



RESEARCH ARTICLE

Pharmacognostical Evaluation of Arjuna Flowers: *Terminalia Arjuna* (Roxb.) Wight & Arn

¹M Prathapa Reddy, ²Shantha T Ramaseshan, ³Naveen KS Parvatamma, ⁴Vendrapati R Rao

⁵Shiddamallayya Nagayya, ⁶Sulochana Bhat

ABSTRACT

Introduction: *Terminalia arjuna* (Roxb. ex DC.) Wight & Arn., known as *Arjuna*, is an important medicinal plant used in Ayurvedic and traditional systems of medicine. This plant is being used to cure various ailments in India for several years. According to *Pushpaayurvedah* written by Priya Vrat Sharma, Arjuna flowers are used as one of the chief ingredient in some Ayurvedic formulations, which are used for preventing of baldness and graying of hairs, i.e., *Mahanila taila*, *Nilabindu taila*, *kasmariyadi taila*, *Ketakiyadi taila*. It is also useful in Helminthiasis (*Krimi-roga*), *raktapitta* (internal hemorrhage), and for some poisons. Though many therapeutics uses have been prescribed in Ayurveda for Arjuna flowers in addition to the other parts, no work has been carried out on flower part. Hence, the present study has been attempted for the first time. Physicochemical analysis, such as loss on drying, total ash, acid-insoluble ash, and different extractive values and preliminary phytochemical screening for various groups of secondary metabolites has been carried out as per standard protocols.

Aim: The present study was carried out to establish pharmacognostical standards and important identification/diagnostic characteristics for identification of *Terminalia arjuna* flowers.

Materials and methods: Flower material was collected from its natural habitat in Bengaluru, Karnataka, India, and authenticated by subject expert, Regional Ayurveda Research Institute for Metabolic Disorders, Central Council for Research in Ayurvedic Sciences, Ministry of AYUSH, Government of India. The flowers were shade dried, powdered, and used for tests. The macro-, microscopical, physicochemical, and preliminary phytochemical studies have been carried out by adopting standard methods.

Results: The microscopic characteristics of the flowers showed the presence of abundant combretaceous-type trichomes, rosette and clustered type of calcium oxalate crystals, reddish orange tannin content, resin ducts, endothecium cells, and abundant rounded pollen grains in three colporate and in monads.

Preliminary phytochemical screening showed the presence of carbohydrates, phenols, proteins, saponins, and tannins.

Conclusion: The macro-, microscopical, powder studies, and preliminary phytochemical investigations of *T. arjuna* flowers may be used to establish the botanical standards for identification and standardization of *T. arjuna* flowers.

Keywords: Arjuna, Microscopy, Pharmacognosy, Phytochemicals, Powder study, *Terminalia arjuna*.

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INTRODUCTION

Terminalia arjuna (Roxb. ex DC.) Wight & Arn., commonly known as *Arjuna* (or) *Arjuna tree*, belongs to the family of Combretaceae. It is a large evergreen deciduous tree, commonly found throughout the greater parts of the country and also planted in many parts for shade and ornamental purposes. Stem rarely long or straight, generally always buttressed and often fluted. Bark is very thick, grey or pinkish green, smooth, exfoliating in large, thin, irregular sheets. Leaves subopposite, oblong or elliptic, coriaceous, cordate, shortly acute or obtuse at the apex. Fruits long, nearly glabrous, ovoid or ovoid-oblong with 5 to 7 hard-winged angles. Flowers sessile, in short axillary spikes or in terminal panicles. Calyx triangular, glabrous. Ovary glabrous, disk clothed with yellowish hairs. Drupe ovoid to oblong, fibrous-woody, glabrous, dark brown, with five hard projecting wings striated with numerous curved veins.^{1,2}

The bark of *Arjuna* is astringent, cooling, aphrodisiac, demulcent, cardio tonic, styptic, antidiarrhetic, expectorant, alexiteric, lithontriptic, and tonic. The fruit is tonic and deobstruent. The fresh leaves juice is useful in ear ache.³ Though the *Arjuna* bark has been used as an ingredient of many formulations mentioned in classical texts of Ayurveda, flowers also have some medicinal/therapeutic uses. The flowers are used as one of the ingredients in the preparation of *Masakahara Dhupa*, which is used for fumigation to control mosquitoes, bed-bugs, and lice.⁴ Arjuna flowers are used as one of the major ingredients in

