Research Article

A Comparative Analytical Study of Two Zinc Compounds – Yashada pushpa and Yashada bhasma with Ayurvedic and Modern Parameters

***Dr.S.Dhanya[1], Dr.P.K.Vineeth[2], Dr.NV Ramesh[3], Dr.K.Unnikrishnapillai[4], Bri.Sailaja.M[5]**
[1.]PG.Scholar [2.]AssistantProfessor [3.]Professor, [4.]Professor, [5.]Head-QualityControl Lab
Dept of Rasashastra and Bhaishajya kalpana (Medicinal Chemistry and Pharmacy),
Amrita School of Ayurveda, Amritapuri, Amrita Vishwa Vidyapeetham, India.
***Corresponding author's E-mail:** dr.dhanyaranjit@gmail.com

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ABSTRACT

Quality of a product is very important, especially in the Pharmaceutical industry. To establish quality, every product requires certain analytical standards or parameters. These are more essential and mandatory, particularly in case of drugs and formulations. Present work is a comparative study on Yashada pushpa and Yashada bhasma with different analytical parameters. For preparing Yashada pushpa, Yashada was purified in general and specific purification methods. Then intense heat was given to the purified Yashada in a musha. Yashada bhasma taken for the study was procured from a GMP certified pharmacy. Both the samples were tested with modern and Ayurvedic parameters to know the physical and chemical characteristics of the products. Organoleptic characters gave an idea about the physical properties of the samples. The pH values showed that both the products were basic in nature. Loss on drying values or the moisture contents of both the samples were less. Ash values of the products showed that the organic matter present in both the samples was less. The XRD identified both the products as Zinc oxide. The Atomic absorption spectroscopy showed the presence of Zinc as major portion along with the other elements like Fe, Pb, Cu, Sn, Mg, Mn in the final product in both the samples. Scanning electron microscopy revealed that Pushpa had crystalline and polyhedral particles in it and bhasma had amorphous structure. Also Yashada bhasma had comparatively smaller particle size than Yashada pushpa. So Yashada bhasma may be better than pushpa in internal administration. Since the pharmaceutical processing of pushpa is comparatively easier and less time consuming than bhasma, Yashada pushpa can be used instead of bhasma where ever ZnO is used as external medicine.

Keywords: Yashada pushpa, Yashada bhasma, XRD, AAS, SEM.

INTRODUCTION

Yashada (Zinc) is the third putiloha(group of metals). The name Yashada was first mentioned in Madanapalanighantu in 15th century. Ayurvedaprakasha has dealt with Yashada in detail for the first time and classified it under puthiloha. Rasatarangini has dealt with the practical aspects of Yashada and Yashada compounds. Yashada pushpa and Yashada bhasma are the two compound preparations of Yashada. Yashada pushpa was mentioned in Rasatarangini in the context of anjana. No attempts had been yet made to compare the physical and chemical characteristics and elemental composition of these compounds. Analytical standards are the dimensions to evaluate a product. The regulatory authorities have paid special attention to quality, in this particular industry, due to the high risk of damage to life and health of patients possible, and developed many guidelines to ensure a sufficient level of quality[1].So in the present study,we were trying to analyse and compare the two Yashada compounds.

MATERIALS AND METHODS

Yashada bhasma was procured from a GMP Certified Pharmacy.Yashada pushpa was prepared according to Rasatarangini in the analytical lab of Amrita school of Ayurveda, Kollam, Kerala. For the preparation of Yashada pushpa, raw Yashada was purchased from Bharat trading company Mumbai.

Samanya shodhana (general purification) of Yashada was conducted by melting and pouring Yashada into kanji (Fermented Ayurvedic preparation), takra (butter milk), kulattha kwatha (decoction of horse gram), gomutra (cow's urine) and tilataila (sesame oil) taken in a pithara yantra (an instrument) in that order. The same process was repeated for two times[2]. For visesha shodhana (purification) Yashada was melted and poured into pithara yantra containing churnodaka ($CaCo_3$in water) for seven times[3]. After samanya and visesha shodhana, Yashada pushpa was prepared by heating Yashada in a musha(crucible) at high temperature[4]. For preparing Yashada bhasma, visesha shodhita Yashada was triturated with kumari swarasa (Aloe vera juice) and incinerated it till fine bhasma(ash) particles are obtained.

