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PHYSICOCHEMICAL ANALYSIS OF MARKET SAMPLE OF ARJUNA (*TERMINALIA ARJUNA*)

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ABSTRACT: Arjuna is a well-known drug in Ayurveda. It is mainly used for heart disease, Obesity, and hemorrhagic disorders. It is used in various dosage form in Ayurveda such as powder, milk-based decoction, alcoholic fermented liquids, tablets, etc. Its bark is used for therapeutic purposes. Although it is widely available all over India, most of the time it is procured from the market; hence it needs to assure the quality of marketed Arjuna for standard quality formulations. Ayurvedic pharmacopeia of India (API) has given a monograph of Arjuna bark. So in this study, authentication, organoleptic, macroscopic, microscopic, and physicochemical analysis of a market sample of Arjuna was carried out. Organoleptic, macroscopic, microscopic studies have shown relatively similar characteristics as per standard. In physicochemical analysis, foreign (0.06%) matter was within normal range. Ash value (27.77%) was higher whereas acid insoluble ash (1.08%) almost matches with standard value, which shows more inorganic contents in Arjuna. Acid insoluble ash was nearly the same as a standard value. Water soluble extractive value (19.98 %) was good in studied sample which ensures its water based formulations. However alcohol soluble extractive value (17.91%) was less than standard. pH (4.85%) value is the new parameter added in this study which may be considered as reference for further study. This study added this parameter (pH) for further comparative analysis. Further qualitative, as well as HPTLC study for main marker identification and quantification, needs to carry out with more market samples from various regions in order to ensure market sample quality.

INTRODUCTION: Arjuna (*Terminalia arjuna*) is the most popular Dravya (Drug) in Ayurveda. *Terminalia arjuna* belongs to the genus Terminalia, which belongs to the Combretaceae family, and this plant is well distributed to the tropic and subtropics like warm temperature regions like Bangladesh, India, Srilanka, etc.¹ It is widely used in various formulation for therapeutic purposes. It is especially recognized for its "Hridaya" action (Cardiac tonic).

Mainly its bark is used for therapeutic use. It has Laghu (Easy to digest), Rukshya (brings dryness) in Guna (property), Rasa Kashaya (Pungent taste), Vipaka Katu and Virya Sheeta. It is Kaphapitta Shamak (Pacify Kapha and Pitta), Hridayottajak (Heart Stimulant), Shothaghna (Antiinflammatory), Sandhaniya (Fracture healing properties), and Vranaropana (Wound healing properties). It is used in Hridayaroga (Heart diseases), Medoroga (Obesity), Jeernajwara (Chronic pyrexia), Rakta-pitta (Hemorrhagic disorders)².

In Ayurveda, it is used in Churna (Powder), Kshirapaka (Milk-based decoction), Ghrut (Medicated Ghee) Arishta (Alcoholic fermented liquids), Vati (Tablets) form. Mostly Kshirapaka form is preferred to combat with its extreme



astringent taste and Ruksha (Dryness) property. It is the main content in various formulations such as Arjunarishta, Arjuna Ghruta, *etc.*³

Ayurved Pharmacopeia of India (API) has given a monograph of Arjuna. The medicinal importance of this tree is also well documented in Indian pharmacopeia, according to this its stem, bark, and leaves possess glycosides, large quantities of flavonoids, tannins and minerals⁴.

Although Arjuna is widely available all over India, Ayurved Pharmaceutical industries often procured Arjuna bark from the market to meet large-scale demand. But commercialization of medicinal plants is a great concern nowadays. While providing significant scale demand, there may be a compromise with the quality of raw material.

Substitution and adulteration are prevalent due to unscientific collection practices, ignorance regarding species, unknown sources of collection, *etc.* Herbal adulteration is one of the common malpractices in the herbal raw material trade. Medicinal plant dealers have discovered the Scientific methods in creating adulteration of such high quality that without microscopic and chemical analysis, it is very difficult to trace these adulterations⁵.

The potency of plant-based drugs depends on maturity of plant, collection period, its territory, plant part used, Storage conditions *etc.* These factors are well-thought-out while drugs are field collected. However, now a day's self-collection practice is reduced due to lack of time; hence marketed drugs are taken for pharmaceutical purposes.

Nevertheless, marketed raw drug sources are unknown, so not assured about its collection time, maturity of the drug, expiry date, and storage practices. Although many reputed pharmaceutical companies have quality control laboratories, when used for small-scale preparation, the need arises to ensure its quality. So Present study is planned to study physicochemical parameters of the market sample of Arjuna bark as per Ayurvedic pharmacopeia of India standards.