¹Lab Technician (Chemistry), ^{2,4}Research Officer, ³Research Scholar (Botany), ⁵Assistant Research Officer, ⁶Assistant Director

^{1,2,4-6}Regional Ayurveda Research Institute for Metabolic Disorders, Bengaluru, Karnataka, India

³Department of Botany, Bangalore University, Bengaluru Karnataka, India

⁶Raja Ramdeo Anandilal Podar Central Ayurveda Research Institute for Cancer, Mumbai, Maharashtra, India

Corresponding Author: M Prathapa Reddy, Lab Technician (Chemistry), Regional Ayurveda Research Institute for Metabolic Disorders, Bengaluru, Karnataka, India, Phone: +919538543026, e-mail: prathapanadri@gmail.com

the preparation of Ayurvedic taila, namely *Nilikadya taila*, which is used for *Khalitya* (hair fall), *indralupta* (baldness), *kandu* (itching), *vali* (wrinkles), *palita* (graying of hairs), and *upajihvika* (glossitis).⁵

In different regional languages of India, it is known as follows, i.e., Kakubha, Arjuna, partha, veeravriksha, indradru in Sanskrit; Arjun, orjun in Assamese; Arjuna, Arjhan in Bengali; White Marudah in English; Sadado in Gujarati; Arjuna, Arjun in Hindi; Maddi, Mathi, Bilimatti in Kannada; Arjuna in Malayalam; Sanmadat, sadaru, vellamarda in Marati; Arjuno, Sahajo, Hanjal in Oriya; Arjan, Arjuna in Punjabi; Marudam, Vellamatta in Tamil; Maddi chettu in Telugu; Arjun in Urdu.¹⁻³

Pharmacognostic and phytochemical evaluation of different parts of the plant is the primary step in standardization of a crude drug. These parameters play very significant role in the identification of correct plant source. Recent literature review shows that though different parts of *Arjuna* have been studied for their pharmacognostical and preliminary phytochemical properties, no work has been reported on scientific evaluation of its flowers. Therefore, the present study has been planned to establish some important identification characters of *T. arjuna* flowers. Morphological, microscopical, and phytochemical studies of both fresh and powder of *T. arjuna* flowers were carried out following the standard guidelines.

MATERIALS AND METHODS

Flower material was collected by following good collection practices in the vicinity of Bengaluru, Karnataka. The collected plant material is identified and authenticated by Survey of Medicinal Plant Unit, Regional Ayurveda Research Institute for Metabolic Disorders, Bengaluru (Herbarium Reference No. RRCBI-11397). The flowers were shade dried, pulverized by mechanical grinder as coarse powder, and stored in an air-tight container. This powder is used to carryout microscopical, physicochemical, and preliminary phytochemical analysis.

The macroscopical characters of the flowers were observed with naked eye. Powder microscopical study by microscopy of peduncle was carried out by methods prescribed by Trease and Evans.⁶ Camera lucida drawings were drawn with the help of monocular microscope with mirror type camera lucida. Physicochemical parameters, such as total ash, acid-insoluble ash, loss on drying at 105°C, pH, and extractive values like petroleum ether, chloroform, ethyl acetate, and methanol were determined as per the standard Ayurvedic pharmacopoeial methods and recorded in Table 1.⁷⁻⁹ Preliminary phytochemical

Table 1: Physicochemical parameters of *T. arjuna* flowers

Name of the parameter	Values
Description	Yellowish powder
pH (10 % w/v aq. solution)	4.45
Loss on drying at 105°C	9.22% w/w
Total ash	8.20% w/w
Acid-insoluble ash	0.31% w/w
Water-soluble extractive	27.93% w/w
Alcohol-soluble extractive	10.28% w/w
Petroleum ether-soluble extractive	1.03% w/w
Chloroform-soluble extractive	1.80% w/w
Ethyl acetate-soluble extractive	1.23% w/w
Methanol-soluble extractive	12.04% w/w

