Available online on www.ijppr.com
International Journal of Pharmacognosy and Phytochemical Research 2016; 8(5); 710-721

ISSN: 0975-4873

Research Article

Pharmacognostical and Physico-Chemical Studies of *Barringtonia acutangula* Fruit

Mohanty A*, Das C, Ghosh G, Sahu P K

School of Pharmaceutical Sciences, Siksha 'O' Anusandhan University, Bhubaneswar, Odisha

Available Online: 1st May, 2016

ABSTRACT

Barringtonia acutangula belongs to family Barringtoniaceae, useful in the treatment of wound, syphilis, liver troubles. The present study has been attempted to evaluate pharmacognostical and physico-chemical studies of *Barringtonia acutangula* fruit and seed. Transverse section of fruit shows the presence of mesocarp, endocarp and endosperm. Seed shows the presence of endocarp, sclereids, endosperm and starch grains. The powder microscopy of fruit and seed show lignified sclereids, fragment of endosperm, starch grains, fibres, crystals and xylem vessels. Histochemical tests of fruit reveal the presence of lignins, starch and phenols which are characterised by different histological zones. Physico-chemical studies such as ash value, extractive value, moisture content, powder behaviour and fluorescence analysis were carried out on both fruit and seed. Total ash, water soluble and methanol soluble extractive values were found more in fruit than seed. Moisture content was found more in seed. Phytochemical screening of methanolic extract indicates the presence of important secondary metabolite like carbohydrate, glycoside, saponins, alkaloids, tannins and phenols. These studies help in identification and authentication of the plant material. Such information can act as reference information for correct identification of particular plant and useful in making a monograph of the plant

Key words: Powder microscopy, physico-chemical analysis, phytochemical study

INTRODUCTION

Since time immemorial, there is a symbiotic relationship between nature and human beings. The people around the world are becoming aware of side-effect of conventional drugs. So, there is an increasing demand in the natural product remedies, which was thought worthwhile as safe and free from adverse effects[1]. Herbal drugs are also contributing their major role in health care system as they have fitted the immediate personal need, easily accessible and inexpensive[2]. Now a day, plants are considered as reliable sources for development of new drugs and play important role in popular therapeutic diversity[3]. Natural product chemistry and its standardization parameters are very much helpful to recognize the importance of plants as sources of medicines. This scientific approach may be considered in various research works either to isolate new lead compounds or to produce standardized extracts[4]. So the evaluation of various qualitative and quantitative parameters is necessary to set the standards for particular plant or parts of the medicinal plant. An individual drug can easily be identified and characterized with the help of the standard parameters, which may play a major role in maintaining quality of that drug and prevent it from being adulterated by other spurious or sub-standard drug having low potency[5]. In order to safe use of herbal medicines, establishment of standards of quality, safety and efficacy is required.

Barringtonia acutangula is a medium-sized evergreen tree belonging to the family Barringtoniaceae. It is distributed in tropical Africa, Asia, Australia and Polynesia[6].It is mostly found in Meghalaya, Assam, West Bengal, Bihar, Orissa, Madhya Pradesh, Bangladesh, Myanmar and Sri Lanka[7]**.** Leaves are generally obovate, rarely oblanceolate. The length and width is about 7-13 x 4-10 cm, apex is rounded or subacute, glabrous, base is narrowed; petiole 5-15 mm. Leaves are crowded at the ends of the branches, margin is crenate-serrate. Fruits are 3.2-3.8 in length and 1.3-2 cm in width. They are bluntly quadrangular, broadest in the middle and slightly narrowed towards each end, and crowned by small persistent calyx[8]. The plant is traditionally used in treatment of diarrhoea, dysentery, fish poison[9]**,** syphilis[7]. It is also used as antipyretic[6], anti-emetic[6], anthelmintic and anti-ulcer agents[7]**.** Fruit contains three triterpenoid sapogenins, barringtogenol B, C and D and two triterpenoid acid sapogenins through their methyl esters, methyl barringtogenate and methyl acutagenate. Another triterpene acid, barrigenic acids has also been isolated[6]. Barringtogenin and barringtogentin have been isolated from the seed[6]. Three monodesmosidie glucuronide saponins of barringtogenol C, named barringtosides A, B and C were isolated as their methyl esters from the dried seeds[10]. Seed is used in liver troubles[7]. The powder is inhaled as snuff for relief in headache. The powdered seeds are given to children as expectorant and emetic. The seeds are also used as fish poison[6]. Powder seeds used as aromatic, carminative, emetic[9]. Fruit is given as

*Author for Correspondence

Figure 1(a): Fruit of *Barringtonia acutangula*

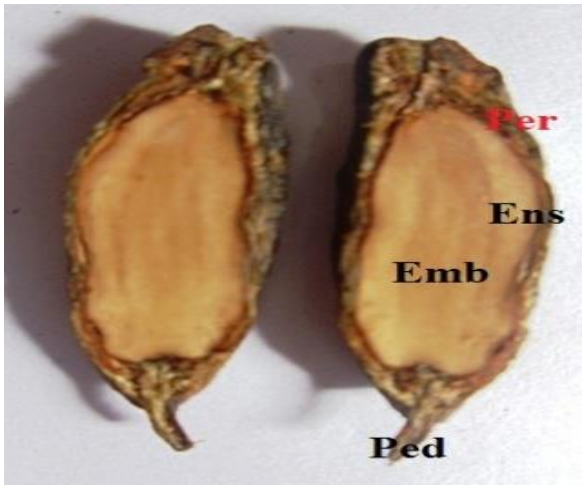


Figure 1(b): Longitudinal section of fruit

Table 1: Histochemical test of *Barringtonia acutangula* fruit

S.no	Reagents	Test for	Histological zone	Inference
1	Section + Safranin	Lignins	Mesocarp, endocarp, vascular strand & in oleo resin canal	+
2	Section + Phloroglucinol & HCL	Lignins	Mesocarp, endocarp, vascular strand & in oleo resin canal	+
3	Section + Iodine solution	Starch	Endosperm	+
4	Section + IKI	Starch	Endosperm	+
5	Section + Ferric chloride	Phenol	Mesocarp	+
6	Section + Toluidine blue	Polyphenol	-	-

+ Present, - Absent

tonic in gingivitis[8]. Fruit is used as bitter, acrid, cool, astringent to bowels, vulnerary, alexipharmie, anthelmintic; causes 'vata'; useful in biliousness, diseases of the blood, bronchitis, sore eyes, headache, hallucinations; cures 'tridosha'. It is lactagogue, useful in gleets, abdominal colic, jumbar pain, wound, syphilis, and nasal catarrh. The fruits of *Barringtonia acutangula* contribute their significant therapeutic role in health care system but very fewer studies have been reported so far on pharmacognostic parameters. Considering this fact, the attempts were made to establish pharmacognostical standards of the plant *Barringtonia acutangula*, which will be helpful in crude drug identification as well as standardization of this drug in crude form.

