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Pharmacognostic standardisation of *Maranta arundinacea* L. - An important ethnomedicine

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Abstract

Plants are said to be medicinal when they are used to promote health beyond basic nutrition. Various bioactive compounds present in the plant are responsible for the medicinal properties of the plant. The present study aims to establish pharmacognostic standardization such as macro and microscopic standards, physico-chemical analysis, powder analysis and preliminary phytochemical screening of rhizome of *Maranta arundinacea* L. Phytochemical screening was carried out with petroleum ether, chloroform, methanol and distilled water respectively. The study revealed the presence of bio-active compounds such as alkaloids, carbohydrate, cardiac glycosides, aminoacids, phenolic compounds, terpenoids, saponins, flavones and gum. Histochemical studies showed the presence of innumerable starch grains. Physicochemical parameters like moisture content (6.6%), total ash (2.5%), extractive values of alcohol (1.8%) and water (25.1%) were also evaluated. The above parameters are significant towards establishing the pharmacognostic standards for future identification and authentication of genuine plant material.

Keywords: *Maranta arundinacea* L., pharmacognostic standardisation, physicochemical evaluation, phytochemical analysis

1. Introduction

Herbal medicines have become more popular in the treatment of many diseases due to popular belief that green medicine is safe, easily available and with fewer side effects. Around a quarter of all pharmaceutical drugs currently on the market are derived from plants. The pharmacological treatment of disease began long ago with the use of herbs [1]. The medicinal value of plants lies in some chemically active substances that produce a definite physiological action on the human body. The most important of these chemical constituents of plants are: alkaloids, tannins, flavonoid and phenolic compounds. Methods of folk healing throughout the world commonly used herbs as part of their tradition. However the documentation of the phytochemicals which make the plant medicinally important in scientific method is less. So that the documentation and standardization of the raw materials used in herbal medicine is very essential for the worldwide acceptance of this system of medicine. Pharmacognostic standardisation, physicochemical analysis and preliminary phytochemical studies will help in the identification of authentic plant materials. Pharmacognostic standardisation of plant material include its morphological, anatomical and biochemical characteristics [2].

Maranta arundinacea L., commonly known as West Indian arrowroot is an important starchy medicinal plant which finds uses in traditional food and medicine from time immemorial. It is a widely cultivated root crop for its starchy rhizomes that form the source for extraction of easily digestible starch which finds use as infant and convalescent food [3]. It belongs to the family Marantaceae having 31 genera and about 550 species distributed throughout the tropics [4]. West Indian arrowroot is a tropical perennial with clusters of long, thin stems and small, cream colored flowers that grow in pairs. Once revered by the ancient Mayans and other inhabitants of Central America as an antidote for poison-tipped arrows, the herb is mainly used today to soothe the stomach and alleviate diarrhea. It has also been popular for centuries in the culinary arts and is still used in many American kitchens as a thickening agent. While arrowroot is native to Central America and widely cultivated in the West Indies, it can also be found growing in many tropical regions of the world, including Southeast Asia, South Africa, Australia, and in Florida in the United States.

Maranta arundinacea is reported for the antioxidant activity and hypolipidemic effect [5, 6]. These biochemical activities of plants are mainly due to the phytochemical components present in it. In this context, present study was focused to the pharmacognostic standardisation of rhizomes of *Maranta arundinacea* in order to establish its macro and microscopical standards, physicochemical parameters and preliminary phytochemical investigation.

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2. Materials and methods

1. Collection of plant material

The tuberous rhizomes with leaves and flowers of *Maranta arundinacea* L. were collected from Thenhipalam, Malappuram District, Kerala, India and authenticated at Calicut University Herbarium, Department of Botany, University of Calicut, Kerala (Fig.1:A&B). Microscopic studies were carried out with fresh samples. Remaining plant materials were washed with distilled water and dried at room temperature. The dried rhizomes were manually ground to a fine powder. Fine powder of rhizome was used for the physicochemical analysis.