Table 2: Phytochemical tests for different solvent extracts of *T. arjuna* flowers

Natural product group	Test for natural products	Presence (+)/absence (-)
Alkaloids	Dragendorff's test	-ve
	Hager's test	-ve
	Mayers' test	-ve
	Wagner's test	-ve
Carbohydrates	Anthrone test	+ve
	Benedict's test	+ve
	Fehling's test	++ve
	Molisch's test	+ve
Flavonoids		-ve
		-ve
Phenols	Ferric chloride test	++ve
	Lead acetate test	+ve
Proteins	Biuret's test	+ve
	Millon's test	+ve
Saponins	Sodium bicarbonate solution	+ve
Starch		-ve
	Iodine + potassium iodide solution	-ve
Steroids	Salkowski reaction	-ve
Tannins	Ferric chloride test	+ve
	Lead acetate test	+ve
Resins	Ethanol ext. in acetone+ water	-ve

analysis was carried out following standard guidelines and the findings are recorded in Table 2.¹⁰

RESULTS AND DISCUSSION

Macroscopic Features

Flowers are small, white, sessile yellowish in short axillary spikes. Bracteoles are minute. Calyx teeth are nearly glabrous both in and without. Petals are zero. Calyx limb is deciduous. Young ovary is very short, covered with crisped yellowish hair. Stamens ten remains inside the bud, and pollen grains are yellow in color, medium, and spherical (Fig. 1).

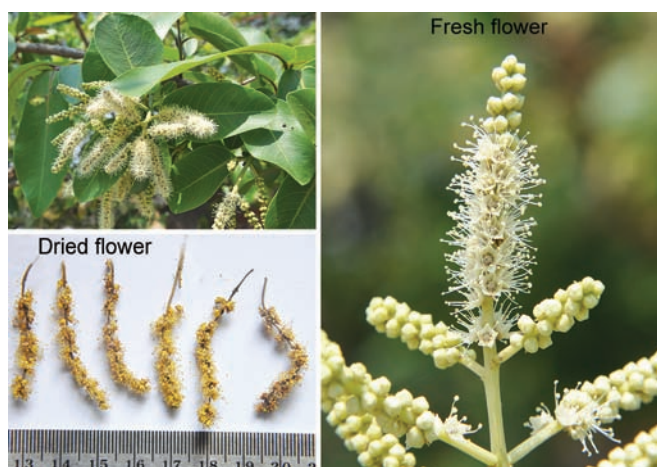


Fig. 1: Macroscopy of *T. arjuna* flowers

Microscopic Features of Flower

Transverse section of the peduncle shows single-layered outer epidermis covered with abundant, small to elongated combretaceous type of trichomes throughout the epidermis. Epidermis is followed by many layered thin-walled parenchymatous cortex; some of the parenchymatous cells show rosette calcium oxalate crystals and clustered calcium oxalate crystals. Distinct endodermis separated by xylem and phloem, vascular bundles are collateral, conjoint, and open. Central region shows many layered thin-walled parenchymatous cells filled with rosette calcium oxalate crystals, clustered calcium oxalate crystals and reddish orange red content. Six to eight resin ducts are present above the vascular bundles (Fig. 2). Since the androecium and gynoecium are very small and it is very difficult to hold with hand and taking of section, hence microscopical studies have not been carried out. But in powder microscopy, we have mentioned the characteristic features of androecium and gynoecium.

Powder Microscopy

Powder light brown shows abundant combretaceous type of trichomes having swollen base and tapering pointed apex, rosette crystals of calcium oxalate, clustered calcium oxalate crystals, abundant groups or patches of endothecium cells in surface view, fragments/debris of annular xylem vessels, single stomata, thin-walled parenchymatous cells filled with crystals and orange reddish contents, peduncular epidermal cells with stomata and trichomes in surface view, endothecium wall with epidermal cells, pollen grains are rounded and 3-colporate. Pollen grains in monads, rotate spheroidal, radially symmetrical, heterocolpate, syncolpate, exine thick, scabrate, sexine, and nexine of same thickness (Figs 3 and 4).

