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PREPARATION AND CHARACTERIZATION OF *CHANDRAPRABHA VATI,* AN *AYURVEDIC* FORMULATION

SAFIULLAH A[1], DEVANATHAN RENGARAJAN[2], BRINDHA PEMIAH[1,2], SRIDHARAN KRISHNASWAMY[1], UMA MAHESWARI KRISHNAN[1,3], SWAMINATHAN SETHURAMAN[1,3], RAJAN K. SEKAR[1,3*]

[1]School of Chemical & Biotechnology, [2]Centre for Advanced Research in Indian System of Medicine, [3]Centre for Nanotechnology & Advanced Biomaterials, SASTRA University, Thanjavur 613 401, Tamil Nadu, India. Email: ksrajan@chem.sastra.edu

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ABSTRACT

Chandraprabha vati is a widely used *Ayurvedic* formulation for the treatment of Diabetes and urinary diseases. The present work deals with the preparation of *Chandraprabha vati* tablets as per the procedure prescribed in the ancient texts, starting with the authentication of herbs through botanical characterization followed by purification of raw materials. The importance of purification steps was studied through the analysis of raw material and the intermediates using X-ray fluorescence spectroscopy. The scanning electron micrographs of *Chandraprabha vati* tablets show the presence of pores as well as the plate-like objects. The formation of pores may be attributed to the evaporation of volatile molecules during heating.

Keywords: *Chandraprabha vati*, Herbs, X-ray fluorescence spectroscopy, pore, Volatile molecules.

INTRODUCTION

Ayurveda, an Indian System of medicine is known for its significant contribution in maintaining the health care of human society. However, the scientific evidence to prove the rationale of using these formulations in health care is not well established. The need to explore time-tested, though less-scientifically proven, *Ayurvedic* system of medicine in health care has been realized of late[1]. Standardization and quality control have remained grey areas in the preparation of *Ayurvedic* medicines. Incomplete understanding of the process coupled with insufficient scientific evidence for some of the preparation steps have been partly responsible for lack of standardization and quality control. Hence, the concepts of Good Manufacturing Practices (GMP) and Process Validation could not be adopted effectively for the preparation of *Ayurvedic* medicines. With the tireless initiatives of the Government of India, the Department of AYUSH (*Ayurveda, Yoga, Unani, Siddha* and *Homeopathy*) has been publishing *Ayurvedic* pharmacopeia and Formulary from time-to-time. It needs to be borne in mind that the establishment of protocols for quality control in preparation of *Ayurvedic* medicines is an ongoing process that requires multi-disciplinary approaches[2].

Chandraprabha vati, a tablet formulation of several ingredients, is used in the treatment of genito-urinary ailments, muscular & joint pain, obesity, etc. Among many other drugs and formulations of *Ayurveda* used for rejuvenation[3], *chandraprabha vati* is one among them. The present work discusses the purification of various ingredients used in the preparation of *chandraprabha vati* tablets, along with the characterization of the final product.

MATERIALS AND METHODS

Materials

Several herbal-based materials are required for the preparation of *chandraprabha vati*. Table 1 shows the various ingredients along with the quantity required for formulation of *chandraprabha vati* tablets. These materials were procured from the markets of Trichy and Thanjavur, India and were subsequently screened through botanical analysis for their suitability for this preparation. Similarly Terminalia chebula, Terminalia bellerica and Phyllanthus emblica were obtained from gardens in Thanjavur and used after ascertaining their authenticity. *Gomutra* (cow urine) was collected from Shanmugha Farms, SASTRA University campus, India. Few of the raw materials obtained were impure and hence they were purified as explained below.

Table 1: Ingredients and their quantity required for formulation of *chandraprabha vati.*

Material	Quantity
Plant ingredients:	10 g each
Commipora wightii, *Gomutra silajith*	80 g each
***Bhasma* ingredients:**	
Sugar	40 g

Methods

A flow diagram depicting the various purification steps for treatment of raw materials and for the formulation of *chandraprabha vati* tablets is shown in Figure 1.

Purification of raw materials

Purification of *Plumbago rosea*

Plumbago rosea roots were added to 1:3 solutions of lime stone in water and washed until the pink color disappeared. The roots were then dried under sunlight to obtain powders of roots of *Plumbago rosea*.