Taxonomic classification

The scientific classification of *Barringtonia acutangula* is demonstrated as follows[11]

Kingdom: Plantae
Division: Magnoliophyta
Class: Magnoliopsida
Order: Ericales
Family: Lecythidacea/Barringtoniaceae.
Genus: *Barringtonia*
Species: acutangula

Synonym

SEugenia acutangula
Barringtonia spicata[9]
Stravadium acutangulum
Stravadium obtusangulum[7]

Vernacular Names[6]

Oriya-Hinjolo
Sans-Samudraphala
Beng-Hijal, kumia
Hind-Hijjal
Tam-Adampa, kadappai
Tel-Kadapa, kanapachettu

MATERIALS AND METHODS

Collection and preparation of plant specimen

The fruits were collected from Bargarh, Odisha in the month of May, 2015. The plant specimen was authenticated by Boanist, Dr. Padan Kumar Jena, Head of the Department of Botany, Revensaw University, Cuttack, Odissa. They were then washed properly, cut in to small pieces and fixed on the FAA (Formalin-5 ml+Acetic acid 5 ml+70 % Ethyl alcohol 90 ml). After 24 h of fixing, the specimen was dehydrated with graded series of tertiary-butyl alcohol as per the reported method[12]. The outer part of fruit was removed manually to get the seed and processed as above. Infiltration of the specimen was carried out by gradual addition of paraffin wax (melting point 58 ˚C to 60 ˚C) until solution attained super saturation. Then the specimen was cast into paraffin wax blocks for further study.

Table 2: Determination of loss on drying

Parts use	Loss on drying
Fruit	8.4 %
Seed	8.8%

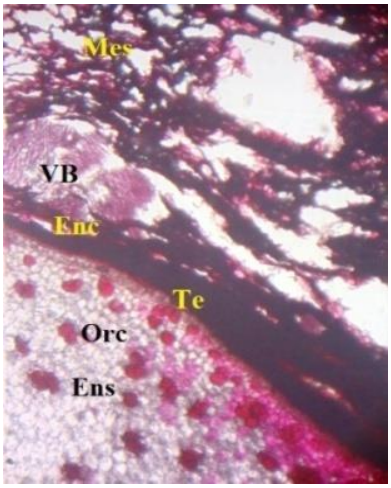


Figure 2: (a)

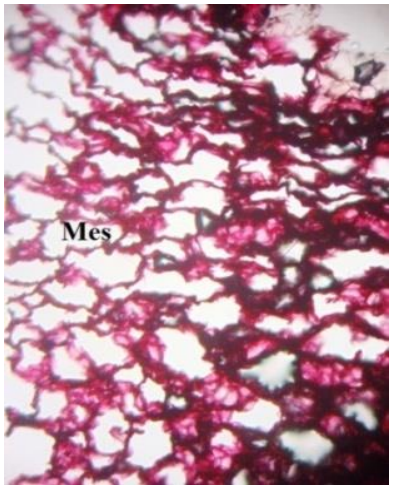


Figure 2: (b)

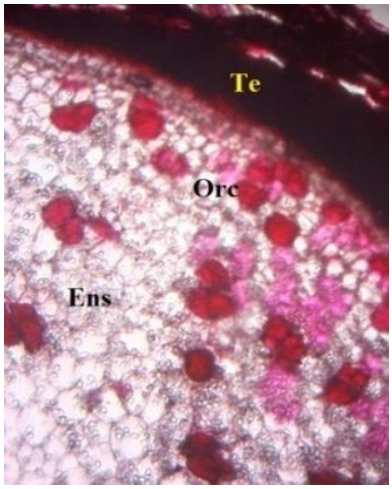


Figure 2: (c)

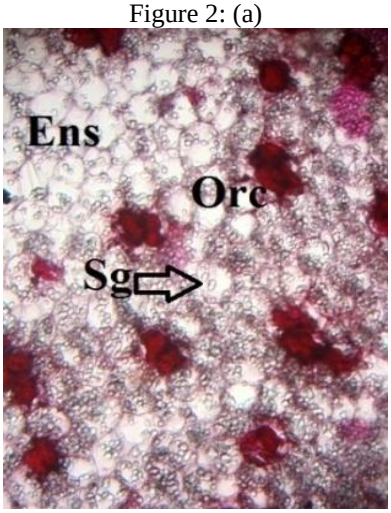


Figure 2: (d)

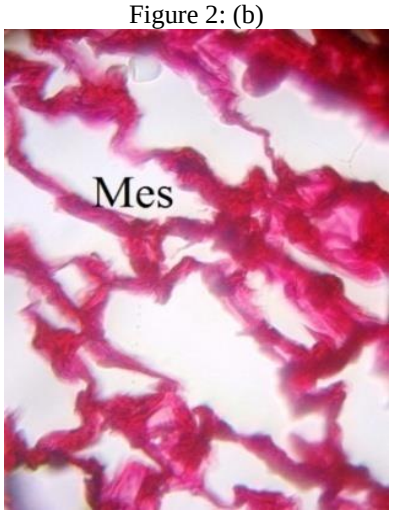


Figure 2: (e)

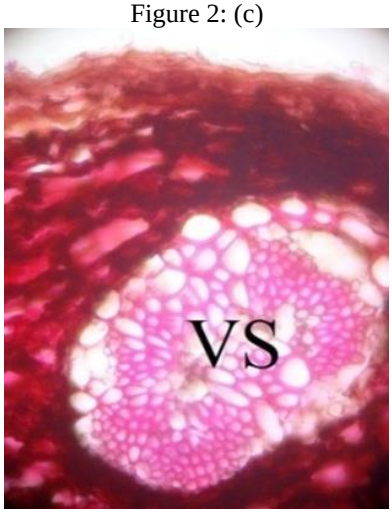


Figure 2: (f)

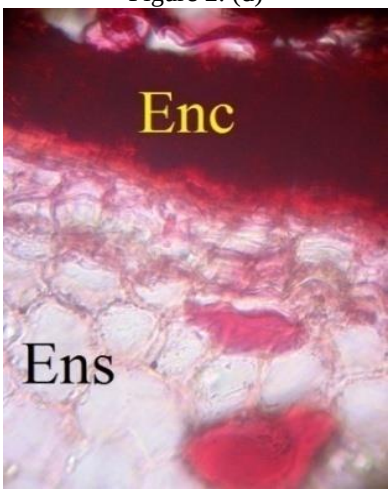


Figure 2: (g)

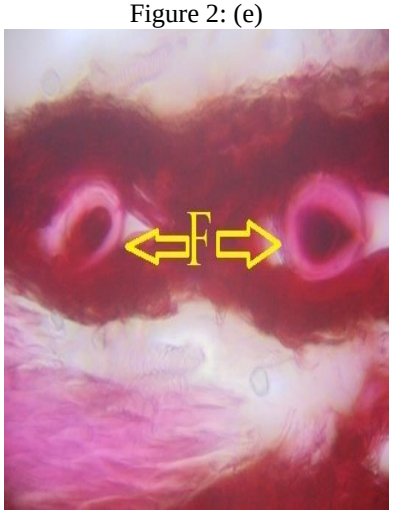


Figure 2: (h)

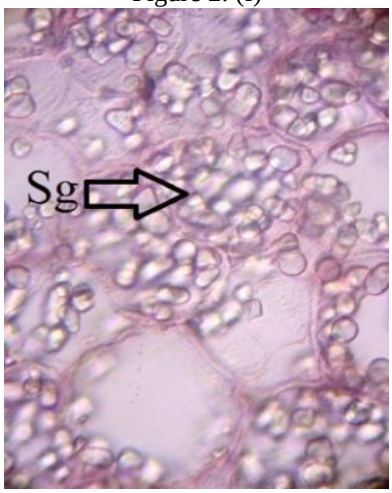


Figure 2: (i)

Figure 2(a): Transverse section of fruit at magnification 5X, 5X, Fig-2(b, c, d)- Transverse section of fruit at magnification 5X, 10X. Fig-2(e, f, g, h, i)-Transverse section of fruit at magnification 5X, 40X. Abbreviations: Mes-Mesocarp, Enc-Endocarp, Ens-Endosperm, Emb-Embryo, Orc-Oleoresin canal, Per-Pericarp, Ped-Pedicel, Sg-Starch grain, Te-Testa, VB-Vascular bundle, VS-Vascular strand, F-Fibre.

ectioning and staining

The specimen was sectioned with the help of Rotary Micrometer. The thickness of the specimen was maintained at 10-12 µm[13].The section was then stained with safranin followed by haemotoxilyne. The dye rendered deep red colour to lignin and violet purple colour to cellulose[14].