2. Preparation of plant extract

Powdered rhizome of *Maranta arundinacea* was serially extracted with petroleum ether, chloroform, methanol and distilled water using soxhlet apparatus. Extracts were concentrated and used for the preliminary phytochemical screening.

3. Pharmacognostic Standardisation

The organoleptic characters such as shape, size, colour, odour, taste and fracture of powdered rhizome were determined. Anatomical studies were done by fresh samples of rhizome with the aid of compound microscope Leica DFC295. Histochemical studies and powder microscopy were carried out to study the inclusions and detailed anatomical characters of the material.

4. Physicochemical Evaluation

Moisture content, total ash and extractive values in alcohol and water were carried out.

a. Moisture content

Fresh weight of the sample was determined and placed the sample in a hot air oven initially for one hour at 100°C and then at 60°C until the dry weight of the sample became constant [7].

$$\text{Moisture content \%} = \frac{\text{Fresh weight} - \text{Dry weight}}{\text{Fresh weight}} \times 100$$

b. Total ash value

About 3 g of powdered rhizome was accurately weighed and taken separately in silica crucible, which was previously ignited and weighed. The powder was spread as a fine layer on the bottom of crucible. The powder was incinerated gradually by increasing temperature to make it dull red hot until free from carbon. The crucible was cooled and weighed. The procedure was repeated to get constant weight. The percentage of total ash was calculated with reference to the air dried powder [8].

c. Extractive value determination

Coarsely powdered air-dried material (4 g) was placed in a glass stoppered conical flask and macerated with 100 ml of solvents (water and ethanol), shaken frequently and then allowed to stand for 18 hours. Then it was filtered rapidly through Whatman No. 1 filter paper, taking care not to lose any solvent. 25 ml of the filtrate was transferred to a flat

bottom dish and allowed the solvent to evaporate on a water bath. Afterwards, it was dried at 105°C for 6 hours, cooled in a desiccator for 30 minutes and weighed immediately. The content of extractable matter in percentage of air dried material was calculated [9].

5. Phytochemical screening

The preliminary phytochemical analysis of the extracts was carried out using petroleum ether, chloroform, methanol and aqueous extracts of the powdered specimens using standard procedures to identify the various chemical components as described by Sofowora [10], Trease and Evans [11] and Harborne [12].

(1) Test for Alkaloids

a. Mayer's test

To 1ml of filtrate, two drops of Mayer's reagent was added along the sides of the test tube and appearance of buff coloured precipitate was taken as positive test for the presence of alkaloids.

b. Dragendorff's test

A few drops of Dragendorff's reagent were added in a test tube containing 1ml of filtrate. The occurrence of orange red precipitated was taken as positive.

(2) Test for carbohydrate

a. Molisch's test

Two ml of filtrate was added with two drops of alcoholic solution of α -naphthol. The mixture was shaken well and 1ml of con.H₂SO₄ was added along the side of the test tube and allowed to stand. A violet or purple ring indicates the presence of carbohydrates.

b. Fehling's test

One ml of filtrate was boiled on water bath with 1ml of each Fehling's solution A and B. A red precipitate indicates the presence of carbohydrate.

(3) Test for cardiac glycosides

a. Borntranger's test

Two ml of filtered hydrolysate was treated with 3ml of chloroform and shaken well. Chloroform layer was separated and 10% ammonia solution was added to it. Pink colour indicates the presence of glycosides.

b. Keller-Killani test

5 ml of each extract were treated with 2ml of glacial acetic acid containing 1 drop of ferric chloride solution. This was underlaid with 1ml con.H₂SO₄. A brown ring of the interface indicates a deoxysugar characteristic of cardiac glycosides. A violet ring may appear below the brown ring, while in the acetic acid layer, a greenish ring may form just gradually throughout thin layer.

