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Review on *Maranta arundinacea* L. (Marantacea)

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Abstract
Our earth has a wealthy plant with medicinal properties. Plants are a good source of nutrition as well as medicines. Plants have these properties due to the presence of different bioactive compounds. As they are being used for different diseases condition with fewer side effects from the traditional period onwards, there is a great demand for medicines or drugs of plant-derived ones. *Maranta arundinacea L.*, (West Indian arrowroot) belongs to the family Marantaceae having 31 genera and about 550 species. It is a good starchy medicinal plant that has easily digestible starch and is used for various stomach and urinary-related problems. And due to its rich starch, it can be used in food industries also. Arrowroot possesses many phytochemicals and thus they exhibit antidiarrheal, antiulcer, antioxidant, antimicrobial, vibriocidal, immunostimulatory effects. In this article, it's phytochemical screening, pharmacognostic studies, pharmacological activity screening will be reviewed out.

Keywords: *Maranta arundinacea,* phytochemical, pharmacological, starch, antidiarrheal activity

Introduction
Herbal medicines which usually possess highly active pharmacological compounds are mostly meant for treatment and anticipation of diverse diseases [1]. Herbs are the primitive fountain of medicine. Because of their pharmacological properties and based on the concept that green remedy is unharmed; the usage of herbal medicine is expanding [2, 3, 5]. Globally, herbal remedies obtain high acceptance as the pharmacologically necessary phytochemicals impart health care as well as nutrient component to the human body [2]. With the increasing popularity, a strong and immense evaluation is required for herbal medicines to ensure their safety, quality, and efficacy [4].
The medicinal value of plants is due to its various naturally derived biologically active components (phytochemicals) like flavonoids, alkaloids, phenols, tannins, saponins, and so on [2, 3]. Therefore, phytochemical screening is important to find diverse potent components which would be a benefit for a drug.
World Health Organization (WHO) provided numerous quality control parameters for herbs [6]. The indication of phytochemicals and standardization of plants will provide a basis to identify and safety of an herbal remedy. The pharmacognostic evaluation, preliminary phytochemical screening, physicochemical studies of the plant will aid in the conformation of plant resources [3].
Our nature has gifted a wealthy herbal world with different kinds of plants in diverse regions [7]. One herb among these is *Maranta arundinacea* (Arrowroot). It is an herbaceous, perennial tropical plant belonging to the family Marantaceae. It is a rich starchy medicinal herb used from the traditional period [3, 8]. It is developed in West Indies (Jamaica and St. Vincent), Australia, South East Asia, and southeast Africa, Florida, Brazil. Arrowroot has rich starch content in its rhizomes. Due to its easily digestible nature, it is used for treating various stomach related and urinary related problems also contribute some nutritional effect. And its gelling ability leads to the formation of films, thickening, and gelling agents also in culinary products [8, 9]. Arrowroot is a source of fibrous starchy food, prebiotics also used for topical application on wounds due to poisons [8, 10]. Its pharmacological activities will be reviewed out in this article.

Description
Maranta arundinacea of the family Marantaceae is a monocot plant having vegetative propagation. The name arrowroot means plant bears rhizomes roots like arrows. It is a perennial herbaceous plant of 0.5-1-meter height. This plant has a cluster of long, slender stems. Stems bear alternate, long lanceolate leaves. This plant has fibrous, fusiform, fleshy rhizomes which are rich in starch. This starchy and fleshy rhizome grows 2.5 to 5 cm in thickness and 20 to 45 cm long. The rhizome is curved like an arrow and is wrapped in overlapping scales. This plant has small, cream, or nearly white-colored compound flowers [11].

Taxonomical Class
Binomial Name: *Maranta arundinacea* L. [3]
Scientific classification
Domain: Eukaryota
Kingdom: Plantae
Phylum: Spermatophyta
Subphylum: Angiospermae
Division: Magnoliophyta
Class: Monocotyledonae
Order: Zingiberales
Family: Marantaceae

Genus: Maranta
Species: *Maranta arundinacea*
Species authority: LINN

Synonyms
Maranta indica Tussac
Maranta ramosissima Wall.
Maranta silvatica Roscoe
Maranta sylvatica Roscoe ex Sm
Maranta tessellata kegeljanii E. Morren
Maranta minor Chantrier ex André
Phrynium variegatum N.E.Br., nom. illeg.

Vernacular names
English: arrowroot, St Vincent arrowroot, West Indian arrowroot, Maranta
Spanish: arraruta; arraruz; chuchute tamalera
French: arrowroot des antilles; herbe aux flèches; Maranta arundinaceae
Chinese: zhu yu
Malayalam: Kuva
Tamil: kookai neer, arurutt
Hindi: tikkor
Kannada: kuvehittu, tavaksiri
Sanskrit: tugakisiri
Telugu: palagunda

Distribution
It is seen as developed in the North-Western part of South America and the Lesser Antilles. It has been extensively scattered throughout tropical countries like India, Sri Lanka, Indonesia, the Philippines, Australia, and West Indies. In India, it is distributed in Uttar Pradesh, Orissa Bihar, West Bengal, Assam, and Kerala [11, 12].