Photomicrographs

Photographs of different magnifications were taken with Nikon Lab photo 2 microscopic units. For normal

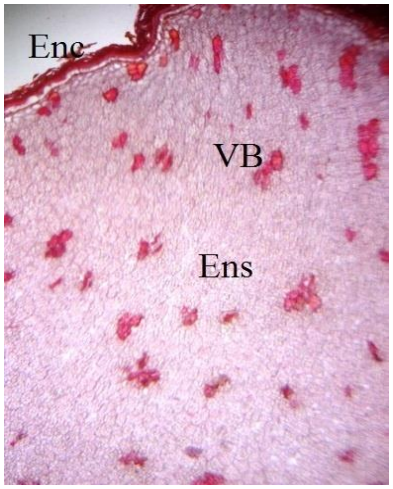


Figure 3: (a)

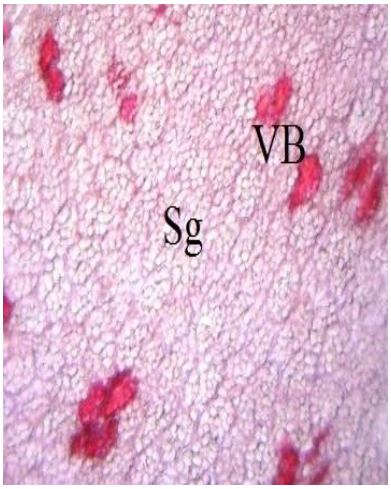


Figure 3: (b)

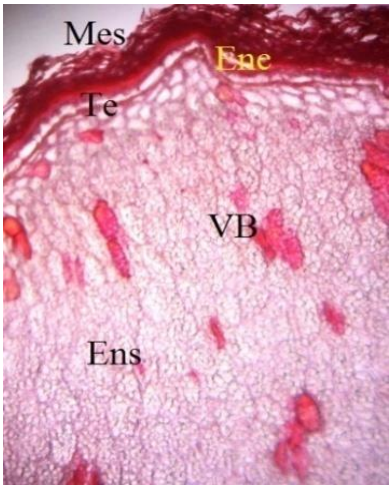


Figure 3: (c)

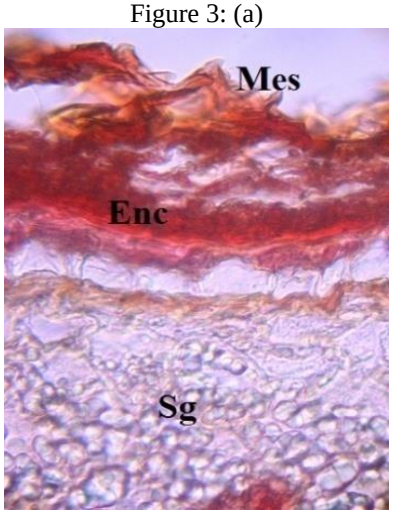


Figure 3: (d)

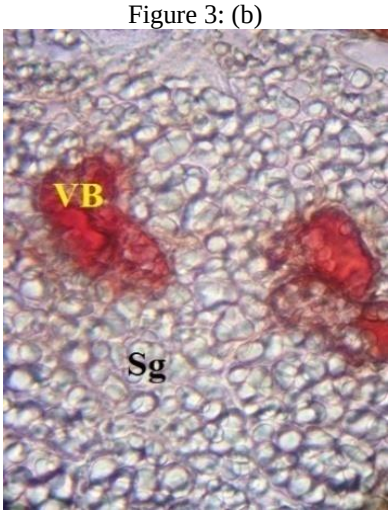


Figure 3: (e)

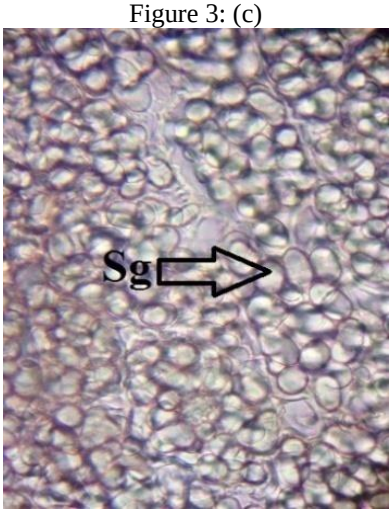


Figure 3: (f)

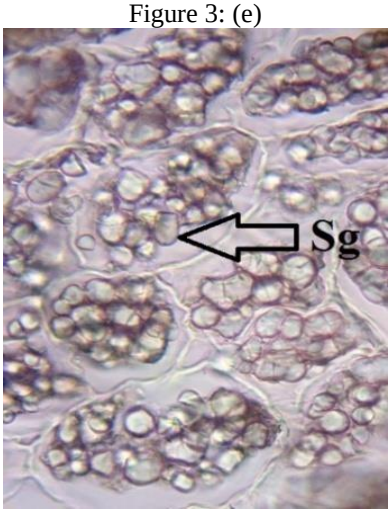


Figure 3: (g)

Figure 3(a, b): Transverse section of seed at magnification 5X, 5X. Fig-3(c)- Transverse section of seed at magnification 5X, 10X. Fig-3(d, e, f, g)-Transverse section of seed at magnification 5X, 40X. Abbreviations: Mes-Mesocarp, Enc-Endocarp, Ens-Endosperm, Sg-Starch grain, Te-Testa, VB-Vascular bundle.

observation, bright field was used. The crystals, starch grains and lignified cells were observed by the help of polarized light. Descriptive term of the anatomical features was used as given in the standard anatomy books[15].

Histochemical analysis

The cross sections of the fruits were done manually using razor blades. The sections were submitted to clarification with 50% sodium hypochlorite and washed in distilled water, neutralized in 1% acetic acid water, and mounted in 50% glycerin. They were stained with specific stains, according to the reported method[16]. The cross sections

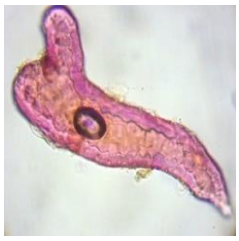


Figure 4: (a)

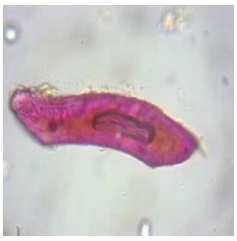


Figure 4: (b)

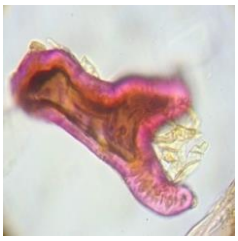


Figure 4: (c)

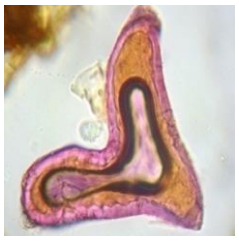


Figure 4: (d)