Purification of *Croton tiglium*

About 250 g of *croton tiglium* was boiled in 2 L of *gomutra* (cow urine) for 5 hours and dried under sunlight. The coating on the seeds of *croton tiglium* was removed followed by the removal of cotyledon. This was followed by grinding in lime juice and dried under sunlight to yield purified seeds of *croton tiglium*.

Purification of *gum guggul*

Triphala decoction was prepared by mixing equal quantities of Terminalia chebula, Terminalia bellerica and Phyllanthus emblica in about 5 L of water. The resultant mixture was heated to reduce the volume to 1/5th of the original. The *gum guggul* was washed with hot water, followed by stirring with boiling in *Triphala* decoction. The residual liquid was evaporated under sun to prepare purified *guggul*.

Formulation of *chandraprabha vati* tablets

Purified *guggul*, *gomutra silajith* and sugar were ground initially, to which plant ingredients were added, followed by grinding to mix the ingredients. Upon ensuring proper mixing, *bhasma* ingredients were added followed by grinding. *Triphala* decoction was added as and when required to obtain a consistency for the paste that facilitates easy grinding. The paste was then made in to spherical tablets called *chandraprabha vati*.

Characterization

Elemental composition

The elemental composition of various purified ingredients, herbal mixture, *bhasma* and *chandraprabha vati* tablet were determined using a X-ray fluorescence spectrometer (S8 Tiger, Bruker AXS, Germany) employing Cu-K radiation. The samples for the analysis were pelletized using a hydraulic press at a load of 25 ton.

Morphological analysis

The morphology of *chandraprabha vati* tablets was studied using a Field-Emission Scanning Electron Microscope (JSM 5701F, JEOL, Japan). The samples were sputtered with gold to render the top surface conducting, before being introduced into the specimen chamber maintained at high vacuum for imaging.

Particle size distribution

The particle size distribution of *chandraprabha vati* was determined by laser diffraction technique using a particle size analyzer (Bluewave, Microtrac, Japan). A small quantity of sample was dispersed in water using homogenizer and analyzed to yield hydrodynamic size distribution of the particles.

RESULTS & DISCUSSION

Elemental composition of *chandraprabha vati*

During the preparation of *chandraprabha vati*, several plant ingredients and two *bhasmas* are added. Hence, *chandraprabha vati* is expected to contain key elements contained in these ingredients. The elemental analysis of *chandraprabha vati* tablet is shown in Table 2. The major elements are iron, chlorine, potassium, sodium, silicon, calcium, aluminum, sulphur, magnesium and phosphorus. The major contributor of iron is *Lauha bhasma*, while that of chlorine is the herbal mixture (Table 3). Potassium is present in *gomutra silajith*, *guggul*, herbal mixture in appreciable quantities and contributes to the potassium content of *chandraprabha vati*. Majority of calcium in *chandraprabha vati* is derived from *guggul* and herbal mixture.

The *chandraprabha vati* tablet did not contain detectable amounts of heavy metals like lead, zinc, copper and toxic elements like arsenic.

