fe (0.029 %). Moreover, the sample was found that Rb, Zn, Cu, Br, Cr and Ni as trace elements.

From these observations, the contents of Si, K and Ca are prominent in sample. K is an important component of cell and body fluids that helps control heart rate and blood pressure. Ca is very essential in muscle contraction, building strong bones and teeth, nerve impulse, transmission, regulating heart beat and fluid balance within cells. Fe is essential for red blood cell production and as a co-factor

for cytochrome oxidases enzymes. Moreover, the *Dendrocalamus longispathus* Kurz leaf sample contains many important minerals for human health. These elements that contains in the sample help the metabolism of human's body.

3.4 Screening of Antimicrobial Activity of *Dendrocalamus longispathus* Kurz Leaves

In this work, bamboo leaves were extracted by ethanol, petroleum ether, methanol and water. These extracts were used to test the antimicrobial activity against *Bacillus substilis, Staphylococcus aureus, Pseudomonas aeruginosa, Bacillus pumilus, Candida albicans* and *Escherichia coli* species by using agar well diffusion method.

EtOH extract showed antimicrobial activities on five test microorganisms except *Staphylococcus aureus* (Inhibition diameter 12-17 mm) and the largest antimicrobial activity was observed in *Escherichia coli* (17 mm). MeOH extract showed antimicrobial activities on *Bacillus substilis, Bacillus pumilus* and *Escherichia coli* and the largest antimicrobial activities were observed in *Bacillus pumilus* and *Escherichia coli* (13 mm). PE extract showed antimicrobial activities on *Pseudomonas aeruginosa and Bacillus pumilus* and the largest antimicrobial activity was observed *Pseudomonas aeruginosa* (14 mm). Water extract showed antimicrobial activities on *Pseudomonas aeruginosa, Bacillus pumilus* and *Escherichia coli* and the largest antimicrobial activity was observed *Escherichia coli* (15 mm). Moreover, the ethanol extract showed better antimicrobial activity than the other extracts. So, the health benefits of *Dendrocalamus longispathus* Kurz leaves include the ability to reduce inflammation throughout the body, improve eye health, boost respiratory health, heal skin conditions. The results are shown in Table 3.4 and Figures 3.1.

Table 3.3 Relative Abundance of Elements in *Dendrocalamus longispathus* Kurz Leaves

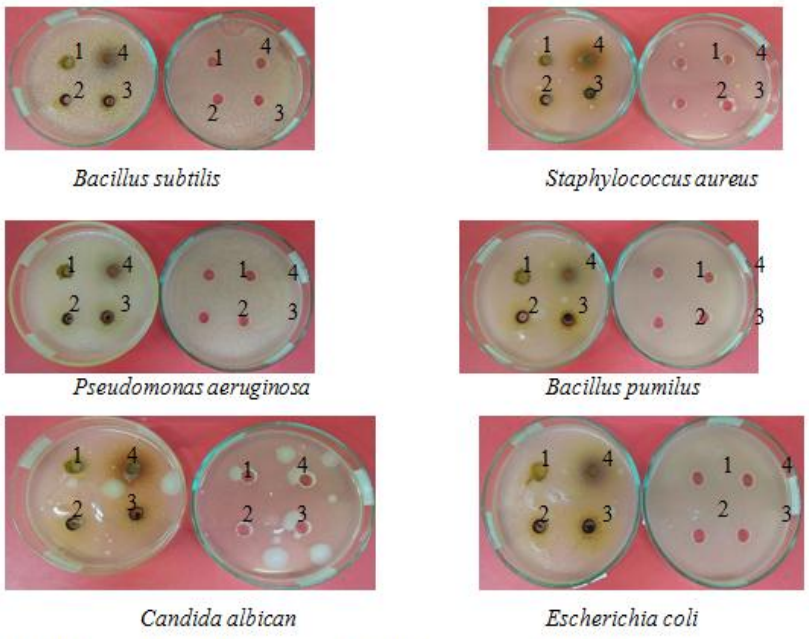
No.	Element	Relative Abundance (%)
1	Si	3.721
2	K	1.910
3	Ca	0.376
4	S	0.358
5	P	0.091
6	Mn	0.055
7	Fe	0.029
8	Rb	0.006
9	Zn	0.003
10	Cu	0.003

11	Br	0.002
12	Cr	0.002
13	Ni	0.001
14	CH	93.442

Table 3.4 Results of Antimicrobial Activity of *Dendrocalamus longispathus* Kurz Leaves

Types of Microorganisms	Inhibition Zone Diameter (mm)			
	PE	MeOH	EtOH	H_2O
Bacillus subtilis	-	12mm (+)	12mm (+)	-
Staphylococcus aureus	-	-	-	-
Pseudomonas aeruginosa	14mm (+)	-	12mm (+)	13mm (+)
Bacillus pumilus	13mm (+)	13mm (+)	14mm (+)	13mm (+)
Candida albican	-	-	12mm (+)	-
Escherichia coli	-	13mm (+)	17mm (++)	15mm (++)

Agar well = 10 mm, 10 mm – 14 mm = (+), 15 mm – 19 mm = (++)
20 mm and above = (+++), (-) = No inhibition zone



(1) = PE (2) = MeOH (3) = EtOH (4) = H_2O
Figure 3.1 Antimicrobial activity of *Dendrocalamus longispathus* Kurz Leaves

4. Conclusion

In this research, the phytochemical investigation, nutritional values, elemental analysis and antimicrobial activity of *Dendrocalamus longispathus* Kurz leaves were investigated.

From phytochemical investigation, *Dendrocalamus longispathus* Kurz leaf sample contains various biologically active compounds, which are responsible for its bioactivities, medicinal and folk medicinal use.

From nutritional values, *Dendrocalamus longispathus* Kurz leaves are considered to be a good source of fiber and low fat content. The fiber content of bamboo leaves proved very effective for lowering blood sugar. In addition, fiber is also very good for weight loss. So, from the nutritional point of view, it may be suggested that bamboo leaf sample is suitable for human's health.

According to elemental analysis, the total of 13 elements were detected in *Dendrocalamus longispathus* Kurz leaf sample. The leaf sample was found that there are essential minerals such as Si, K, Ca, S, P, Mn and Fe. So, the *Dendrocalamus longispathus* Kurz sample contains many important minerals for human health.

Antimicrobial activity assay was carried out by agar well diffusion method and EtOH extract showed the highest antimicrobial activity. *Dendrocalamus longispathus* Kurz leaf was found to be possessed potent bioactive chemical constituents which can fight against the pathogenic bacteria and fungus. So, the leaf sample can be assessed to apply in the treatment of various infectious diseases.

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