(4) Test for proteins and aminoacids

100 mg of all the extracts were dissolved in 10ml distilled water and filtered through filter paper and the filtrate was subjected to test for proteins and amino acids.

a. Ninhydrin test

To drops of ninhydrin solution was added to 2 ml of aqueous filtrate. A characteristic purple colour indicates the presence of aminoacids.

b. Biuret test

An aliquote of 2 ml filtrate was treated with one drop of 2% CuSO₄ solution. To this 1ml of 95% ethanol was added, followed by excess of potassium hydroxide pellets. Pink colour I the ethanolic layer indicate the presence of proteins.

(5) Test for sterols**a. Libermann sterol test**

To a solution of glycoside or steroid aglycones in glacial acetic acid, one drop of con. H₂SO₄ was added. A play of colour was observed starting with rose, red, violet, blue to green.

b. Libermann Burchard's test

5 ml of unsaponifiable fraction was dissolved in 2 ml chloroform and 2 ml of acetic anhydride. After this, two drops of con. H₂SO₄ was added to above solution. A strong blue colouration changing gradually to green indicated the presence of steroids.

(6) Test for fixed oils and fat**a. Spot test**

10 mg of the extract was pressed between to filter paper indicated the presence of fixed oil.

(7) Test for phenolic compounds**a. Ferric chloride test**

50mg of the extract was dissolved in distilled water, and to this a 0.5 ml of neutral 5% ferric chloride solution was added. A dark green colour indicated the presence of phenolic compounds.

(8) Test for terpenoids

2 ml of the extract was dissolved in 2 ml of Chloroform and evaporated to dryness. 2 ml of conc. H₂SO₄ was then added and heated for about 2 minutes. Development of a grayish color indicates the presence of terpenoids

(9) Test for saponins**a. Foam test**

100 mg of extract was diluted with distilled water to 20 ml. The suspension was shaken in a graduated cylinder for 15 minutes. Formation of 2 cm layer foam indicated the presence of saponins.

(10) Test for flavones and flavanones**a. Aqueous sodium hydroxide**

20 mg of the extract was added with 2 ml of aqueous NaOH solution, yellow to orange colour indicates flavones and orange to crimson color indicates flavonones.

(11) Test for tannins

About 2 ml of the extract was stirred with 2 ml of distilled water and few drops of ferric chloride (FeCl₃) solution were added. Formation of green precipitate was indication of presence of tannins.

(12) Test for gum

About 10 ml of extract was slowly added to 25 ml of absolute alcohol under constant stirring. The appearance of precipitation indicated the presence of gum.

Results and Discussion**Pharmacognostic Standardisation****a. Microscopic characters**

Detailed T.S. of rhizome of *Maranta arundinacea* showed epidermal cells followed by an array of parenchymatous cells. These parenchymatous cells were completely filled with oval shaped starch granules (SG) towards the center. Vascular bundles (VB) were scattered in parenchymatous ground tissue (Fig.1: C&D). Epidermal peeling of the leaf of *Maranta arundinacea* showed variously shaped epidermal cells with diacytic type of stomata (ST). The epidermal cells also hold certain trichomes (TR) (Fig.1: E&F).