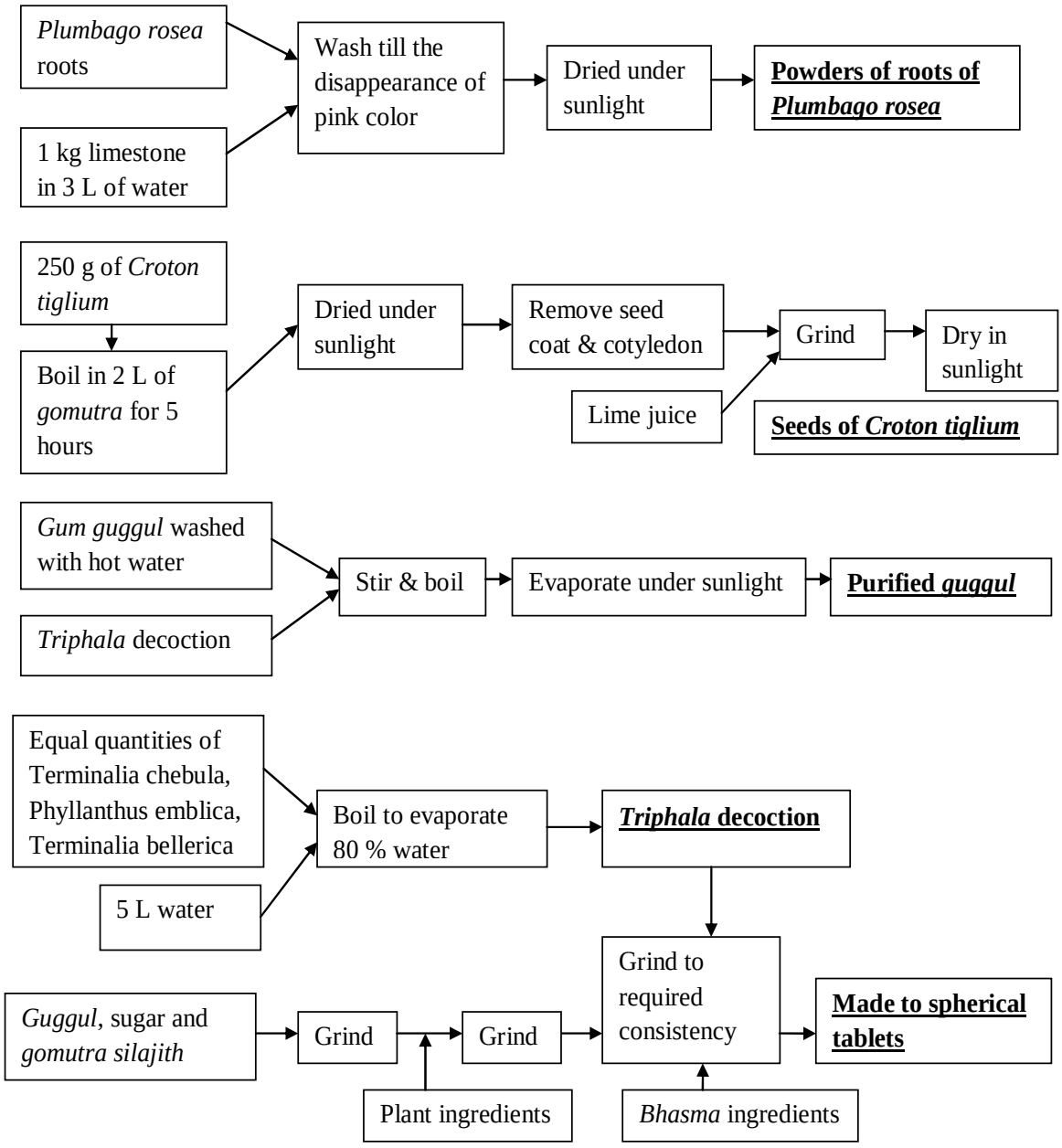


Fig. 1: Process flow diagram for the preparation of *chandraprabha vati.*

Table 2: Elemental composition of *chandraprabha vati* tablet

Element	Fe	Cl	K	Na	Si	Ca	Al	S	Mg	P	O
Mass %	22.34	16.40	13.38	6.87	5.50	4.17	1.33	0.96	0.93	0.63	26.88

Table 3: Elemental composition of purified *guggul*, *Lauha bhasma*, herbal mixture and *chandraprabha vati*

Element	***Gomutra silajith***	***Lauha Bhasma***	**Purified *Guggul***	**Herbal mixture**	***Chandraprabha vati***
Si	6.20±0.20	0.73±0.05	5.10±0.16	2.55±0.15	5.50±0.26
Fe	3.10±0.38	66.61±0.25	6.30±0.24	1.66±0.02	22.34±0.43
K	34.77±1.77	0.167±0.01	17.57±0.15	23.19±3.11	13.38±0.09
P	2.85±0.08	0.063±0.01	0.49±0.02	1.31±0.00	0.63±0.05
S	2.65±0.12	0.15±0.01	1.60±0.04	1.70±0.03	0.96±0.03
Mg	2.99±0.35	0.24±0.01	1.84±0.04	1.77±0.08	0.93±0.15
Cl	4.9±0.21	0.08	4.62±0.30	20.22±0.16	16.40±0.28
Na	0.58±0.69	0.12±0.01	1.60±0.26	0.99±0.11	6.87±0.14
Al	-	0.19	2.12±0.07	0.88±0.07	1.33±0.10
Ca	8.10±0.63	0.77±0.01	27.19±0.01	19.31±0.11	4.17±0.23
Ti	0.33±0.04	-	0.55±0.03	-	0.14±0.01
Sr	0.03±0.01	-	-	-	-
Cu	0.03±0.01	0.05±0.00	-	-	0.11±0.02
Mn	0.09±0.00	-	-	0.18±0.00	0.10±0.01
Zn	0.04±0.00	0.023±0.01	-	-	-
Ni	-	0.02±0.00	-	-	-
Pb	-	-	-	-	0.27±0.06
Sn	-	0.047±0.01	-	-	-
Cr	-	0.03±0.00	-	-	-
As	-	0.02±0.00	-	-	-
O	30.81±0.99	-	-	23.26±0.10	26.88±0.20