Aim and Objective: Aim of present study was to study physicochemical parameters of market

sample of Arjuna as per API standards with the objectives to authenticate market sample of Arjuna, Macroscopic and microscopic study with physicochemical analysis.

MATERIALS AND METHODS:

Collection and Authentication of Raw Drugs:

Procurement of Arjuna bark was done from Manakarnika Ayurved Aushadhalaya, Pune, Maharashtra.

Sample of Arjuna was deposited to Repository section with voucher no S/B – 381at Agharkar Research Institute, Pune, Maharashtra as per API standards.

Authentication, Macroscopic, microscopic and organoleptic characteristics of Arjuna were done at Agharkar Research Institute, Pune, Maharashtra, as per API standards.

Macroscopic Study: Various Morphological characters noted included colour of bark, the shape of the bark, diameter (cm) of bark area (cm²) Color and shape of bark were observed visually.

The bark diameter was measured with the help of vernier caliper. The mean values were taken for statistical analysis⁶.

Microscopic Study: Transverse or longitudinal section of bark was prepared. To soften bark it is broken into pieces of about 1-2 cm long and 0.5-1 cm wide and boiled within a test tube for 1-3 minutes. Soft pieces are then straightened with a scalpel so as to have an exact transverse or longitudinal direction.

A section is cut with a razor and moisturized the surface of the bark with glycerol solution. Sections of bark are removed with a brush and place on the slide.

Thin pieces of the bark were cut by placing them in the pith (potato or carrot). It is stained by phloroglucinol (0.2% in water w/v) and iodine (0.2% in water w/v) to confirm its lignification and presence of starch grains, respectively⁷.

Physico Chemical Characteristics: Physico-chemical analysis was carried out at Agharkar Institute according to the API Appendix three times, and the mean was calculated.

S. no	Analytical Test	Procedure as per API
1	pH Value Analysis ⁸ :	Weighted 10 g of powdered plant material was mixed with 100 ml of water and was shaken vigorously it was then allowed to sediment. After 15 min. pH. was measured
2	Foreign Matter ⁹	Weighted 100 g of the plant material and was spread it out in a thin layer. Observed the sample with the unaided eye or with the use of 6X lens and separated the foreign organic matter manually as completely as possible. Weighted the sorted foreign matter and determined the percentage of foreign matter from the weight of the plant material taken
3	Total Ash ¹⁰	Incinerated 2g accurately weighted, of the ground drug in tarred platinum or silica dish at a temperature not exceeding 600 °C until free from carbon, cool in a desiccator for 30 min and weighted without delay. Percentage of ash was calculated with reference to the air-dried drug
4	Water soluble extractive ¹¹	Macerated 5 g of the air-dried drug, coarsely powdered, with 100 ml chloroform water (2.5 ml chloroform in purified water to produce 1000 ml) of specified strength in a closed flask for 24 h, frequently shaking during 6 hours and allowing to stand for 18 hours. Filtered rapidly, taking precautions against loss of solvent, 25 ml of the filtrate was evaporated to dryness in a tarred flat bottomed shallow dish and dried at 105°, to constant weight and weighted. Then calculate the percentage of water-soluble extractive with reference to the air-dried drug
5	Alcohol soluble extractives. ¹²	Macerated 5 g of the air-dried drug, coarsely powdered, with 100 ml of ethanol of specified strength in a closed flask for 24 h, frequently shaking during 6 h and allowed to stand for 18 h. Filtered rapidly, taking precautions against loss of solvent, and evaporated 25 ml of the filtrate to dryness in a tarred flat bottomed shallow dish and dried at 105°, to constant weight and weighted. Calculated the percentage of alcohol-soluble extractive with reference to the air-dried drug

Observation and Result:

TABLE 1: ORGANOLEPTIC CHARACTERS

S. no.	Sample	Status	Organolectic characters	API standards
1	<i>Terminalia Arjuna</i>	Dry	Odour: Odourless, Taste: Bitter and astringent	Taste: Bitter and astringent

