

Physico-Chemical Analysis of the Aerial Parts of *Diplazium esculentum* (Retz.) Sw. (Family: Athyriaceae)

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ABSTRACT

Diplazium esculentum (Retz.) Sw. (Family: Athyriaceae) is one of the very popular edible ferns, a common pteridophytes usually included in one of the major ingredients in the traditional 'Ulam' (salads) preparations in Malaysia. The plant is highly valued for its several medicinal attributes. The present paper reports the physicochemical studies of the aerial parts. Diagnostic characteristics of the aerial parts powder showed presence of lignified xylem fibres and non-lignified phloem fibres, fragments of epidermal cells containing anomocytic stomata, mesophyll, palisade cells, parenchyma and collenchyma tissues, covering trichomes and prismatic crystals of calcium oxalate. Preliminary phytochemical screening of different extracts showed presence of steroids, triterpenoids, tannins and phenolic substances, flavonoids, carbohydrates, gum and mucilage. The findings of the study will provide substantial information for the proper identification of the plant drug to the future investigators.

Keywords: *Diplazium esculentum* (Retz.) Sw., Morphological studies, Physico-chemical analysis, Preliminary phytochemical studies.

INTRODUCTION

Ferns are mostly considered as ornamental plants but many of these species are edible and eaten either raw or cooked in different parts of the world due to their nutritive values¹. In Malaysia, *Diplazium esculentum* (Retz.) Sw. (Family: Athyriaceae) is one of the very popular edible ferns usually included in one of the major ingredients in the traditional 'Ulam' (salads) preparations. The plant is sold in bundles of fresh aerial parts in the local markets and believed to be the tastiest among other ferns locally used².

D. esculentum is a vascular plant and belongs to the class of Pteridophyta. It does not produce seeds or bear fruits but is propagated through spores. The plant is mainly terrestrial, growing in open marshy areas, stream banks and canals from sea level to 2,300 m and occasionally on limestone rocks^{1,3}.

In Malaysia, the aerial parts eaten by the people to nourish their health⁴. Traditionally, the aerial parts are used to treat fever, dermatitis, and measles⁵. The leaves are believed to be effective in treating pain, wounds, dysentery, diarrhoea and various skin infections⁶. Young fronds are boiled and eaten for laxative effect⁷. Earlier reports on various pharmacological activities as reported by previous researchers include laxative⁸, anti-inflammatory^{8,9}, antioxidant¹⁰, anthelmintic¹¹, antimicrobial¹², cytotoxic^{12,13} activities of the plant. In the present paper, we report the physicochemical analysis of the aerial parts.

MATERIALS AND METHODS

Plant material

The fresh plant material was collected from Ulu Kuang, Perak and authenticated. A voucher specimen was deposited in the Herbarium of the Faculty of Pharmacy and Health Sciences, Universiti Kuala Lumpur Royal College of Medicine Perak for future reference. The collected plant material was washed under water to remove adhering debris, shade dried and pulverised in to coarse powder.

Chemicals

Standard analytical grade chemicals and reagents were used for the study.

Morphological studies

Morphological studies were performed by carefully observing the plant parts under day light using a convex lens. The organoleptic studies included colour, odour, taste

Table 1: Physico-chemical analysis of *D. esculentum* aerial parts.

Parameters	Value (%)
Total ash	11.26 ± 1.16
Acid insoluble ash	2.36 ± 0.36
Water soluble ash	3.85 ± 0.38
Water soluble extractive	21.48 ± 2.13
Ethanol soluble extractive	4.57 ± 0.89
Loss on Drying	10.69 ± 1.32

Results expressed as Mean ± SD from three observations.

Table 2: Behaviour of the *D. esculentum* aerial parts with different chemical reagents.

Treatment	Aerial parts		
	Visible	254 nm	366 nm
Powder + Distilled water	Green	Dark green	Black
Powder + 5% FeCl ₃	Green	Black	Black
Powder + Glacial acetic acid	Light brown	Green	Green
Powder + 5% KOH	Green	Dark brown	Dark brown
Powder + 5% NaOH	Green	Dark brown	Dark brown
Powder + Conc. HCl	Green	Dark green	Dark green
Powder + Conc. H ₂ SO ₄	Dark brown	Dark green	Dark green
Powder + Conc. HNO ₃	Orange	Orange	Dark green
Powder + N/10 Iodine	Green	Dark green	Dark green
Powder + Ammonia	Green	Dark green	Dark green

Table 3: Colour, consistency and extractive values of various extracts of *D. esculentum*.