Particle size distribution of *chandraprabha vati*

The particle size distribution is observed to be multimodal (Figure 2) with modes at 6, 13, 37 and 88 µm. Multiple modes in particle size distribution is reminiscent of particles produced by top-down approach by wet milling or grinding with short grinding times. Since triturating mimics wet grinding, the multiple modes observed may be attributed to the shorter grinding times or inconsistency in the force applied during trituration.

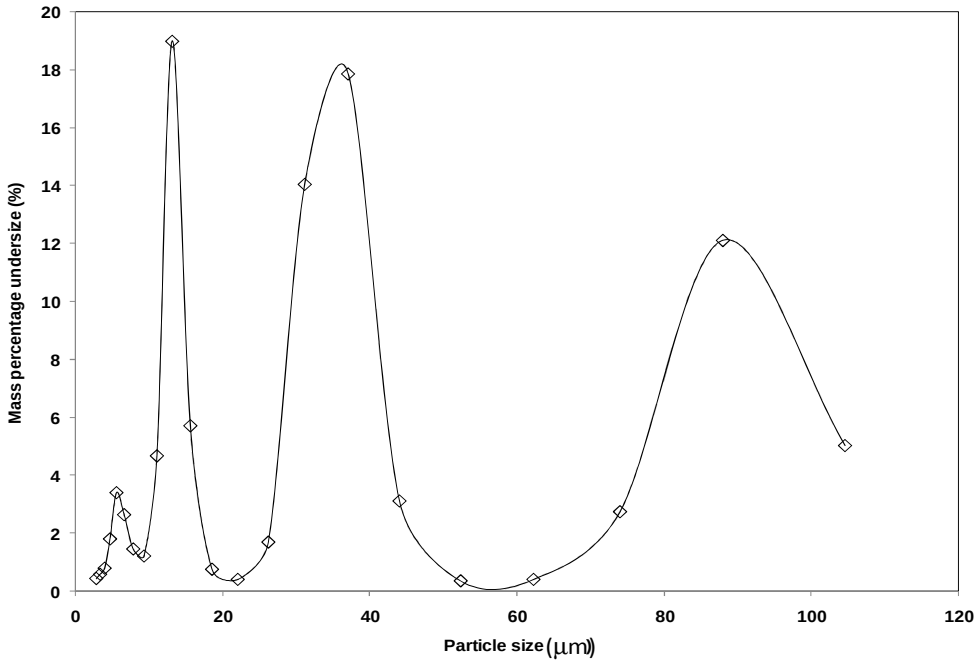