Figure 4: (e)

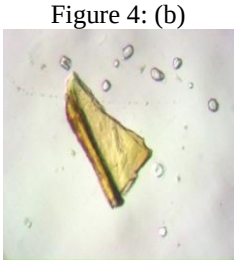


Figure 4: (f)


Figure 4: (g)

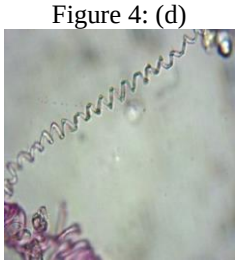


Figure 4: (h)

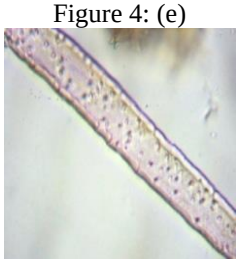


Figure 4: (i)

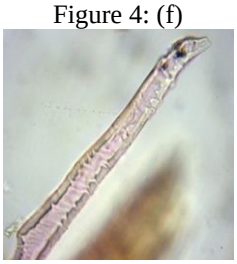


Figure 4: (j)

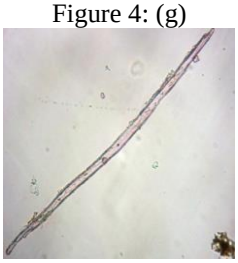


Figure 4: (k)

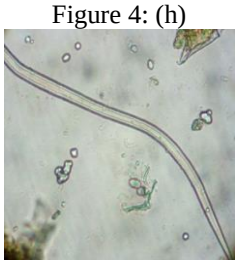


Figure 4: (l)

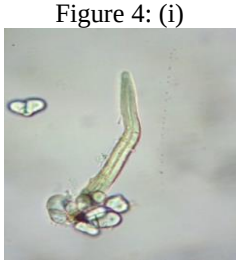


Figure 4: (m)

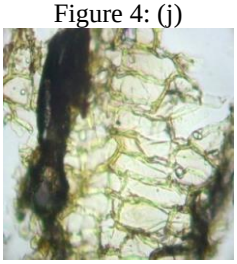


Figure: 4(n)

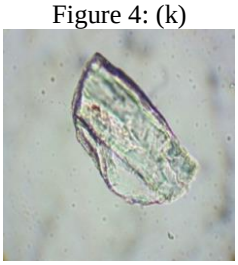


Figure 4: (o)

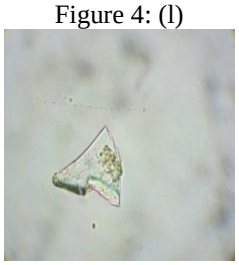


Figure 4: (p)

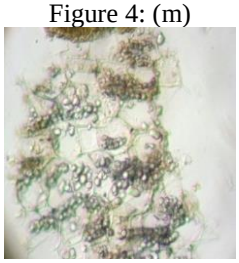


Figure 4: (q)

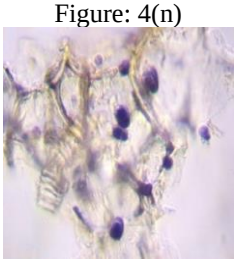


Figure 4: (r)

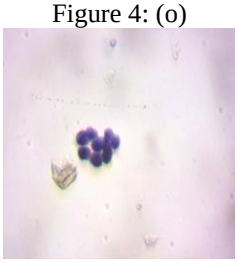


Figure 4: (s)

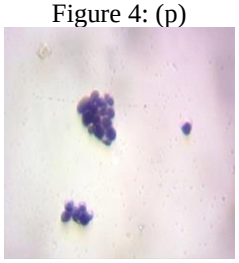


Figure 4: (t)

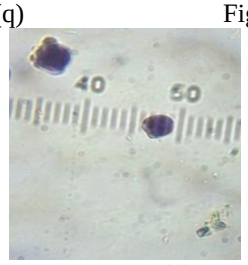


Figure 4: (u)

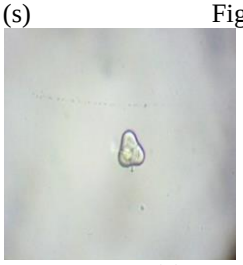


Figure 4:(v)

Figure 4: (a-e)- Sclereids, Fig-4 (q, r)- Fragments of endosperm, Fig-4 (s-v)- Starch granules, Fig-4 (f)- Fragments of pericarp, Fig-4 (n)- Fragments of epicarp, Fig-4 (j-m)- Fibres, Fig-4 (o, p)- Prismatic calcium oxalate crystals, Fig-4 (g, h, i)- Vessels

were submitted to tests with iodine solution and IKI for identification of starch, sudan red for oil globules, ferric chloride for identification of phenol, toluidine blue for identification of polyphenol, phloroglucinol & HCL, safranin for identification of lignins.

Physico-chemical study

The physico-chemical study, behavioural study of powder drug towards different chemical reagents and fluorescence analysis of powder plant materials were carried out using standard methods[17-19].

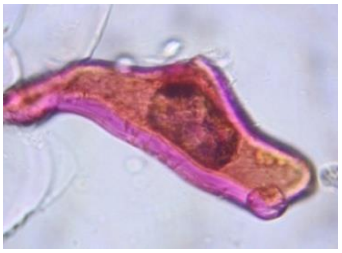


Figure 5(a)

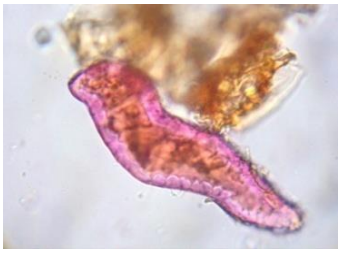


Figure 5(b)

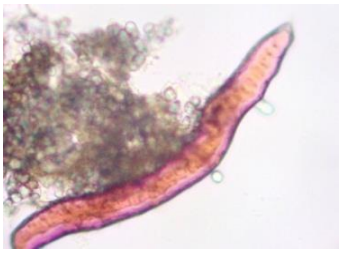


Figure 5(c)

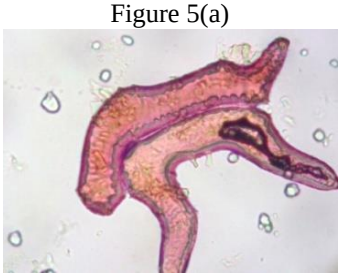


Figure 5(d)

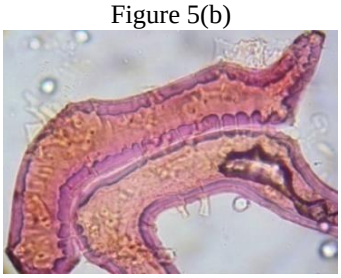


Figure 5(e)


Figure5(f)


Figure 5(g)


Figure 5(h)


Figure 5(i)

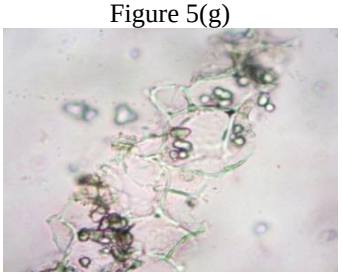


Figure 5(j)