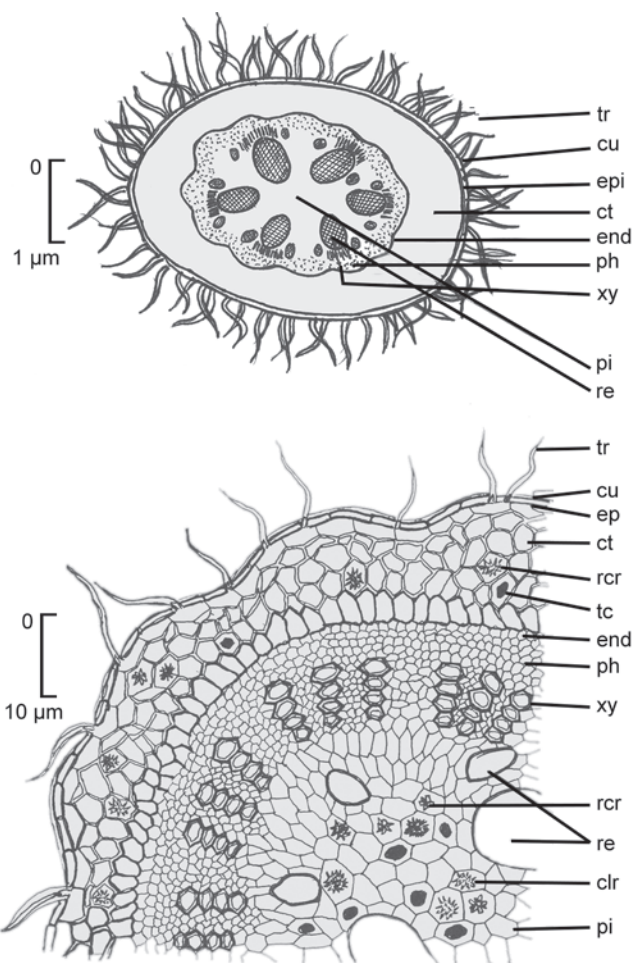


Fig. 2: *Terminalia arjuna* microscopic characteristics

Abbreviations: clr: cluster crystals of calcium oxalate; ct: cortex; cu: cuticle; end: endodermis; epi: epidermis; pi: pith; ph: phloem; rcr: rosette crystals of calcium oxalate; re: resin; tc: tannin cell; tr: trichome; xy: xylem

Physicochemical Analysis

Physicochemical analysis has been carried out for the coarse powder of *T. arjuna*. It revealed loss on drying 9.22% w/w, total ash 8.20% w/w, acid-insoluble ash 0.31% w/w, pH 4.45 (10% w/v aqueous solution), and all extractive values were analyzed and shown in Table 1.

Preliminary Phytochemical Analysis

The qualitative analysis of different extracts of flower showed the presence of carbohydrates, phenols, proteins, saponins, and tannins. The results are shown in Table 2.

DISCUSSION

Pharmacognostical studies on the flowers of *Arjuna*, which is botanically equated to *T. arjuna*, have been carried out. Though the drug is used as an ingredient of many classical formulations and mentioned in Ayurvedic formulary of India, recent literature survey reveals that a detailed pharmacognostical evaluation of