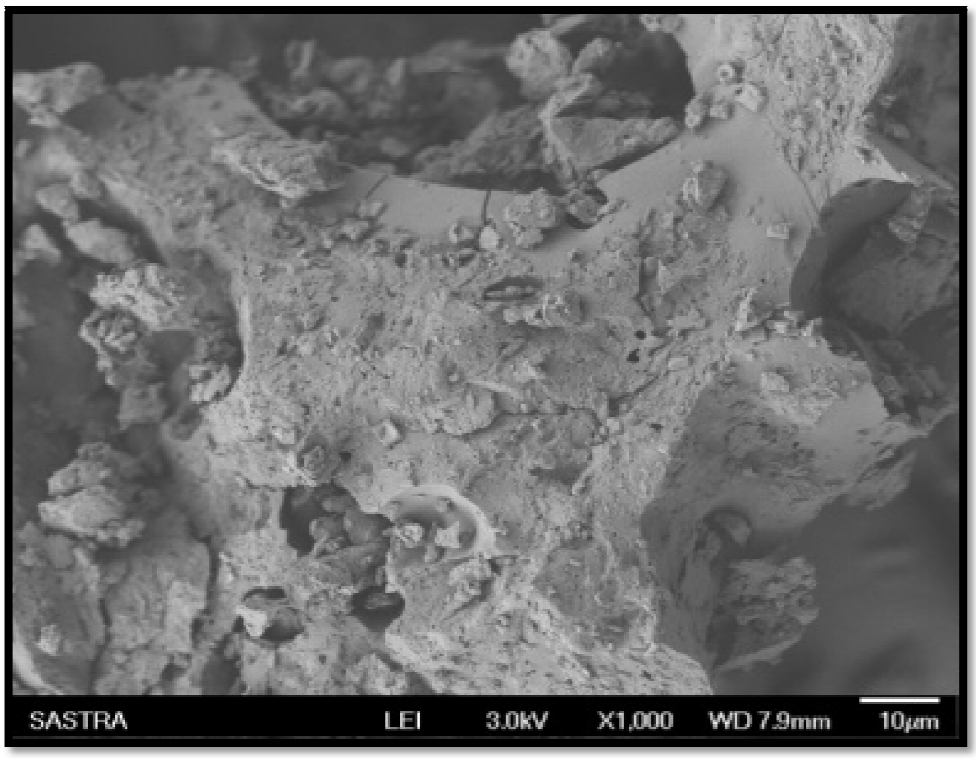
Fig. 2: Particle size distribution of *chandraprabha vati.*

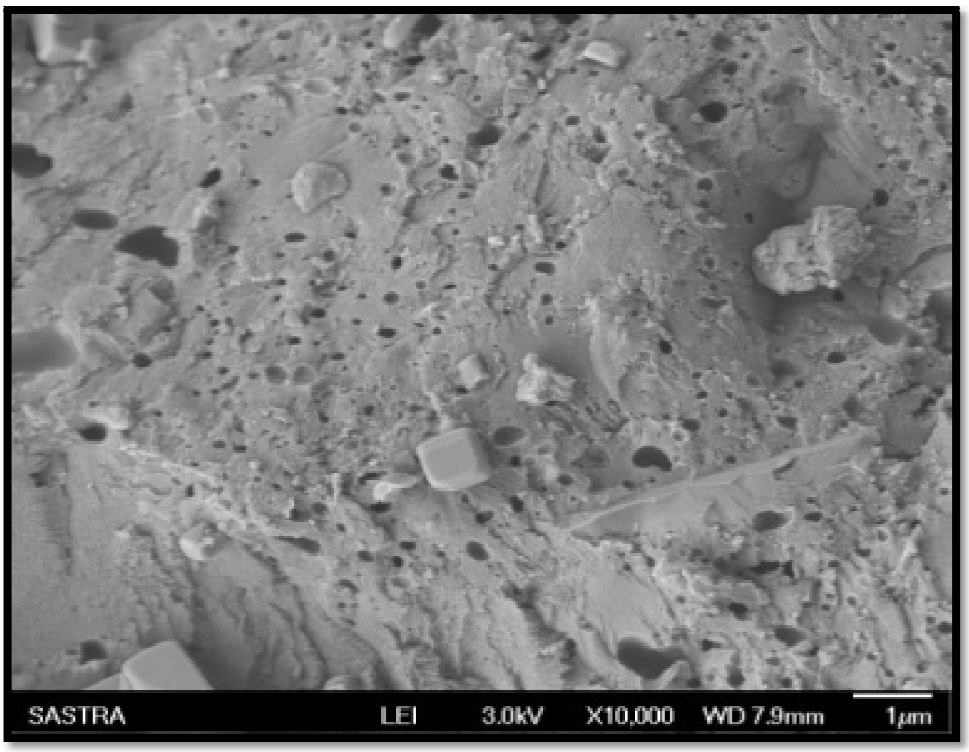
Scanning electron micrographs

To study the morphology of particles comprising the *chandraprabha vati* tablet, scanning electron micrographs were obtained at different magnifications as shown in Figure 3. The low-magnification micrograph shows the particles to be irregular shaped with planar, polygonal morphology. Few relatively small particles may also be observed over the planar surfaces of large particles.