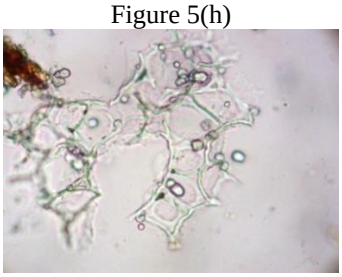


Figure 5(k)

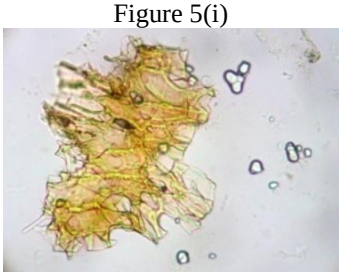


Figure 5(l)

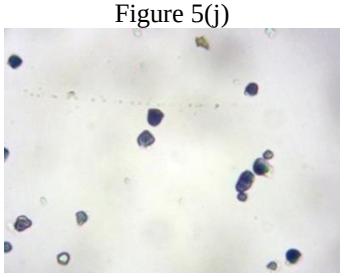


Figure 5(m)

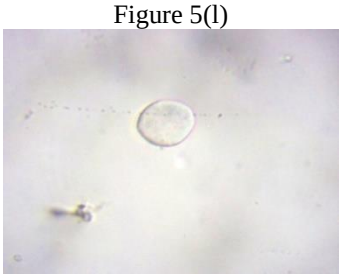


Figure 5(n)

Figure 5: (a-e)- Sclereids, Fig-5 (f, g)- Fibres, Fig-5 (h, i)- Vessels, Fig-5 (j, k)- Endosperm, Fig-5 (m)- Starch granules, Fig-5(n)- Oil globules.

Preliminary phytochemical screening of the plant extracts
Preliminary phytochemical screening of methanol extract was performed as per methods described earlier[20].

RESULTS

Macroscopic study

Fruit is found oblong to oval in shape and broad at the middle. It is 2.5 to 3 cm in length and 1 to 1.5 cm in width. Pedicel is attached at the base. Surface is rough shrivelled due to the longitudinal wrinkled. Externally it is dark brown to light brown. Odour is sweet when it is in fresh and aromatic at dry state. Taste is slightly bitter (Fig-1a). Seeds are externally brown and internally whitish to light brown. Surface of seed shows the presence of longitudinal lines. Longitudinal section of seed shows the presence of outer pericarp, middle endosperm and embryo at centre (Fig-1 b).

Microscopic study

Transverse section of fruit

Transverse section of fruit shows outer mesocarp which consists of about 15-20 layers of irregularly tangentially elongated dark brownish with slightly thick walls parenchymatous cells. Increased number of parenchymatous layers gives the thickness to the pericarp.

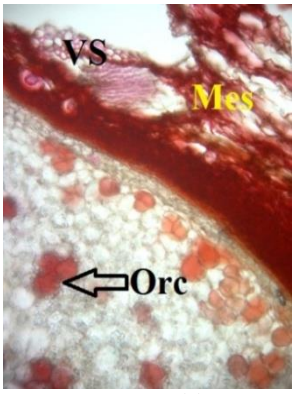


Figure 6(a)

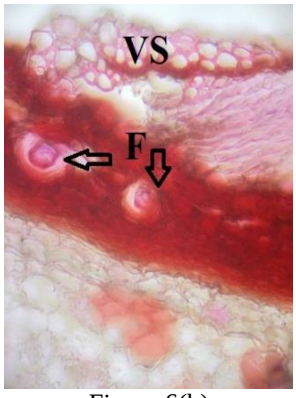


Figure 6(b)

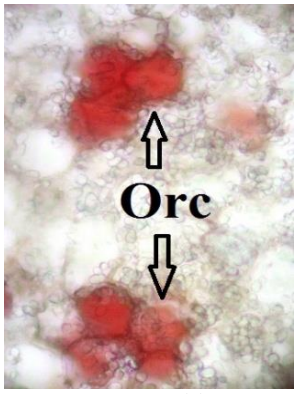


Figure 6(c)

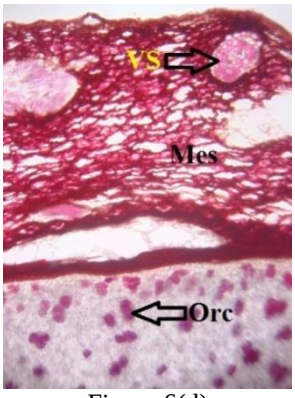


Figure 6(d)

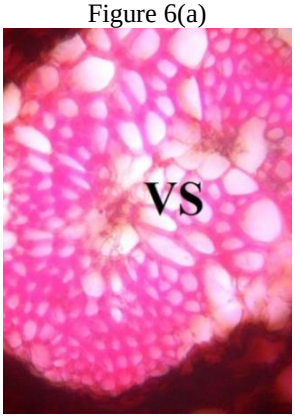


Figure 6(e)

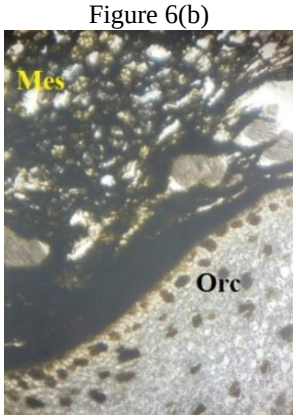


Figure 6(f)

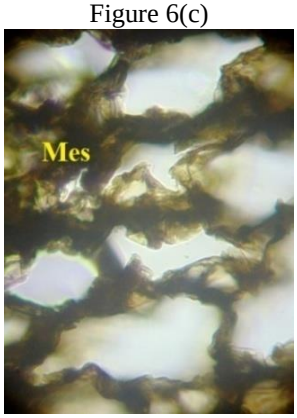


Figure 6(g)

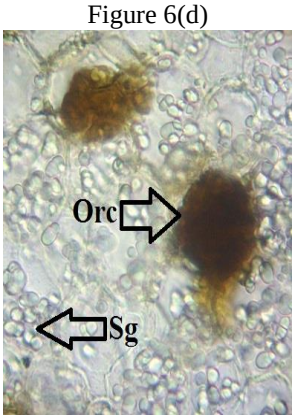


Figure 6(h)

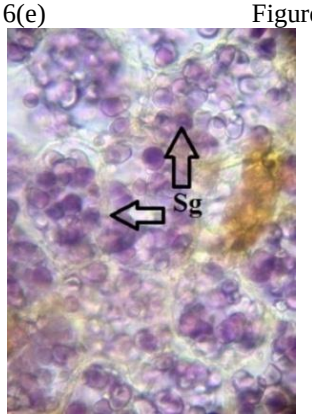


Figure 6(i)

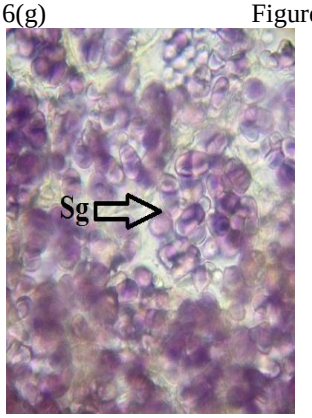


Figure 6(j)

Figure 6(a): Transverse section of fruit at magnification 5X, 10X. Fig-6(b, c)-Transverse section of fruit at magnification5X, 40X. Fig-6(d) - Transverse section of fruit at magnification 5X, 10X. Fig-6(e) - Transverse section of fruit at magnification5X, 40X. Fig-6(f) - Transverse section of fruit at magnification 5X, 10X. Fig-6(g, h) - Transverse section of fruit at magnification 5X, 40X. Fig-6 (i, j) - Transverse section of fruit at magnification 5X, 10X.

