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EXPLORING THE BIOACTIVE PROFILE OF *ARKAPATRA* (*CALOTROPIS PROCERA*) (AIT.) R.BR. LEAF: A PHYTOCHEMICAL AND PHYSICOCHEMICAL INSIGHT

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ABSTRACT

Objective: The purpose of this study is to determine the standardized profile of Calotropis procera (*Arkapatra*) leaves by evaluating their physicochemical properties and conducting a preliminary phytochemical screening. **Material and Method:** The moisture content, ash values (total ash, acid- insoluble ash, and water-soluble ash), and extractive values in various solvents (alcohol and water) were among the physicochemical tests performed on fresh and dried Calotropis procera leaves. Standard qualitative techniques were used in the preliminary phytochemical study to find bioactive components like alkaloids, flavonoids, tannins, saponins, glycosides, steroids, and phenolic compounds**. Result**: These findings will be useful towards establishing pharmacogenetic standards on identification, purity, quality and classification of the plant drug research. **Objective**: To investigate macroscopic, microscopic, qualitative physiochemical parameter of *Arka* (Calotropis procera) leaf. **Conclusions:** Physicochemical study of whole plant is helpful in sample identification and to ensure quality and purity standards of *Arka* (Calotropis procera) leaf. **Result:** The identification and purity of the raw medicine were confirmed by the physicochemical characteristics that were found to be within the permitted range according to Ayurvedic Pharmacopoeial standards. Several active constituents were found by phytochemical screening, especially alkaloids, flavonoids, and saponins, which bolster its conventional medicinal claims. **Discussion and Conclusions:** The study

establishes the basis for *Arkapatra* quality control in Ayurvedic formulations and offers useful data for standardizing the product. To support its medical usage, further thorough pharmacological and toxicological analyses are advised.

KEYWORDS: Calotropis procera, *Arkapatra*, Phytochemical screening, Physicochemical analysis, Herbal standardization, Ayurvedic pharmacognosy.

INTRODUCTION

Arka has been used since ancient times for the treatment of various ailments. In Ayurveda, two varieties of *Arka* has been mentioned. i.e. *Raktaarka* and *Shvetaarka*, the botanical sources of which are Calotropis procera (Ait.) R.Br. and Calotropis gigantea (L.) Ait.f., respectively. But as per availability of plants is considered, Calotropis gigantea (L.) Ait.f. is listed under endangered species. Among the two *Raktaarka* (Calotropis procera (Ait.) R.Br.) is more toxic and is assumed even more poisonous. Both these plants belong to Asclepiadaceae family and closely resemble each other in chemical and physiological actions. In Ayurveda, Raktaarka is also known as *Arka*. It is included under *Bhedaniya* (*Vagbhata*), *Vamanopaga*, *Swedopaga* (*Caraka*), *Arkadi*, *Adhobhagahara gana* (*Susruta*) and also included under *Guduchyadi* and *Osadhi varga*. This plant has been known to possess analgesic, antitumor, anthelmintic, antioxidant, hepatoprotective, antidiarrhoeal, anticonvulsant, antimicrobial, oestrogenic, antinociceptive and antimalarial activity. This article aims at reviewing detailed Ayurveda and modern perspective of *Arka* i.e. (Calotropis procera (Ait.) R.Br.).

Synonyms: *Alarka, Sadapushpa, Tulphala, Asphota, Aak, Akvan, Madar*

Vernacular Names

Table No. 1: Vernacular names of Calotropis procera.

Language	Names
Sanskrit	*Bhanu, Ravi, Tapana*
Assamese	*Akan, Akanda*
Bengali	*Akanda*
English	*Madar Tree*
Gujrati	*Aakado*
Hindi	*Aak, Akavana, Madar*
Kannada	*Ekka, Ekkadagida,Ekkegida*
Kashmiri	*Acka*
Malayalam	*Erikku*
Marathi	*Rui*
Oriya	*Arakha*
Punjabi	*Ak*

Tamil	*Erukku*
Telugu	*Jilledu*

Important formulations - *Arkalavana*

Classical Categorisation

Table No. 2: Classical categorisation of *Arka* (Calotropis procera).