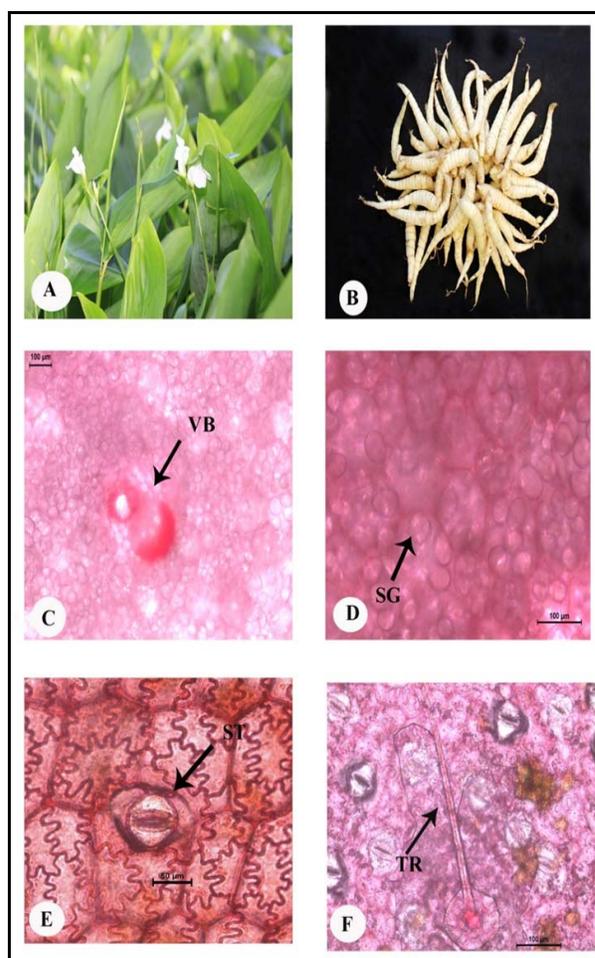


Fig 1: Pharmacognostic study of *Maranta arundinacea* [A] *M. arundinacea* whole plant, [B] Rhizome, [C-D] T.S. of rhizome showing vascular bundle (VB) and starch grains (ST), [E] Epidermal peeling with stomata (ST), [F] Epidermal peeling with trichome (TR).

b. Powder microscopic characters

Powder analysis showed fragments of vessel with spiral thickening, xylem fibers, starch grains and calcium oxalate crystals (Fig. 2). Powder microscopic characters are very important in Ayurveda for the proper identification and authentication of plant materials during drug standardization.

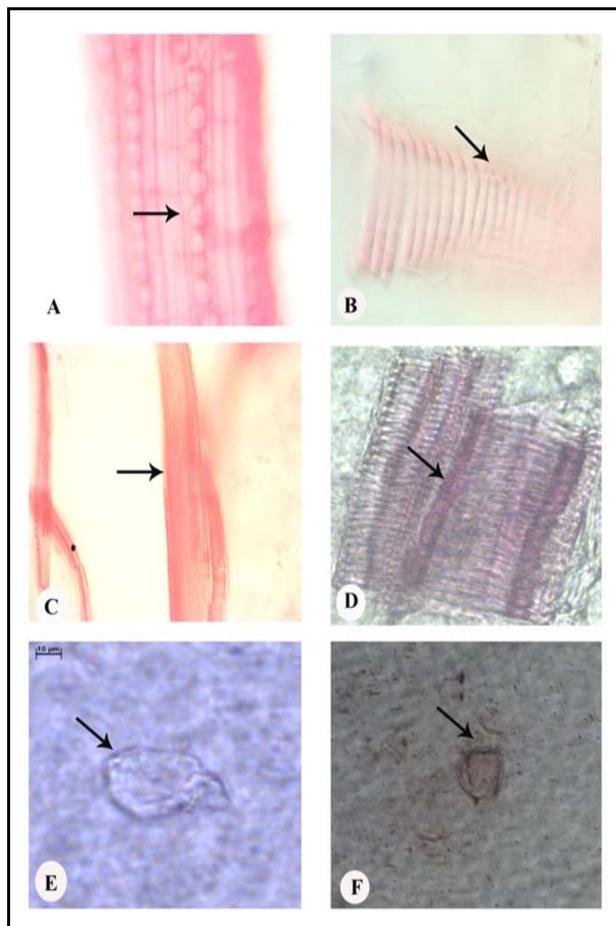


Fig 2: Powder characteristics of *Maranta arundinacea*. [A] Scalariform thickening, [B] Annular thickening, [C] Xylem fiber, [D] Vessel with spiral thickening, [E] starch grain, [F] Calcium oxalate crystal.