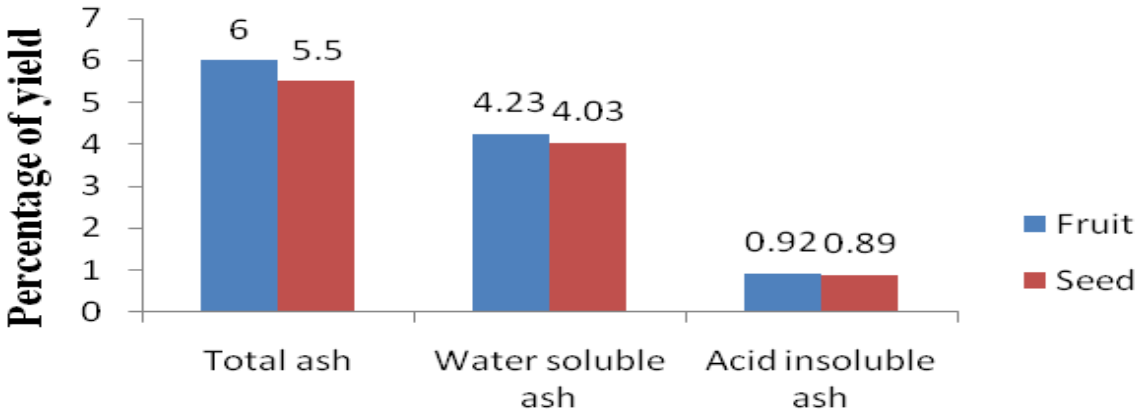
Many patches of vascular strands are embedded in the mesocarp region which is highly lignified. Vascular strands are made of sclerenchymatous cells. Many sclereids of different shapes and sizes are found. Sclereids consist of lignified thick wall with pits and brownish lumen. Mesocarp is followed by endocarp which is stony and shows some lignified fibres. Endosperm covers the major part and scattered with oleoresin cells and abundant starch granules (Fig-2 a, b, c, d, e, f, g, h, i).

Transverse section of seed

Transverse section of seed shows outer endocarp. Endocarp is stony shows rows of (2-3 layers) tangentially elongated lignified sclereids of various sizes and shapes. Sclereids are lignified, thick, pitted wall with brownish lumen. Below the endocarp testa is present. Embryo is located at centre. Endocarp is followed by endosperm. It covers major part of seeds. It is filled with oleoresin cells and abundant starch grainules. Vascular bundles are found in small groups and scattered throughout the endosperm region. Vessels are annular, spiral and pitted (Fig-3 a,b,c,d,e,f,g).

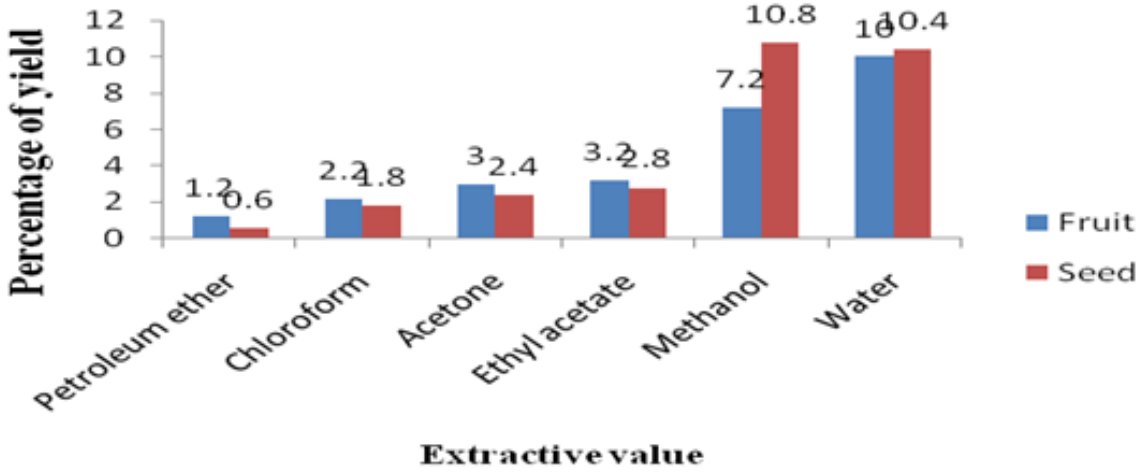
Diagnostic powder characteristics of fruit

In powder microscopic study, sclereids were found separately. The sclereids vary considerably in size and shape, usually elongated, triangular and somewhat peculiar outer lines with thickened pitted wall. The walls are more heavily thickened and lumen contents some



Ash values

Figure 7(a): Determination of ash values



Extractive value

Figure 7(b): Determination of extractive values

Table 3: Behaviour of powdered of *Barringtonia acutangula* with chemical reagent

Acid/Reagent	Observation	
	Fruit	Seed
Powder as such	Brown	Light brown
Powder + Picric acid	Yellow	Yellow
Powder + Con. Nitric acid	Orange	Radish orange
Powder + Con. HCL	Light brown	Light brown
Powder + Con. H_2SO_4	Deep brown	Deep brown
Powder + Glacial acetic acid	Light radish brown	Light radish brown
Powder + 5 % $FeCl_3$	Deep green	Yellowish green
Powder + NaOH (5 N)	Light brown	Light brown
Powder + KOH (5 %)	Light brown	Light brown
Powder + Iodine/20	Deep brown	Deep red

brownish matter (Fig-4 a-e). Fragments of endosperm consist of thin walled parenchymatous cells. Endosperm was found packed with numerous number of starch granules (Fig-4 q, r). These starch granules are found separately and also in group of 8-12 numbers. These are abundantly found in endosperm. The diameter varies from 7.88 µm-19.7 µm. These are mainly simple spherical to slightly polyhedral, compounded granules occurs with two, three, four and more usually 10-17 numbers (Fig-4 s-v). Fragments of pericarp are found which are yellow in colour (Fig-4 f). Fragments of epicarp are found (Fig-4 n). Fibres are both lignified and non lignified. These fibres are elongated, tapering ends and thick walled with narrow lumen (Fig-4 j-m).

Prismatic calcium oxalate crystals are found (Fig-4 o, p). Vessels are lignified, spiral, annular thickening and pitted walls (Fig-4 g, h, i).

Diagnostic powder characteristics of seed

The sclereids of endocarp are found abundantly. They are thick walled, lignified and with numerous pits. They are

Table 4: Fluorescence analysis of powder of *Barringtonia acutangula*.