Pharmacognostic Standardisation
As we believing that green medicines are safe to use, there is a tremendous attentiveness towards naturally derived medicines. As there is a great demand for it, there occur high chances of adulteration. This adulteration will decrease the therapeutic efficacy of natural herbs as the quality and quantity of its chemical constituents get affected. These can be resolve through pharmacognostic studies. Pharmacognostic studies help to identify and authentify the original plant and to avoid adulteration too. These studies include macroscopic and microscopic evaluation [13].
On the fresh rhizomes of arrowroot anatomical and histochemical studies were carried out and by taking the transverse section of rhizome it found the parenchymatous cells that are filled with oval-shaped starch granules to its center. Within the parenchymatous ground tissue, the vascular bundles were scattered. Leaves of arrowroot showed the presence of epidermal cells having diacytic stomata and presences of trichomes too. Powder microscopic characters showed the presence of fragments of the vessel with spiral thickening, xylem fibers, starch grains, and calcium oxalate crystals [3].

Phytochemical Screening
Phytochemical screening is important to find out the different active compounds which could be used for curing various ailments as they possess various biological activity from the ancient period.
The phytochemicals screening of aqueous, methanol, ethanol, and hexane extracts of leaf and rhizome of arrowroot were carried out based on standard procedures. They both leaves and rhizomes of M. arundinacea showed the presence of phenols, flavonoids, tannins, alkaloids, steroids, terpenoids, and glycosides greatly in ethanolic extract. Strong responses had been found for phenols, flavonoids, and tannins in leaf samples and rhizomes, alkaloids, terpenoids, phenols, flavonoids, and tannins. The qualitative phytochemical screening proved that the leaf and rhizome had essential phytoconstituents [2, 14, 15].
After the extraction of leaf and rhizome of M. arundinacea using Soxhlet apparatus with different solvents like water, methanol, ethanol, and hexane, they are subjected to quantitative evaluation of phytochemicals.
Total phenolic contents of different solvent extracts of leaf and rhizome of M. arundinacea were carried out and compared with standard gallic acid using the Folin-Ciocalteu reagent method. In rhizome, ethanolic extract showed a high amount of phenol (20.10±0.22 mg GAE/ g) and in leaves, the largest amount of phenol was also found in the ethanolic extract (13.28±0.20 mg GAE/ g). The total flavonoid content of different extracts of rhizomes was measured by the Aluminum chloride colorimetric assay and the flavonoid content is high in ethanolic extracts of rhizome (4.36±0.14 mg RE/ g) [14]. Total tannin contents of different solvent extracts of rhizomes and leaves were determined by the Folin-Ciocalteu method. Maximum tannin content of rhizomes (50.12±0.24 mg GAE/ g) and leaves (45.12±0.23 mg GAE/ g) were found in its ethanolic extracts [14, 16].
To identify the bioactive constituents of long-chain branched-chain hydrocarbons, alcohols, acids, ester, and so on, one of the suitable methods is GC-MS analysis. The ethanolic extract of rhizomes of M. arundinacea was analyzed using GC-MS [Thermo GC –Trace ultra Ver: 5.0 system and Gas chromatograph interfaced to a Mass spectrometer (GC-MS) (Perkin-Elmer GC Clarus 500 system) equipped with TR 5 – MS capillary non-polar standard column (30mmX0.25mm 1D X 1 µMdf)]. In ethanol extract of rhizomes of M. arundinacea, they identified Forty-nine compounds [15].

Physicochemical Properties
The safety, quality, and efficacy of natural herbs are very essential. Physicochemical parameters like ash values, extractive values, the moisture content will help to establish the identity and purity of medicinal plants [6].
The physicochemical parameters of dried rhizome powder were observed. The moisture content present in the sample was found to be 6.6%. The ash content indicates the amount of inorganic matter present in the sample and found to be 2.5%. Water-soluble extractive 25.1% and Alcohol soluble extractive 1.8 % [3].

Pharmacological Activities
Antidiarrheal Activity
In developing countries, among children of age under 5, one of the major reasons for mortality is diarrhea. Diarrhea causes the expulsions of watery fecal matter 3 or more times a day. This leads to increased secretion and reduced absorption of fluids and causes loss of water and electrolytes and this leads to pain in the abdomen [17]. This can be resolved by using plants with antidiarrheal properties.

The antidiarrheal and cytotoxic effects of methanolic extract of *Maranta arundinacea* leaves are screened in rats and brine shrimp, respectively. Antidiarrheal effect of M. arundinacea was screened out using castor oil-induced diarrhea, enteropooling test, and gastrointestinal motility tests at 200 mg/kg and 400 mg/kg body weight in rats where the cytotoxic activity was carried out by using brine shrimp lethality bioassay at diverse concentrations of M. arundinacea. The extract showed an antidiarrheal effect by inhibiting diarrheal occurrence by 42.67% at the dose of 200 mg/kg and 57.75% 400 mg/kg. It made a significant reduction in the castor oil-induced intestinal volume (2.14 ± 0.16 to 1.61 ± 0.12 mL) in the enteropooling test as well as intestinal transit (33.00 to 43.36%) in the GI motility test. These effects are compared with the standard drug loperamide (5 mg/kg). Brine shrimp lethality test was conducted and LD50 was calculated as 420 μg/ml. Therefore, the non-toxic highest dose of M. arundinacea was 400 μg/ml. This shows that methanolic extract of *Maranta arundinacea* leaves has antidiarrheal activity [18].