Sr. No	Classical Text	Gana/Varga
1.	*Charaka Samhita*[1]	*Bhedaneeya mahakashay, swedopaga mahakashaya, Vamanopaga, Shatashodhana vriksha(Ksheerashraya)*
2.	*Sushruta Samhita*[2]	*Arkadi gana, Adhobhagahara dravya.*
3.	*Astanga Hridaya*[3]	*Arkadi gana*
4.	*Dhanvantari nighantu*[4]	*Karaveeradi varga*
5.	*Sodhala nighantu*[5]	*Karaveeradi varga*
6.	*Hridayadeepaka nighantu*[6]	*Tiktadravya skandha*
7.	*Madanapala nighantu*[7]	*Kaphavataghna varga, Kaphapittaghna varga.*
8.	*Kaiyadeva nighantu*[8]	*Abhayadi varga*
9.	*Bhavaprakasha nighantu*[9]	*Guduchyadi varga*
10.	*Raj nighantu*[10]	*Karaveeradi varga*
11.	*Priya nighantu*[10]	*Shatapushpadi varga*
12.	*Nighantu Adarsha*[11]	*Arkadi varga*

Varieties

Table No 3: Varieties of Arka (Calotropis procera).

Types OF *Arka*	
Dhanvantari Nighantu	1. *Arka* 2. *Rajarka*
Sodhala Nighantu	1. *Raktarka* 2. *Shvetarka*
Bhavaprakash Nighantu	1. *Svetarka* 2. *Raktarka*
Raj Nighantu	1. *Arka* 2. *Rajarka* 3. *Shuklarka* 4. *Sveta mandaraka*

Taxonomical Position[13]

Table No. 4: Taxonomical classification of Arka (Calotropis procera).

Sr No.	Taxonomical Classification	
1.	Kingdom	Plantae
2.	Phylum	Tracheophyta
3.	Class	Angiosperms
4.	Order	Gentianales
5.	Family	Apocynaceae *(formerly Asclepiadaceae)*

6.	Genus	Calotropis
7.	Species	*procera*
8.	Binomial Name	*Calotropis procera* R.BR.

Botanical Description[14]

a) Macroscopic Description

Habit: A shrub upto 2.5 m high. Young leaves hoary, glabrous when fully grown.

Leaves: Sub-sessile, broadly ovate, ovate-oblong, elliptic or obovate, cottony pubescent when young. 10-18 cm long, infloresence covered with white wooly-tomentum.

Flowers: In terminal and axillary corymbose cymes, purplish-red. Follicles: 6.5 - 9.5 × 2 – 5.1 cm.

Seeds: With a silky white coma. Blooming and Fruiting time: Spring to summer season.

Frutis- follicles, 10-14 cm long, recurved. Seeds numerus with silk hair.

Distribution[15]

It is often found as a weed throughout India in more or less warm dry places, predominantly in Sub – Himalayan tracts, Bihar, Orissa, West Bengal, Assam, Punjab, Sindh, Rajasthan, Deccan to Kanya- Kumari.

Cultivation and Propagation[16]

It is a hardy shrub growing on different types of soils and in different climate, occurs as weed in cultivated field. It does not require specific cultivation practices or irrigation. It has been observed to grow mainly on coarse, sandy and alkaline soils. The growth is luxuriant on rubbish heaps, waste and fallow lands, roadsides, on the ruins of building, sea – shores, riverbanks etc. On sand dunes, the root branching is more than in other soils. It easily grows from seeds; even root and shoot – cuttings are recommended. It is a good soil blinder and are recommended for deserts.

Chemical constituents[17]

β- amyrin, cardenolides, calotropin, calotropagenin (Leaves).

Pharmacological activities[18]

Anticancer, Antiimplantation, Antimicrobial, nematicidal, high fibrinolytic, anticoagulant,

vermicidal, anthelmintic, stimulant, spasmogenic and mild diuretic. Calotropin showed digitalis like action on heart, but it`s action was not cumulative and less harmful.

Actions and Uses[19]

The whole dried plant is bitter, thermogenic, laxative, anthelmintic, anticarcinogenic, expectorant, depurative and good tonic. It is used in worms, ulcers. The leaves are used in the treatment of paralysis, arthritis, swellings, pain, leprosy, skin diseases, wounds, ear diseases and cancer.

Part Used[20]

Root, Root bark, Leaf, Flower, Latex.

Doses[21]

Root bark – 0.5 to 1 gm; Latex – 250 to 750 mg; Flower – 1 to 3 gm,[65] Leaf - 250-750 mg of the drug in powder form.

Toxicology[22]

Latex is highly toxic to rabbits, dogs and donkeys when administered in large doses. Lethal dose of usharin and calotoxins (the constituents of latex) are 0.5 microgram and 0.7 microgram per gram of frog respectively.