Reagent	Fruit		Seed	
	Day light	Short wave	Day light	Short wave
Powder as such	Brown		White	
Powder+1N NaOH in methanol	Light green	Light green	Light brown	Brown
Powder+1N NaOH	Light brown	Straw colour	Light brown	Light green
Powder+ 50% HCL	Light brown	Light green	Reddish brown	Brown
Powder+50 % H_2SO_4	Light brown	Light green	Light brown	Brown
Powder+50 % HNO_3	Light brown	Yellow	Yellowish brown	Straw colour
Powder + Petroleum ether	Light brown	Light brown	Light brown	Brown
Powder + Chloroform	Light brown	Brown	Light brown	Straw colour
Powder + Picric acid	Yellow	Yellow	Deep yellow	Yellow
Powder + 5% $Fecl_3$	Deep green	Light green	Deep brown	Deep brown
Powder + 5% Iodine solution	Yellowish red	Deep green	Brownish black	Brown
Powder + Methanol	Light brown	Blackish brown	Light brown	Light brown
Powder + HNO_3+NH_3	Light brown	Light brown	Yellowish brown	Brown

found larger than the sclereids of fruit. They are variable in size and shapes (Fig-5 a-e). Fibres are appeared in both lignified and non lignified, narrow and elongated (Fig-5 f, g). Vessels are found lignified, spiral and annular thickened (Fig-5 h, i). Endosperm consists of parenchymatous cells of thin walls, filled with starch granules (Fig-5 j, k). Starch granules are found abundantly throughout the powder. The starch granules are simple and compounded with two, three or more components. These are spherical or ovoid in shape with diameter from 7.21µ to 18.85µ (Fig-5 m). Some oil globules are also found in the endosperm region which is rounded in shape (Fig-5 n).

Histochemical analysis

Histochemical analysis was conducted through histological sections of the fruit of *Barringtonia acutangula*. The endosperm of the seed is white; relatively hard contain starch grains and oil globules. The cells are isodiametric and polygonal in paradermal section. Section treated with phloroglucinol & HCL, safranin showed the presence of lignins. Lignins are clearly identified in the histological zone of mesocarp, endocarp, vascular strand and in oleo resin canals (Fig-6 a, b, c, d, e), Ferric chloride test confirms the presence of phenolic compound which are indicated by black colours in the mesocarp region (Fig-6 f, g, h), section treated with iodine gave positive result for the starch granules (Fig-6 i, j). Starch granules are abundantly found in the endosperm region which is indicated by imparting blue colour. Section treated with toluidine blue gave negative result for polyophenols. Results are given in (Table-1).

Ash values

The total ash, water soluble ash and acid insoluble ash of *Barringtonia acutangula* fruit were determined following standard procedures and were found to be 6%, 4.23% and 0.92% w/w respectively. Similarly, the total ash, water soluble ash and acid insoluble ash of *Barringtonia acutangula* seed were found to be 5.5%, 4.03% and 0.89% w/w respectively Fig-7(a). Total ash of *Barringtonia acutangula* fruit and seed was found more than water soluble ash and acid insoluble ash. Acid insoluble ash was found very less as compared to total ash and water soluble ash.

Total extractive values

The extractive values are determined to find out the amount of soluble compounds available in a crude drug. Various extractive values of *Barringtonia acutangula* fruit were determined using standard procedures. The petroleum ether, chloroform, acetone, ethyl acetate, methanol and water soluble extractive values of fruit of *Barringtonia acutangula* were found 1.2 %, 2.2 %, 3 %, 3.2%, 7.2% and 10 % w/w respectively. The fruit showed more amounts of water soluble component than petroleum ether, chloroform, acetone, ethyl acetate and methanol soluble components. The petroleum ether, chloroform, acetone, ethyl acetate, methanol and water soluble extractive values of seed of *Barringtonia acutangula* were found 0.6 %, 1.8 %, 2.4 %, 2.8 %, 10.8 % and 10.4 % w/w respectively. The seed showed more amount of methanol and water soluble component than petroleum ether, chloroform and ethyl acetate extractive values Fig-7(b). The water and methanol extractive value of seed was found to be more than the extractive value of fruit. Similarly, petroleum ether, chloroform, acetone and ethyl acetate extractive value of seed were found to be less than the extractive value of fruit.

Loss on drying

The moisture (Loss on drying) content of fruit and seed of *Barringtonia acutangula* were found 8.4 % and 8.8 % respectively. The seed of the plant showed more moisture content (Table-2).

Behaviour of powdered materials towards chemical reagent

The dried powdered fruit and seed of *Barringtonia acutangula* were treated with picric acid, concentrated sulphuric acid, hydrochloric acid, nitric acid, glacial acetic acid, 5 % ferric chloride, sodium hydroxide (5 N), potassium hydroxide (5 N), iodine/20 solution and their behaviours against these reagents were observed in (Table-3).

Fluorescence analysis of Barringtonia acutangula seed and fruit powder

Table 5: Phytochemical screening of methanolic extract of fruit of *Barringtonia acutangula*

Extract	Test for		Inference
Methanol	Carbohydrate	Molisch's test	++
		Fehling's test	+
		Benedict's test	+
		Barfoed's test	+
	Glycoside	Baljet's test	+
		Legal's test	+
		Borntrager's test	+
	Saponins	Foam test	++
	Flavonoids	Ferric chloride test	++
		Shinoda test	+
		Lead acetate test	+
	Alkaloids	Dragendorff's test	+
		Wagner's test	+
		Mayer's test	+
		Hager's test	+
	Tannins & Phenols	Test with heavy metals	+
		Ferric chloride test	+
		Nitric acid test	+

+: Mild, ++: Moderately present

Fluorescence analysis of powdered fruit and seed of *Barringtonia acutangula* has been carried out in day light and under UV light (256 nm). The fluorescence study of powdered seed and fruit was shown in (Table-4).

Phytochemical screening of the extracts

The phytochemical screening was carried out on methanolic extract of the fruit of *Barringtonia acutangula* and the result revealed the presence carbohydrate, glycoside, saponins, flavonoids, alkaloids, tannins and phenols (Table-5).

DISCUSSION

The plants have been used for the treatment and prevention of various diseases since time immemorial. Proper authentification and identification of such potential plants play a significant role in the field of research and heath care system. So, detailed pharmacognostical study of plant drug is very necessary before its use in the field of research and also in pharmaceutical formulation. It also helps to identify other allied species and adulterants from the authentic drug. To full fill the above requirement, the pharmacognostical studies of fruit and seed of *Barringtonia acutangula* were undertaken. The standardization on pharmacognostic parameters of a crude drug is an integral part to establish its correct identity. The pharmacognostic parameters and standards must be established before introduction of any crude drug in Herbal Pharmacopoeia[1]. Morphological evaluation of crude drug plays an important role in identification and detection of adulteration. It is the simplest technique to check the quality of crude drug as well as quickest means to establish the identity and purity of particular drug[21].The longitudinal wrinkled surface of fruit and presence of longitudinal lines on seed are important characteristic features for identifying the plant. A research work cannot be considered scientific unless the test sample is not standardized. Therefore, microscopic and macroscopic techniques will be very helpful to tackle this problem. Microscopic approach utilizes techniques such as light microscopy to analyze characteristics such as the presence or absence of particular cell types to distinguish between the desired plant species and plant part at ultra structural level[22]. Many patches of vascular strands, stone cells of different shape and sizes in mesocarp region and the presence of oleoresin canals and numerous starch grains in the endosperm were found helpful in the identification of this plant. The calcium oxalate crystals in higher plant are the mineral deposits, which are formed by the combination of environmentally derived calcium and biologically synthesized oxalate, and may be deposited within intravacuolar chambers of specialized cells in any tissue[23].The calcium oxalate crystals are generally involved in ionic balance, osmoregulation, mechanical support and protection against foraging animals. The presence of prismatic calcium oxalate crystals is one of the important parameter for identification of *Barringtonia acutangula.* Presence of highly lignified sclereids, starch granules, vessels of different types and calcium oxalate crystals are the important diagnostic character of powder analysis. Different cellular component like lignin, starch materials and phenolic compounds are identified histologically by reaction with reagents and chemicals at different zones. Fluorescence study is considered for first line standardization of crude drug. Light of short wave length is very active in producing fluorescence and for this reason ultraviolet light produces fluorescence in many substances which do not visibly fluorescence in day light[24]. If the substances themselve are not fluorescent, they may be converted into fluorescent derivatives or decomposition products by using different reagents. Hence, the crude drugs are often evaluated qualitatively in this way and it serves as an important parameter for pharmacognostic evaluation of crude drugs[25]. The different colour produced by powdered drug under ultraviolet light may be one of the criteria for