Analysis of Yashada pushpa and Yashada bhasma

In the present study Organoleptic and Physio-Chemical analysis of Yashada pushpa and Yashada bhsama was carried out at the Analytical lab of Amrita School of Ayurveda, Kollam and XRD, AAS and SEM were carried out at National Institute for interdisciplinary Science and Technology, Thiruvanantapuram.

Table 1: showing the list of analytical parameters done for Yashada pushpa and Yashada bhasma

A.Organoleptic characters	B. Physiochemical parameters	C. Other parameters tested
1. Colour	1. pH value	1. Xray diffraction analysis
2. Odour	2. Loss on drying	2. Atomic absorption spectroscopy
3. Taste	3. Total ash	3. Scanning electron microscopy
4. State	4. Acid insoluble ash	
	5. Water soluble ash	

Organoleptic Characters

Organoleptic properties are the aspects of substances that an individual experiences via the senses including taste, sight, smell and touch[5].

Figure 1: Yashada pushpa

Figure 2: Yashada bhasma

Table 2: showing the organoleptic characters of Yashada pushpa and Yashada bhasma

Parameters	Yashada pushpa	Yashada bhasma
Colour	White	Light yellow
Odour	Odourless	Odourless
Taste	Tasteless	Pungent
State	Fine powder	Fine powder

Physiochemical parameters

The physiochemical properties of a drug are that relating to both physical and chemical properties of that drug. pH value fundamentally represents the value of hydrogen ion activity in solution. It represents the acidity or alkalinity of an aqueous solution. Loss on drying is a widely used test method to determine the moisture content of a sample. Loss on drying/loss on ignition describe the process of measuring the weight change of a sample after it has been heated to high temperature causing some of its contents to burn or to volatilize[6]. Ash content is a measure of the total amount of minerals present in a sample. The mineral content is a measure of the specific organic compounds. Acid-insoluble ash is the residue obtained after boiling the total ash with dilute hydrochloric acid, and igniting the remaining insoluble matter[7].Water soluble ash is the difference in weight between the total ash and the residue after treatment of the total ash with water[8].

Figure 3: Acid insoluble ash (YP) **Figure 4:** Acid insoluble ash (YB)

Table 3: showing the physiochemical characters of Yashada pushpa and Yashada bhasma

Sl.No	Parameters	Yashada pushpa	Yashada bhasma
1.	pH value (5% solution)	8.72 at 28.5^{0}C	11.2 at 28.5^{0}C
2.	Loss on drying	0.67%	1.46%
3.	Total ash	98.09%	97.52%
4.	Acid insoluble ash	1.92%	2.89%
5.	Water soluble ash	1.49%	7.82%