The electron micrograph at magnification of 10,000 shows open pores with dimensions ranging from few 100 nm to µm. The formation of these pores may be attributed to the removal of

volatile species from the plant ingredients during grinding. It is well-established that size reduction is an energy-inefficient operation with more than 99 % of energy supplied being lost as heat [4]. This would have led to local increase in temperature leading to evaporation of volatile species. The electron micrograph at a magnification of 30000 reveals that the boundaries of the pores are decorated by nanoparticles. Also, the planar morphology for polygonal particles observed at the magnification of 1000 is result of fusion of such nanoparticles. The interaction of solid particles with the liquid is influenced by the morphology of the particles. Porous solid materials with open pores have higher surface area which potentially transforms to interfacial area for contact with the fluid phase. The modern literature contains several illustration of the role of particle size and surface area in determining the performance of systems and operations involving fluid-solid interactions [5,6,7,8,9,10]. The improved therapeutic activity may be achieved due to the presence of nanostructures[11].





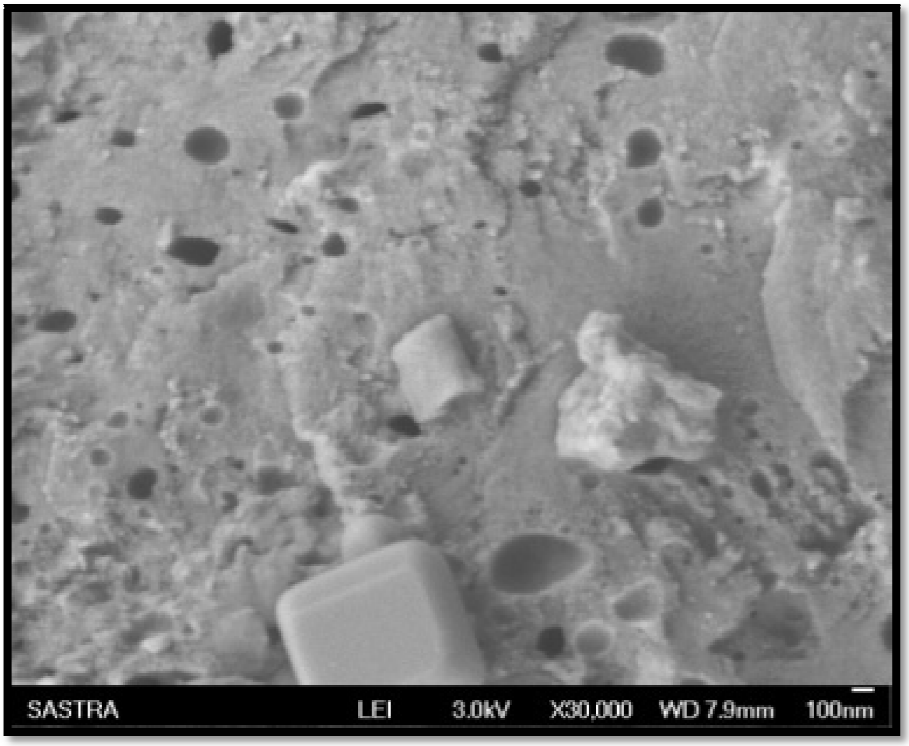


Fig. 3: Scanning electron micrographs of *chandraprabha vati* tablets at magnifications of 1000, 10000 and 30000

CONCLUSIONS

Chandraprabha vati was prepared from its ingredients following the procedure described in the *siddha* texts. The elemental analysis of *chandraprabha vati* showed the presence of iron, chlorine, potassium, calcium, sodium and aluminum at greater than 1 wt % each, while other elements like magnesium, sulphur and phosphorus were present at < 1 wt % each. The multi-modal nature of particle size distribution indicated the presence of particles of different sizes in the product, with wide size distribution characteristics of short-period wet grinding. The pores formed on *chandraprabha vati* due to removal of volatile species contribute to increased surface area and hence the expected efficacy of the formulation.

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