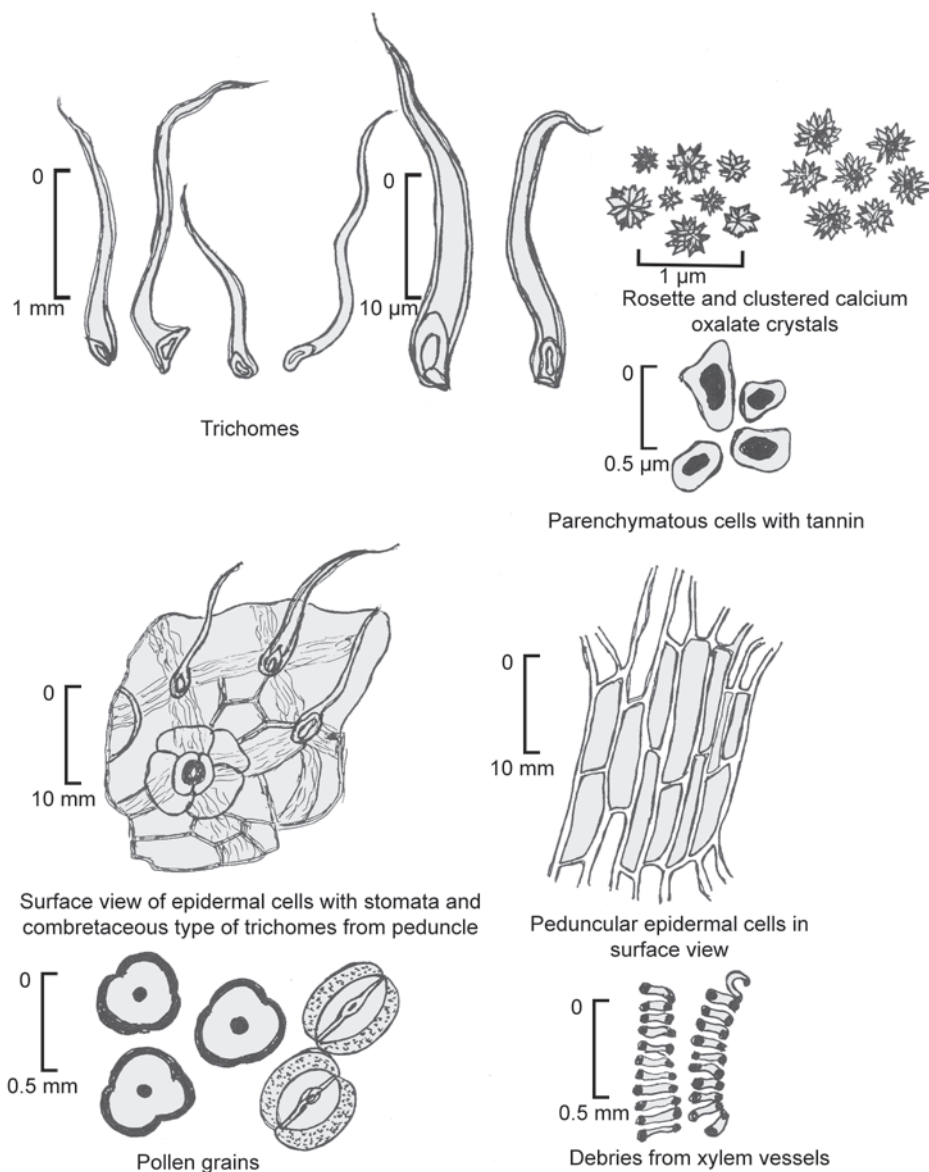


Fig. 3: *Terminalia arjuna* flower powder characteristics

its flowers is still lacking. Therefore, the present work has been planned to establish standard pharmacognostical characters of *T. arjuna* flowers. A detailed evaluation of flowers in both fresh as well as powder form could be more useful in authentication of the drug.

Some of the important characters which can be considered for fixing pharmacognostic standards are:

- Presence of abundant Combretaceous type of trichomes, having swollen base, and tapering pointed apex throughout the epidermal region of peduncle.
- Presence of abundant clustered and rosette type of calcium oxalate crystals.
- Presence of resin ducts near the vascular bundle of peduncle.
- Presence of reddish orange tannin content.
- Presence of abundant pollen grains, which are rounded and 3-colporate.
- Presence of endothecium cells in groups/patches in surface view.

CONCLUSION

The macro-, microscopical, powder studies and preliminary phytochemical investigations of *T. arjuna* flowers showed some important diagnostic characteristics. Some of the key pharmacognostical characters are presence of abundant combretaceous-type trichomes, rosette and clustered type of calcium oxalate crystals, reddish orange tannin content, resin ducts, endothecium cells, etc. These characters along with physicochemical and phytochemical parameters can be considered as the standards for genuinity of the plant. The observed results can be used to establish the botanical standards for identification and standardization of *T. arjuna*.