Other parameters tested

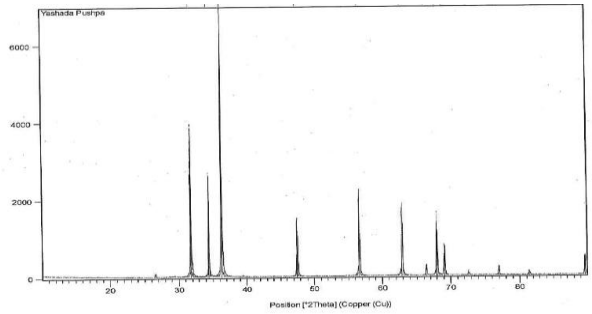

Figure 5: XRD of YP

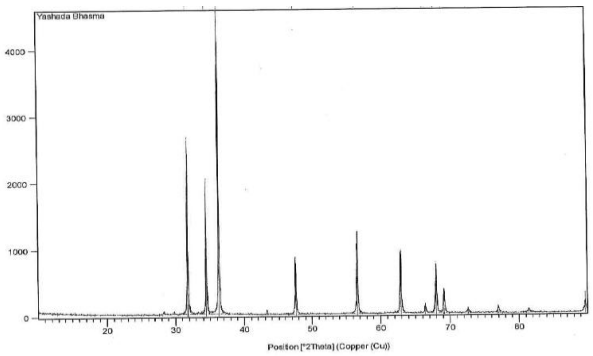

Figure 6: XRD of YB

Xray diffraction analysis

Powder diffraction is a scientific technique using X-ray, neutron, or electron diffraction on powder or microcrystalline samples for structural characterization of materials. An instrument dedicated to performing such powder measurements is called a powder diffractometer[9]. The geometry of an X-ray diffractometer is such that the sample rotates in the path of the collimated X-ray beam at an angle θ while the X-ray detector is mounted on an arm to collect the diffracted X-rays and rotates at an angle of 2θ.

Table 4: showing the 2θ values of Yashada pushpa and Yashada bhasma

Samples	2θ values
Std ZnO	36.252, 31.767, 34.420, 56.593, 62.853, 67.944, 47.537,69.083,66.373,76.956,72.561
Yashada pushpa	36.2802,31.7941,34.4523,56.6137,62.8822,67.9669,47.5641,69.1048,66.3905,76.9802,72.5936
Yashada bhasma	36.285,31.7989,34.4699,56.6071,62.9069,47.5758,67.9669,69.0997,66.3871,76.961,72.6211,81.4787

Heavy metal analysis by atomic absorption spectrometry

Atomic absorption spectrometry is designed to determine the amount of an element in a sample, utilizing the phenomenon that the atoms in the ground state absorb the light characteristic wavelength passing through an atomic vapor layer of the element[10]. Atomic absorption spectrometry is used in the determination of heavy metal elements and some non-metal elements in the atomic state.

Table 5: showing the AAS results of Yashada pushpa and Yashda bhasma

Sl No	Elements	Yashada pushpa	Yashada bhasma
1.	Zn	98.239%	92.019%
2.	Ca	1.103%	1.673%
3.	Fe	316.6ppm	0.832%
4.	Mg	439.6ppm	889.1ppm
5.	Cu	94.1ppm	439.6ppm
6.	Co	106.7ppm	171.6ppm
7.	Mn	185ppm	196ppm

Scanning Electron Microscopy

A scanning electron microscope (SEM) is a type of electron microscope that produces images of a sample by scanning the surface with a focused beam of electrons. The electrons interact with atoms in the sample, producing various signals that contain information about the sample's surface topography and composition. The electron beam is scanned in a raster scan pattern, and the beam's position is combined with the detected signal to produce an image. SEM can achieve resolution better than one nanometer. Specimens can be observed in high vacuum, in conventional SEM or wet conditions in variable pressure or environmental SEM, and at a wide range of cryogenic or elevated temperatures with specialized instruments.

The most common SEM mode is detection of secondary electrons emitted by atoms excited by the electron beam. The number of secondary electrons that can be detected depends, among other things, on specimen topography. By scanning the sample and collecting the secondary electrons that are emitted using a special detector, an image displaying the topography of the surface is created[10].