Extract	Consistency	Yield (% w/w)	Observation		
			Day light	UV 254 nm	UV 366 nm
Pet. ether	Greasy	0.43%	Olive green	Green	Brick red
Chloroform	Sticky	2.9%	Dark green	Dark green	Brick red
Methanol	Hard sticky	4.18%	Dark green	Dark green	Brick red
Aqueous	Hard sticky	6.2%	Brown	Deep brown	Green

Table 4: Preliminary phytochemical analysis of various extracts of *D. esculentum*.

Test for	Extracts			
	Pet. ether	Chloroform	Methanol	Aqueous
Alkaloids	-	-	-	-
Carbohydrates	-	-	-	+
Flavonoids	-	-	+	+
Gums and mucilages	-	-	-	+
Protein and amino acid	-	-	-	+
Steroid and sterols	+	+	-	-
Tannins	-	-	+	+
Terpenoids	+	+	-	-

'+' = present; '-' = absent

and texture of the aerial parts.

Powder microscopy

The powder microscopy characteristics of the aerial parts were studied by staining the coarse powder separately with phluoroglucinol-hydrochloric acid (1:1), N/20 iodine solution and distilled water to identify the presence of lignified tissues, starch grains, calcium oxalate crystals and other components¹⁴.

Physico-chemical analysis

Physico-chemical analysis of the dried aerial parts included determination of moisture content, ash and extractive values. The parameters were studied according to the procedures laid down in British Pharmacopoeia¹⁵. The behaviour of the powder plant materials with different chemical reagents were studied using recommended methods¹⁶. The powder, after being treated separately with reagent were examined under visible light and UV at 366 nm and 254 nm.

Extraction and preliminary phytochemical studies

About 30 g of the dried plant material was successively extracted with petroleum ether (40 - 60°C), chloroform, methanol and distilled water by ultrasonic extraction^{17,18}. Following extraction, the liquid extracts were concentrated and extractive values were noted. The extracts were subjected to fluorescence analysis to identify the presence

of any fluorescence components if any they contain^{19, 20}. The colour, consistency and extractive values of all extracts were recorded. Preliminary phytochemical analysis was performed on the extracts using recommended methods¹⁷.

RESULTS AND DISCUSSION

Morphological studies

Colour: green

Odour: no characteristic odour

Taste: no characteristic taste

Texture: stem erect, 20-50 cm long, green and smooth; fronds pale brown above, darker and scallier at the base

Powder microscopy

Diagnostic characteristics of *D. esculentum* aerial parts powder showed presence of lignified xylem fibers and non-lignified phloem fibers, fragments of epidermal cells containing anomocytic stomata, mesophyll, palisade cells, parenchyma and collenchyma tissues, covering trichomes and prismatic crystals of calcium oxalate.

Physico-chemical analysis

The percentage of total ash, acid-insoluble ash, water soluble ash, water soluble extractive, ethanol soluble extractive and loss on drying of the dried aerial parts are presented in Table 1. Behaviour of the powdered aerial

parts with different chemical reagents were observed under visible light and UV at 254 nm and 366 nm and are presented in Table 2.

Preliminary phytochemical studies

The colour, consistency, extractive values of all extracts obtained through successive extraction are presented in Table 3. The liquid extracts were examined under visible light and UV at 366 and 254 nm respectively. The results of the preliminary phytochemical screening are presented in Table 4. Preliminary phytochemical screening of different extracts revealed presence of steroids, triterpenoids, tannins and phenolic substances, flavonoids, carbohydrates, gum and mucilage in the plant.

CONCLUSION

Apart from its traditional medicinal attributes, *D. esculentum* is widely used as an important ingredient in the traditional Malaysian salad 'Ulam' or cooked and eaten by the people to maintain healthy life style. Several pharmacological studies have been reported by previous researchers and documented significant activities. The findings of the study will provide substantial information for the proper identification of the plant drug to the future investigators.

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