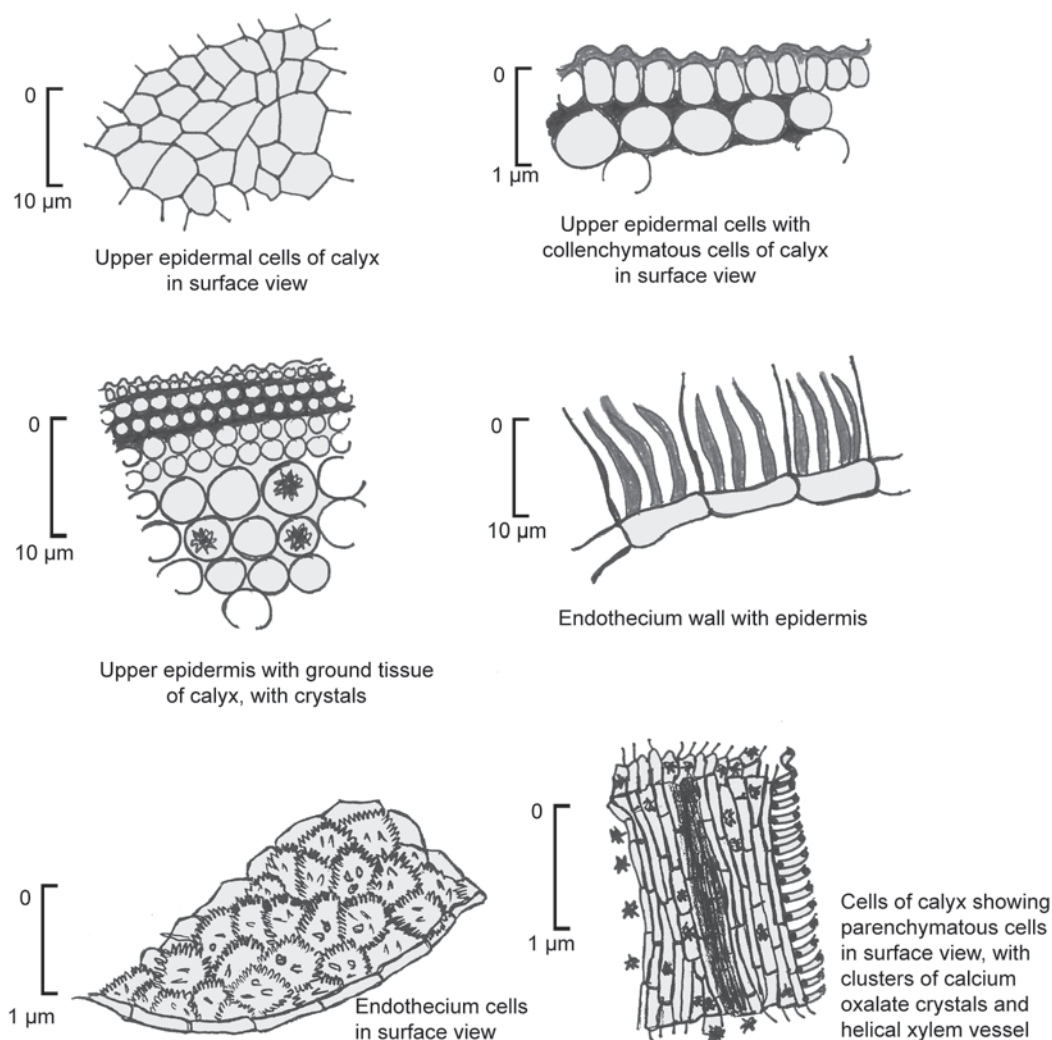


Fig. 4: *Terminalia arjuna* flower powder characteristics

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हिन्दी सारांश

अर्जुन (टर्मिनोलिया अर्जुना (रोक्सब. एक्सडीसी विट् व अन) पुष्पों का भेषजअभिज्ञानीय मानकीकरण