Physicochemical parameters

The value of loss on drying at 110 °C showed the moisture content present in the sample, which was 6.6%. The total ash was found to be 2.5%. The ash content indicates the amount of inorganic matter present in the sample. Extractive values of ethanol and water were 1.8% and 25.1% respectively (Table 1).

Table 1: Physicochemical constituents of *M. arundinacea*

Physico chemical constants (%)	Total ash	Moisture content
		2.5
Extractive values (%)	Ethanol	water
	1.8	25.1

Preliminary phytochemical investigation

The rhizome of *Maranta arundinacea* possess various chemical components such as alkaloids, carbohydrate, cardiac glycosides, proteins, amino acids, phenolic compounds, terpenoids, saponins, flavones and gum. Among the different solvents tried, methanolic extract was found to be effective in carrying almost all classes of chemical compounds (Table 2). These are the most important bioactive constituents of plants [13]. The presence of flavonoids indicates the naturally occurring phenolic compound, with beneficial effects in the human diet as antioxidants and neutralizing free radicals [14]. Steroids are of great importance and interest in pharmacy due to their relationship with such compounds as sex hormones [15]. The biological, pharmacological, and medicinal properties of the flavonoids have been extensively reviewed [16, 17, 18]. Flavonoids and other plant phenolics are reported, in addition to their free radical scavenging activity [19], to have multiple biological activities [20,21] including vasodilatory [22,23], anticarcinogenic, anti-inflammatory, antibacterial, immune-stimulating, antiallergic, antiviral, and estrogenic effects. Secondary metabolites such as alkaloids and terpenoids are reported mainly for the plant defence mechanism. Alkaloids are also used in medicines for reducing headache and fever. These are attributed for anti-bacterial and analgesic properties. Saponins have the properties of precipitating and coagulating red blood cells and anti-inflammatory activity [24]. Flavonoids, triterpenoids and tannins are well known for their hepatoprotective activities [25]. The present study clearly communicates that *Maranta arundinacea* plant can be used as a potential source for an array of new useful drugs. The phytochemical characterization of the extracts, the isolation of responsible bioactive compounds and understanding their biological activity are necessary for further studies.

Table 2: Phytochemical constituents of *M. arundinacea*

Phytochemical components	Petroleum ether extract	Chloroform extract	Methanolic Extract	Aqueous Extract
Alkaloids	-	-	+	-
Carbohydrate	+	+	+	+
Cardiac glycosides	+	+	+	+
Proteins & amino acids	-	-	+	+
Sterols	+	+	-	-
Fixed oils & fat	-	-	-	-
Phenolic compounds	-	-	+	+
Terpenoids	-	-	+	-
Saponins	+	+	+	-
Flavones	-	-	+	-
Flavonones	-	-	+	-
Tannins	-	-	+	-
Gum	-	-	+	-

(+): present; (-): absent

Conclusions

Since ancient times, medicinal plants have played a vital role in preventing various diseases. The medicinal properties of plants are attributed to the phytochemicals present in them. *Maranta arundinacea* is a well known medicinal plant used against diarrhea and urinary related diseases. The present study discloses the phytochemical components which make the plant a medicinal one. The phytochemical analysis of the plants is also important and pharmaceuticals companies for the novel drugs for treatment of various diseases. Microscopic studies, powder microscopic studies and physicochemical parameters are also significant for future identification and authentication of genuine plant material.