identification. Powdered crude drug showed different colours at ordinary day light when it was treated with different chemical reagents. Physico-chemical evaluation of crude drugs also ensures the identity of drug and determines the quality and purity of drugs. The evaluation of crude drug is necessary as biochemical variation takes place in drug during treatment with other chemicals, storage for long time, adulterated with sub-standard drugs[26]. Total ash is the important standardization parameter for checking the purity of the drugs by identifying the presence or absence of foreign inorganic matter such as metallic salts or silica[27]. It indicates presence of various impurities like carbonate, oxalate and silicate. The water soluble ash is used to estimate the amount of inorganic compound present in drugs. The acid insoluble ash indicates the presence of earthy material in drug[28]. The total ash, water soluble ash and acid insoluble ash were found more in fruit than seed. Moisture content of drugs should be at minimal level to discourage the growth of bacteria, yeast or fungi during storage[28].The moisture content of the drug is not too high thus it can prevent bacterial, fungi or yeast growth, as the general requirement for moisture content in crude drug is not more than 14% w/w[27]. The moisture content was found more in seed. The extractive values determine the amount of the active constituents in a given amount of plant material when extracted with a particular solvent[28]. Water and methanol extractive value was found more in both fruit and seed. The extractions of any crude drug with a particular solvent yield a solution containing different phytoconstituents. The compositions of these phytoconstituents depend upon the nature of the drug and the solvent used. It also gives an indication whether the crude drug is exhausted or genuine[28].

CONCLUSION

In the present study, morphological, histological and physicochemical characters of *Barringtonia acutangula* were investigated. This study showed botanical characteristics that can differentiate the plant from other plants. The macroscopic description helps in identification of the plant. Microscopical study in entire and powdered form of the drug is one of the aspects of histological evaluation. The results of the present investigation provide dependable diagnostic features of the vegetative organs of the plant for the identity of the drug in entire and in powdered form. Pharmacognostical study of *Barringtonia acutangula* fruit and seed provides specific parameters that will be useful in the identification and authentication of the drug as well as in preventing possible steps of adulteration. Powder characteristics of fruit Powder characteristics of seed Abbreviations: Mes-Mesocarp, Orc-Oleoresin canal, Sg-Starch grain, VS-Vascular strand, F-Fibre.

REFERENCES

1. Verma S, Singh SP. Current and future status of herbal medicines. Veterinary World 2008; 1(11): 347-350.
2. Mukherjee PK. Quality control of herbal drugs. Edn 1, Horizon Pharmaceutical Publishers, 2008, 13.
3. Tijani Y, Uguru MO, Salawu WA. Anti inflaamatory and anti-diarrhoel properties of Faidherbia albida in rats. African Journal of Biotechnology 2008; 7(6): 696 -700.
4. Prasad SK, Singh PN, Wahi AK, Hemalatha S. Pharmacognostical Standardization of Withania coagulans Dunal. Pharmacognosy Journal 2010; 2(11): 386-393.
5. Shanbhag DA, Jayaraman S. Application of HPTLC in standardization of Homoeopathic Mother Tincture. Pharmacognosy Journal 2008; 4(15):155–159.
6. Anonymous. Wealth of India, A dictionary of Indian raw materials and industrial products. Edn 2, vol. 2: B, Council of scientific and industrial research, New Delhi, 1988, 48-49.
7. Guha Bakshi DN, Sensarma P, Pal DC. A Lexicon of Medicinal plants of India. Vol.1, Nayaprakash, 206 Bidhan sarani, Culcutta, 1999, 243-244.
8. Kirtikar KR, Basu BD. Indian medicinal plants. Edn 2, Vol. IV, Periodical Experts Book Publication, Allahbad, 1996, 1058-1059.
9. Joshi SG. Medicinal plants. Oxford and IBH publication, New Delhi, 2003, 237-238.
10. Anonymous. Reviews on medicinal plants. Vol. IV, Indian council of medical research, New Delhi, 2004, 84-91.
11. https://en.wikipedia.org/wiki/Barringtonia acutangula.
12. Rastogi RP, Mehrotra BN. Compendium of indian medicinal plants. Vol. 5, Central Drug Research Institute Lucknow: CSIR, New Delhi, 1991, 122.
13. Sass JE. Elements of Botanical Microtechnique. Edn 1, Mc Graw Hill Book Co, New York, 1940.
14. Johansen DA. Plant Microtechnique. Edn 1, Mc Graw Hill Book Co, New York, 1940.
15. Khandelwal KR. Practical Pharmacognosy Techniques and Experiments. Edn 12, Nirali Prakashan, Pune, 2004, 157.
16. Cromwell BT, Tracey MV. Modern methods of plant analysis. Vol. 178, Berlin Heidelberg, 1995, 18-20.
17. Anonymous. Quality control methods for medicinal plants materials. WHO Geneva, 1998.
18. Rayner RW. A Mycological Colour Chart. Common Wealth Mycological Institute. Kew Surrey and British Mycological Society. England, 1970.
19. Pratt RJ, Chase CR. Fluorescence of powder vegetable drugs with particular reference to development of identification. Journal of the American Pharmacists Association 1949; 38: 324-33.
20. Kokate CK. Practical Pharmacognosy. Edn 1, Vallabh Prakashan, New Delhi, 1994, 107.
21. Rungsung W, Dutta S, Mondal DN, Ratha KK, Hazra J. Pharmacognostical Profiling on the Root of Rauwolfia Serpentina. International Journal of Pharmacognosy and Phytochemical Research 2014; 6(3): 612-616.
22. Subramanion JL, Sreenivasan S. The usage of microscopy method for herbal standardizations. Current Microscopy Contributions to Advances in

Science and Technology. Vol-2, Formatex, 2012, 704-710.
23. Nakata PA. Advances in our understanding of calcium oxalate crystal formation and function in plants. Plant Science 2003; 164: 901-9.
24. Arya V, Gupta R, Gupta VK. Pharmacognostic and phytochemical investigations on Pyrus pashia Buch. - ham. Ex D. Don stems bark. Journal of Chemical and Pharmaceutical Research 2011; 3(3): 447-456.
25. Zhao Z, Liang Z, Guo P. Macroscopic identification of Chinese medicinal materials: Traditional experiences and modern understanding. Journal of Ethnopharmacology 2011; 131: 556-561.
26. Jarald EE, Jarald SE. Textbook of Pharmacognosy and Phytochemistry. Edn 1, CBS Publication, New Delhi, 2007, 96-101.
27. Anonymous. African pharmacopoeia. General methods for analysis. Edn 1, Vol. 2, Lagos, 1986, 123.
28. Tatiya A, Surana S, Bhavsar S, Patil D, Patil Y. Pharmacognostic and preliminary phytochemical investigation of *Eulophia herbacea* Lindl. Tubers (Orchidaceae). Asian Pacific Journal of Tropical Disease 2012; 2(1): S50-55.