Substitute and Adulterant[23]

Calotropis procera (Ait.) R.Br. and Calotropis gigantea (Linn.) (L.) Ait.f., both the species are used as substitutes for one another and are said to have similar effects.

MICROSCOPIC DESCRIPTION

Midrib

Transverse section through midrib shows an upper and lower single layered epidermis externally covered with thick, striated cuticle, few epidermal cells on both surfaces of leaf elongated to form uniseriate, 2- 3 celled trichomes, epidermal cells cubical and radially elongated, epidermis followed by 3-8 layered collenchyma on both lower and upper surfaces, parenchymatous cells thin-walled, isodiametric to circular with intercellular spaces present in ground tissue, stele crescent shaped composed of bicollateral and open vascular bundle, xylem consists mostly of vessels and tracheids, a strip of cambium present between xylem and phloem tissues, laticifers also present in the phloem and parenchymatous zone.

Lamina

Dorsiventral with mesophyll differentiated into a palisade and spongy tissue, upper and lower epidermis covered externally with a thick, striated cuticle, below upper epidermis three rows of elongated, closely arranged palisade parenchyma present, spongy parenchyma tissues almost radially elongated with intercellular spaces, central cells irregular in shape, laticifers and vascular bundles also present scattered in this region.

MATERIAL AND METHOD

Plant Collection

The healthy and matured whole plants of *Arkapatra* (Calotropis procera) were collected from the peripheries of Shri Ayurveda Mahavidyalaya, Nagpur where it was growing abundantly. The leafs were manually defoliated and was thorough washed with clean water. The collected sample was cut into small pieces and was shed dried at normal room temperature for four weeks. After complete drying, the sample was crushed into fine powder with the help of mixture grinder. The obtained powered sample of approximate 500 gm in weight was used for phytochemical and physicochemical analysis.

Preparation of Plant Solvents

For preparing the Aqueous, Ethanol, Methanol, Hydro-alcoholic, Chloroform, and Ether solvents, a 5 gm sample and 50 ml of each solvent were kept in conical flasks separately and was stirred vigourously for six hours then was kept for 18 hours. Then the mixture was filtered using filter paper for carrying out the phytochemical and physicochemical screening.

Phytochemical analysis

Priliminary phytochemical analysis of *Arkapatra* in the solvents for carbohydrates, flavonoids, tannins, amino acids, starch, glycosides, steroids, triterpenoids, proteins, alkaloids and saponin using standard phytochemical screening methods. Results are tabulated in table no. 5.

1. Test for Carbohydrates

Molisch's test- Add few drops of alcoholic α- naphthol to the test solution, then add few drops of conc. H_2SO_4 through the sides of test tube, purple to violet color ring appears at the junction.

2. Test for Flavonoids

Shinoda's test- Add few magnesium turnings and conc. HCl acid dropwise to the test solution, pink scarlet, crimson red or occasionally green to blue color appears after few minutes.

Alkaline reagent test- Add few drops of sodium hydroxide solution to the test solution, intense yellow color is formed which turns colourless on adding few drops of dil. HCl indicates presence of flavonoids.

Zinc hydrochloride test- To the test solution, add mixture of zinc dust and conc. HCl, it gives red colour after few minutes.

3. Test for Tannins

Ferric chloride test- Treat the test solution with ferric chloride solution, green colour appears if condensed tannins are present.

Lead acetate test- When lead acetate solution is added to the test solution, white precipitate is formed indicating the presence of tannins.

4. Test for Amino acids

Ninhydrine test- Add ninhydrine to the test solution, boil, voilet colour indicates the presence of amino acids.

5. Test for Starch

By adding weak iodine solution to the aqueous solvent, blue colour appears indicating the presence of starch which disappears on heating.

6. Test for Glycosides

Baljet's test- On treating the test solution with picric acid, orange colour is formed, showing the presence of cardiac glycosides.

7. Test for Steroids and Triterpenoides

Libermann - Burchard test- Treat the extract with few drops of acetic anhydride, boil and cool. Then add concentrated Sulphuric acid from the side of the test tube, brown ring is formed at the junction of two layers and upper layer turns green which shows present f steroids and formation of deep red color indicates presence of tri terpenoids.

Salkowski test- Treat the extract with few drops of concentrated sulphuric acid, red colour at lower layer indicates presence of steroids and formation of yellow coloured lower layer

indicates presence of triterpenoids.