पृष्ठभूमि: अर्जुन के नाम से ज्ञात टर्मिनोलिया अर्जुना (रोक्सब. एम्स डीसी) विट् व अन आयुर्वेदिक एवं पारम्परिक चिकित्सा पद्धति में प्रयुक्त एक महत्वपूर्ण औषधीय पादप है। कई वर्षों से भारत में विभिन्न रोगों की चिकित्सा के लिए इस पादप का प्रयोग किया जा रहा है। प्रियव्रतशर्मा लिखित पुष्पायुर्वेद के अनुसार खालित्यव पालित्य के निवारण हेतु प्रयुक्त कुछ आयुर्वेदिक औषधयोगों के एक मुख्य घटक के रूप में अर्जुन पुष्पों का उपयोग किया जाता है जैसे—महानील तैल, नीलबिन्दु तैल, काश्मर्यादि तैल, कतक्यादि तैल। यह कृमिरोग, रक्तपित्त तथा कुछ विषनिवारण में भी उपयोगी है। अर्जुन के अन्य प्रयोज्यों के साथ इसके पुष्पों का चिकित्सीय प्रयोग आयुर्वेद में वर्जित है लेकिन पुष्पों पर कोई कार्य नहीं किया गया है। इसलिए पहली बार वर्तमान अध्ययन का प्रयास किया गया है। भौतिकरासायनिक विश्लेषण जैसे शुष्कता पर क्षय, कुल भस्म, अम्ल अघुलनशील भस्म तथा विभिन्न निष्कर्षण मूल्य एवं माध्यमिक चयापचयों के विभिन्न समूहों के लिए प्रारम्भिक पादपरासायनिक जाँच मानक प्रोटो कॉल के अनुसार की गई।

उद्देश्य: टर्मिनोलिया अर्जुना पुष्पों की पहचान के लिए भेषजअभिज्ञानीय मानक तथा महत्वपूर्ण पहचान/नैदानिक विशेषताओं को स्थापित करने के लिए वर्तमान अध्ययन किया गया।

सामग्री एवं विधि: अर्जुन के पुष्प इसके प्राकृतिक स्थान बैंगलोर, कर्नाटक, भारत से संग्रहित किए गए तथा क्षेत्रीय आयुर्वेद चयापचय अनुसंधान संस्थान, बैंगलोर के विषय विशेषज्ञ द्वारा प्रमाणित किया गया। पुष्पों को छायाशुष्क किया, चूर्णित किया तथा परीक्षणों के लिए प्रयोग किया। मानक विधियों को अपनाते हुए स्थूल-सूक्ष्मदर्शीय, भौतिक रासायनिक एवं प्रारम्भिक पादपरासायनिक अध्ययन किए गए।

परिणाम: पुष्पों की सूक्ष्मदर्शीय विशेषताओं ने प्रचुरकॉम्ब्रेटेशियस टार्इप ट्राइकोम्स, रोसेट, क्लस्टर्ड टार्इप केलिशियम आक्सेलेट क्रिस्टल्स, लालनारंगी टेनिन कान्टेन्ड रेजिन डक्ट्स, एण्डोथेशियम सेल्स तथा ईकाई में व तीन कोल्पोरेट में प्रचुर गोल परागकण की उपस्थिति दर्शाई। प्रारम्भिक पादपरासायनिक जाँच ने कार्बोहाइड्रेट्स, फेनोल्स, प्रोटीन्स की उपस्थिति दर्शाई।

निष्कर्ष: अर्जुन पुष्पों की पहचान व मानकीकरण के लिए वानास्पतिक मानक स्थापित करने हेतु अर्जुन पुष्पों के स्थूल सूक्ष्मदर्शीय चूर्ण अध्ययनों एवं प्रारम्भिक पादपरासायनिक जाँचों का उपयोग किया जा सकता है।

मुख्य शब्द: अर्जुन, सूक्ष्मदर्शी, भेषजअभिज्ञानीय, पादपरासायनिक, चूर्ण अध्ययन, टर्मिनोलिया अर्जुना।