TABLE 2: MACROSCOPIC CHARACTERS

S. no.	Sample	Status	Macroscopic characters	API Standards
1	<i>Terminalia Arjuna</i>	Dry	Bark pieces are flat or slightly curved, channelled to half quilled, 0.8-1.3 cm thick, about 8 cm in length and 4.5-6.3 cm in width, outer surface grey, inner surface somewhat fibrous and pinkish.	Bark available in pieces, flat, curved, recurved, channelled to half quilled, 0.2-1.5cm thick, market samples upto 10 cm in length and upto 7 cm in width, outer surface somewhat smooth and grey, inner surface somewhat fibrous and pinkish, transversely cut smoothened bark shows pinkish surface, fracture, short in inner and laminated in outer part

TABLE 3: MICROSCOPIC CHARACTERS

S. no	Sample	Status	Microscopic characters	API Standards
1	<i>Terminalia Arjuna</i>	Dry	Cork consist of about 6 to 8 layers of tangentially running and radially elongated cells. Phloem very broad, traversed by uniseriate medullary rays running straight. Rosette crystals of calcium oxalate are present. Some cells of cortex and secondary phloem contains reddish-brown pigment and some cells contain starch grains	Mature bark shows cork consisting of 9-10 layers of tangentially elongated cells, a few outer layers filled with brown colouring matter; secondary phloem occupies a wide zone, consisting of sieve tubes, companion cells, phloem parenchyma and phloem fibres, traversed by phloem rays, usually uniseriate but biseriate rays also occasionally seen; in the middle and outer phloem region, sieve tubes get collapsed and form ceratenchyma; phloem fibres distributed in rows and present in groups of 2-10; rosette crystals of calcium oxalate present in most of the phloem parenchyma, alternating with fibres; idioblasts consisting of large cells having aggregates of prismatic and rhomboidal crystals of calcium oxalate in row starch grains distributed throughout the tissue (absent in <i>T. alata</i>); in a tangential section the uniseriate phloem rays 2-10 cells high and biseriate, 4-12 cells high; in longitudinal section rosette crystals of calcium oxalate found in the form of strands in phloem parenchyma

TABLE 4: pH VALUE

Sr. no.	Sample	Status	pH (%)	API Std
1	<i>Terminalia arjuna</i>	Dry	4.85	Not mentioned

TABLE 5: FOREIGN MATTER

Sr. No.	Sample	Status	Foreign Matter %	API stand %
1	<i>Terminalia arjuna</i>	Dry	0.06	Not more than 2%

TABLE 6: ASH ANALYSIS

Sr. No.	Sample	Status	Total ash (%)	API std (%)
1	<i>Terminalia arjuna</i>	Dry	27.77	Not more than 25

TABLE 7: ACID INSOLUBLE ASH

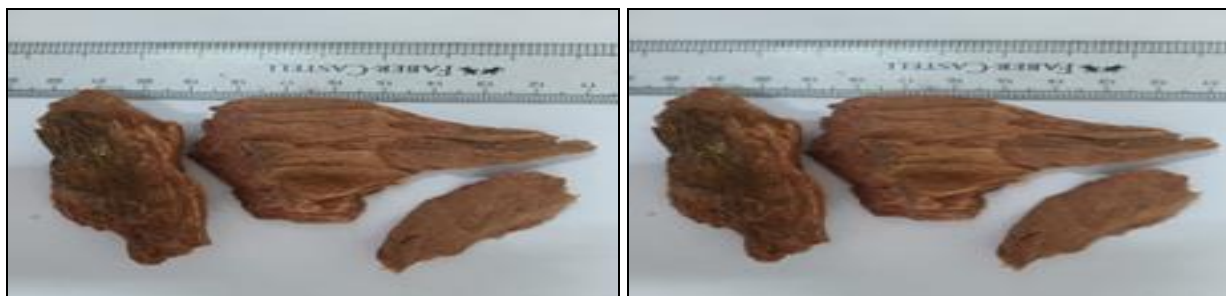
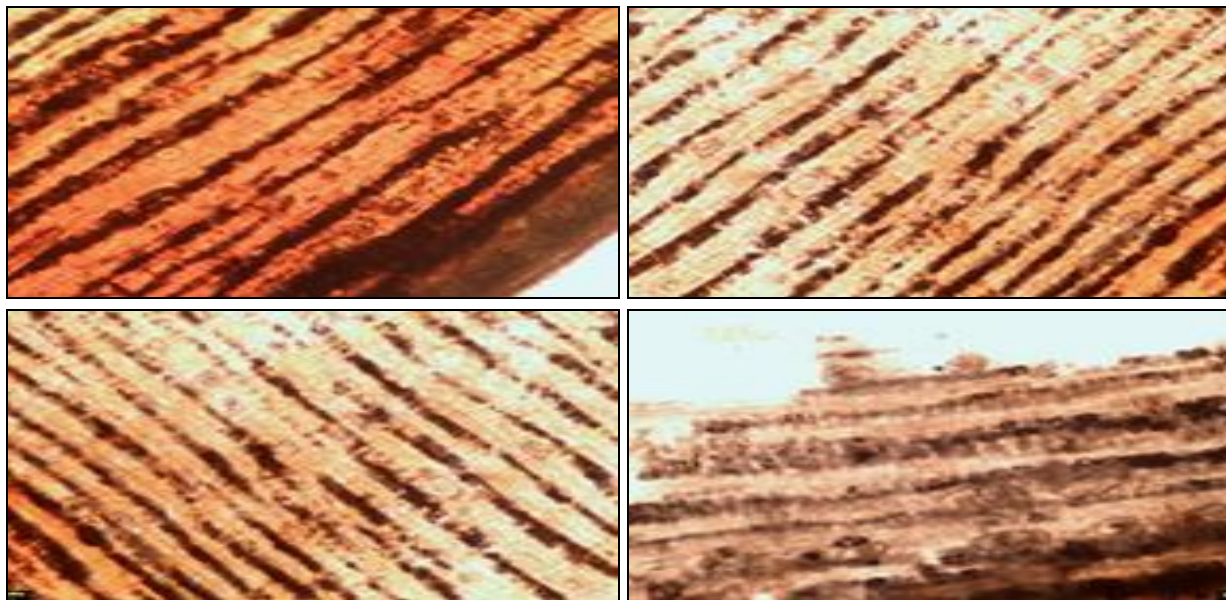
Sr. No.	Sample	Status	Acid insoluble ash (%)	API std (%)
1	<i>Terminalia arjuna</i>	Dry	1.08	Not more than 1%