8. Test for Proteins

Xanthoproteic test- To the 5ml of test solution, add 1 ml of concentrated nitric acid and boil, yellow precipitate is formed, after cooling it, add 40% sodium hydroxide solution, orange colour appears showing proteins presence.

9. Test for Alkaloids

Mayer's test- Alkaloids gives cream coloured precipitate with Mayer's reagent (Potassium mercuric iodide).

Wagner's test- Alkaloids gives reddish-brown precipitate with Wagner's reagent (Iodine potassium iodide).

Hager's test- Alkaloids gives yellow precipitate with Hager's reagent (Saturated solution of picric acid).

Tannic acid test- Alkaloids gives buff colour precipitate with tannic acid solution.

10. Test for Saponins

Froth formation test- Add 2ml of test solution in water in a test tube and shake well, stable froth (foam) is formed.

Physicochemical analysis

The physicochemical analysis helps in assessing the quality of the crude drugs. Biochemical variation, adulteration, substitution, effects of storage occurring in the drug can be tested. The foreign matter, moisture content / loss on drying, total ash, acid insoluble ash, water soluble ash, water soluble extractive and pH of the powdered sample were determined by using standard procedure mentioned in the context of the WHO guidelines for the assessment of herbal medicines. These guidelines provide a framework for ensuring the quality, safety and efficacy of herbal medicines. The reference values which is mentioned in API and the values obtained are tabulated in table no. 6.

RESULTS AND DISCUSSION

a) Preliminary phytochemical screening of Leaf powder of Calotropis procera

Table no. 5: Phytochemical analysis of *Arkapatra* (Calotropis procera) in six different solvents.

Phytochemicals	Test	Aqueous	Hydroalcoholic	Ethanol	Methanol	Cholorform	Ether
Carbohydrates	Molish test	+	+	-	-	-	-
Proteins	Xanthoproteic Test	-	+	-	-	-	-
Alkaloids	Mayers Test	+	+	+	+	+	-
	Wagner's Test	-	-	-	-	-	-
	Hager's Test	-	-	-	-	-	-
	Tannic Acid	+	+	-	-	+	-
Flavonoids	Shinoda test	-	-	-	-	+	-
	Alkaline Reagent	-	-	-	-	+	-
	Zinc Chloride Test	-	-	-	-	-	-
Terpenoids	Absent	+	+	+	+	+	-
Tannin	Ferric Chloride	-	-	-	-	+	-
	Lead Acetate	-	+	-	-	-	-
Glycoside	Borntrager's Test	-	-	+	+	-	-
Amino Acid	Ninhydrin Test	-	-	+	-	-	-
Steroid	Libermann Burchard's Test	-	-	-	-	+	-
	Salkowski Test	-	-	-	-	-	-
Saponins	Froth formation Test	-	-	-	-	-	-

CONSTITUENTS - Glycoside (Calotropin).

b) Physicochemical Analysis

PhysicoChemical Analysis Result of Calotropis procera

The physicochemical standards help in assessment of crude drug. These are rarely constant, but helps in evaluation of drug. Quality of the drug can be assessed with this analysis and thus biochemical variations, adulterations, substitutions, effect of storage/treatment occurring in it can be tested. The moisture content / loss on drying, ash value, acid insoluble ash, water

soluble ash, acid insoluble ash, water soluble extractive, alcohol soluble extractive and pH of the powdered sample were determined by the method as described in WHO guidelines.[24] Results are tabulated in table no. 5.

Table No. 5: Physico Chemical Analysis Result of Arka (Calotropis procera).

Parameters	Value
Foreign matter	1.2
Loss on Drying	9
Total Ash Value	9.1 %
Acid Insoluble Ash	1.6 %
Alcohol soluble Extractive	3.5 %

The physicochemical parameters, i.e., foreign matter, moisture content, total ash, acid-insoluble ash, water-soluble ash, and water-soluble extractive values obtained, were within the API standards, which not only assures the good quality of the sample but also suggests that the collected plant material is free from impurities and adulteration and is suitable for further pharmacological and formulation studies.

CONCLUSION

The values obtained after experimental study of Calotropis procera are very much similar to the values mentioned in Ayurvedic Pharmacopoeia of India (API). Arka has been traditionally used in Ayurvedic medicines and its potential as a source of novel drugs or lead compounds is promising due to its rich phytochemistry. Further research is needed to explore its potential in various diseases.

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