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Reference

- Schulz V, Hansel R, Tyler VE. Rational phytotherapy: a Physician's Guide to Herbal Medicine, Psychology Press, 2001.
- Anonymous. Macroscopic and Microscopic Examination: Quality Control Methods for Medicinal Plant Materials, WHO, Geneva, 1998.
- Pradeepkumar S, Nair GM, Padmaja G. Purification and characterization of peroxidase from arrowroot (*Maranta arundinacea* L.) leaves. *J Root Crops*. 2008; 34:164-171.
- Andersson L, Chase MW. Phylogeny and classification of Marantaceae. *Bot. J Linn. Soc.* 2001; 135:275-287.
- Nishaa S, Vishnupriya M, Sasikumar J, Hephzibah P, Christabel Gopala Krishnan VK. Antioxidant activity of ethanolic extract of *Maranta arundinacea* L. tuberous rhizomes. *Asian J Pharm Clin Res*. 2012; 5:85-88.
- Damat. Hypolipidemic effect of cake from butyrlated arrowroot starch. *ARPN J Sci and Tech*. 2012; 2:1007-1012.
- Copland LO, Mc Donald. Seed Science Technology. 3rd ed. Chapman and Hall, 1995.
- Nirmal SA, Pal SC, Mandal SC. Pharmacognostic evaluation of *Nyctanthes arbortristis* bark. *Asian Pac. J. Trop. Biomed* 2012, S494-S500.
- WHO. Quality Control Method for Medicinal Plant Materials. (A.I.T.B.S) Publishers & Distributors, Delhi, 2002.
- Sofowara A. Phytochemical Screening of Nigerian Medicinal Plants Part III. *Lioyeria* 1990; 41:234-246.
- Trease GE, Evans WC. Pharmacognosy 11th ed. Baillere Tindoll, London, 1989, 45-50.
- Harborne JB. Phytochemical Methods, Chapman and Hall Ltd., London, 1973, 49-188.
- Hill AF. Economic Botany, A textbook of Useful Plants and Plant Products, 2nd ed. Mc Garw-Hill Book Company Inc, New York, 1952.
- Del-Ri A, Obdulio BG, Casfillio J, Marin FG, Ortuno A. Uses and properties of Citrus flavonoids. *J Agric Food Chem*. 1997; 45:4505-4515.
- Okwu DE. Evaluation of the chemical composition of indigenous spices and flavouring agents. *Global J Pure Appl Sci*. 2001; 7(3):455-459.
- Cody V, Middleton E, Harborne J. B(eds). Plant Flavonoids in Biology and Medicine: Biochemical, Pharmacological and Structure-activity Relationships. Alan R. Liss. Inc., New York, 1986, 113-124.
- Cody V, Middleton E, Harborne JB, Beretz A (eds). Plant Flavonoids in Biology and Medicine: H-Biochemical, Cellular and Medicinal Properties. Alan R. Liss. Inc., New York, 1988.
- Das NP(ed). Flavonoids in Biology and Medicine- III. Current Issues in Flavonoids Research. Singapore University Press, Singapore, 1990.
- Kandaswami C, Middleton E. Free radical scavenging and antioxidant activity of plant flavonoids. *Adv. Exp Med. Biol* 1994; 366:351-376.
- Ho CT, Chen Q, Shi H, Zhang KQ, Rosen RT. Antioxidative effect of polyphenol extract prepared from various Chinese teas. *Prev. Med* 1992; 21:520-525.
- Kinsella JE, Frankel E, German B, Kanner J. Possible mechanisms for the protective role of antioxidants in wine and plant foods. *Food Technol*, 1993, 85-88.
- Duarte J, Perez-Vizcainom F, Utrilla P, Jimenez J, Tanargo J, Zarzuelo A. Vasodilatory effects of flavonoids in rat aortic smooth muscle, Structure-activity relationships. *Gen. Pharmacol* 1993; 24:857-862.
- Duarte J, Perez-Vizcaino F, Zarzuelo A, Jimenez J, Tanargo J. Vasodilator effects of quercetin in isolated rat vascular smooth muscle. *Eur. J Pharmacol* 1993; 239:1-7.
- Shi J, Arunachalam K, Yeung D, Kakuda Y, Mittal G, Jiang Y. Saponins from edible legumes-chemistry, processing and health benefit. *J Med Food*. 2004; 7:67-78.
- Manjunatha BK, Vidya SM. Hepato protective activity of *Vitex trifolia* against carbon tetrachloride induced hepatic damage. *Ind. J Pharm Sci*. 2008; 70(2):241-245.