Antioxidant activity

Compounds that can inhibit reactive oxygen species or reactive nitrogen species and free radicals are called antioxidants. They have the power to prevent the oxidative damage of cells and diseases like cancer, cardiovascular disease, cataracts, atherosclerosis, diabetes, arthritis, immune deficiency diseases, and aging [19].

The antioxidant activity of M. arundinacea was found using the ethanolic extract of its rhizomes using 1,1-diphenyl-2-picryl hydroxyl (DPPH) quenching assay, 2,2'-azinobis-3-ethylbenzothiozoline-6-sulfonic acid (ABTS) cation decolorization test, Reducing power, scavenging capacity towards hydrogen peroxide (H2O2) radical, nitric oxide (NO) radical inhibition activity with standard assay procedures and Ferric Reducing Antioxidant Power (FRAP) Assay [20].

Methanol extract of *Maranta arundinacea* rhizome showed antioxidant and free radical scavenging activity through *in vitro* models such as DPPH, hydroxyl radical, superoxide radical, ABTS radical cation, and reducing power in a dose-dependent manner when compared to the standard antioxidant These studies showed that *Maranta arundinacea* rhizome can be used as a good natural antioxidant [19].

Immunostimulatory effect

By boosting our natural immune protection in our body, we can obtain a healthy body by reducing exposure to diseases. The arrowroot tuber extracts were evaluated *in vitro* by using animal cell culture techniques, and *in vivo* by using BALB/c mice for screening their immunostimulatory effect. It showed that the extract stimulated IgM production by HB4C5 cells and immunoglobulin (IgG, IgA, and IgM) production by splenocytes *in vitro* also enhanced interferon production. *In vivo* study showed that the arrowroot extracts increased the serum immunoglobulins levels in mice [21].

Antimicrobial activity

Clinically, microbial infections are the most threatening ones. The discovery of new antibiotics is needed to overcome the microbial resistance towards antibiotics. Plants with flavonoids usually have antimicrobial effects. The antimicrobial effect of M. arundinacea is determined *in vitro* with its methanolic tuberous extract against gram-positive bacteria, Staphylococcus aureus. Minimum inhibitory concentration and Minimum bacterial concentration against Methicillin-Resistant Staphylococcus aureus (MRSA) which is a strain of S. aureus is 100%. The inhibitory zone diameter was found to be 100% with a mean inhibitory zone diameter of 15.5mm [22, 23].

Vibriocidal activity

The vibriocidal activity of the different solvents (aqueous, methanolic, ethanolic, and hexane) extracts of leaf and rhizome of *Maranta arundinacea* was conducted *in vitro*. It found that both leaf and rhizome extract was effective against the strains of Vibrio cholerae using agar well diffusion and minimum inhibitory concentration method. The ethanolic extract showed maximum inhibitory effect with an inhibition zone of 26.23 ± 0.53 mm (MIC of 80.00 ± 10.06 µg/ ml) in rhizome and 24.27 82 ± 0.12 mm (MIC of 100.00 ± 12.82 µg/ ml) in and leaf [24].

Antiulcerogenic activity

The antiulcerogenic activity of starch from *Maranta arundinacea* was evaluated in comparison with Curcuma angustifolia *in vivo* by the pyloric ligation-induced gastric ulcer method in albino rats. *Maranta arundinacea* showed a statistically significant decrease in volume, increase in the pH, reduced the free acidity of gastric juice, and decreased peptic activity. So, they have an antiulcer effect [25].

Anti-inflammatory activity

Anti-inflammatory activity of arrowroot extract mediated with selenium nanoparticles was evaluated using albumin denaturation assay and cytotoxic analysis had carried out on brine shrimp nauplii. An increase was found in the anti-inflammatory property of arrowroot-mediated selenium nanoparticles with increasing concentration in comparison to the standard diclofenac. The cytotoxic activity of arrowroot mediated selenium nanoparticles showed decreased cytotoxic activity in lesser concentrations [26].

Conclusion

Nowadays the usage of herbal medicines is increasing worldwide as they are easily available, cheap, and safe to use with lesser side effects. Our nature has a diverse source of medicinal plants with different pharmacological properties. *Maranta arundinacea* L. is an herbaceous, perennial tropical plant. It contains various phytochemicals like alkaloids, phenols, flavonoids, saponins, terpenoids. Traditionally, it was used for treating many stomach-related problems. It possesses antidiarrheal, antiulcerogenic, antioxidant, anti-inflammatory, antimicrobial, vibriocidal, and immunostimulatory activity. This article reviewed its pharmacognostic, phytochemical properties as well as its pharmacological activities.

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Conflict of Interest

The authors declare no conflict of interest.

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