TABLE 8: WATER-SOLUBLE EXTRACTIVE VALUES

Sr. No.	Sample	Status	Water soluble extractive (%)	API Std (%)
1	<i>Terminalia Arjuna</i>	Dry	19.98	Not less than 20%

TABLE 9: ALCOHOL SOLUBLE EXTRACTIVES VALUE

S. no.	Sample	Status	Alcohol soluble extractive (%)	API Std(%)
1	<i>Terminalia arjuna</i>	Dry	17.91	Not less than 20%

**FIG. 1: MARKETED SAMPLE OF ARJUNA****FIG. 2: L. S. OF ARJUNA BARK**

DISCUSSION: Ayurvedic pharmacopeia of India has set a standard monograph of raw drugs in order to evaluate quality of drugs. Arjuna is widely used in Ayurveda so in this study, standard parameters for Arjuna bark were evaluated. In this organoleptic character showed bark as Odourless, Taste: bitter and astringent. Although Arjuna bark showed Kashaya (Astringent) taste, predominantly

bitterness is also present in Arjuna. The length, width, and thickness of the Market sample were lesser as compare to API standards. In microscopic study not more distinct characteristics are observed such as sieve tubes, companion cells, phloem parenchyma and phloem fibres in marketed Arjuna bark as compare to standard.

pH (4.85) Value of Arjuna directed its acidic nature. pH value for Arjuna is not mentioned in API. Foreign matter (0.06%) is within normal range. Ash value (27.77%) is more in the studied sample, which shows more inorganic contents in Arjuna.

It may be due to absurd collection and storage practices. Acid insoluble ash (1.08%) has a borderline value as per API. In water-soluble extractive value (19.98%) almost same standard value. It shows Kwath preparation gives optimum yield in water media whereas alcohol soluble extractive (17.91%) is quite less than the standard value. Mostly kwath (Decoction) is used for Arjunarishta (Alcohol fermented preparation of Arjuna) hence both water-soluble and alcohol-soluble extractive are expected in fermented preparation which enhance its therapeutic potency.

Physicochemical parameters are dependent on various factors such as maturity of plant, locale, and collection of the period, etc., so even though the drug is procured from the market, strict vigilance of authority should be needed on the dealer of plant oriented drugs regarding its complete profile.

CONCLUSION: Physicochemical analysis of the market sample of Arjuna has shown relatively the same standard as mentioned in API except for Ash Value. As pH value is not mentioned in Monograph of Arjuna, this study has added pH as a new parameter. Further qualitative, as well as HPTLC study for main marker identification and quantification, needs to carry out with more market samples from various regions in order to ensure market sample quality.

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