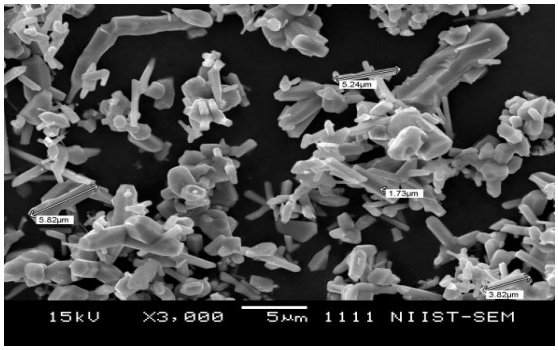

Figure 7: SEM of YP

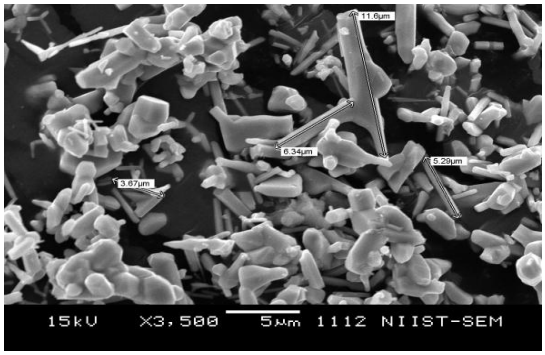

Figure 8: SEM of YP

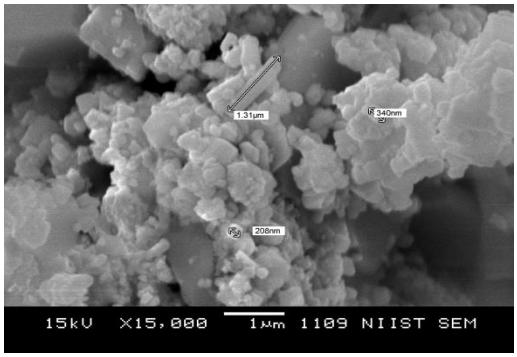

Figure 9: SEM of YB

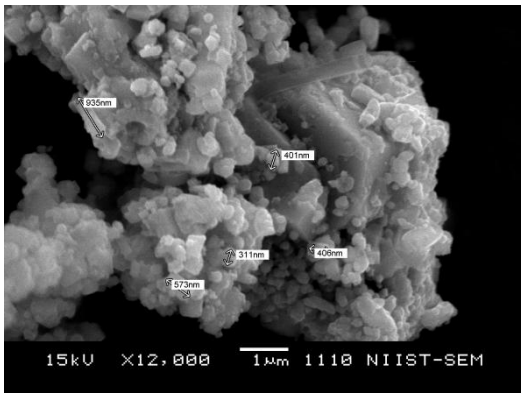

Figure 10: SEM of YB

Ayurvedic parameters

Rekhapurnata

When Yashada pushpa and Yashada bhasma were rubbed in between the thumb and index finger, they entered into the minute lines (grooves) of the fingers.[11]

Figure 11: rekhapurnata of YP

Figure 12: rekhapurnata of YB

Varitara

Yashada Pushpa was sprinkled on the surface of water taken in a glass and allowed to stand still. It was observed that most of the sample floated on the surface of water[12].

Yashada bhasma was also sprinkled on the surface of water taken in a glass and allowed to stand still. It was observed that most of the sample sank to the bottom of water.

Nishchandrata

There were no shining particles in both the samples when it was taken and observed under bright sunlight[13].

Nirdhumatva

Sprinkled a pinch of bhasma of Pushpa and bhasma on ignited charcoal. It was observed that no fumes were emerging out of it[14].

- Slakshnata (smoothness), sukshmata, laghutwa (lightness), mrdu varnata (light colour) are the other characters observed for both bhasma and pushpa.

DISCUSSION

Discussion on Organoleptic parameters

Colour of Yashada pushpa was white and that of bhasma was light yellow. Both of the samples were fine powders. Yashada pushpa was tasteless and bhasma had katu rasa (pungent). Both the samples were odourless.

Discussion on Physiochemical parameters

The pH value gave us an idea about the acidic or basic nature of the material tested. pH (5% solution) value of Yashada pushpa was 8.72 and Yashada bhasma was 11.2 at 28.5^{0}C. Both the samples were basic in nature and Yashada bhasma was more basic than Yashada pushpa.

The loss on drying test is to measure the water and volatile matters, when the sample is dried under specified conditions. The LOD of Yashada pushpa was found to be 0.67% and Yashada bhasma was found to be 1.46%. Decreased LOD values showed that both the samples had less water content and volatile matters in them. LOD of bhasma was found to be more than pushpa. Yashada bhasma had more water and volatile matters compared to Pushpa which may be due to the use of bhavana dravyas during marana in bhasma preparation.

Ash content is a measure of the amount of inorganic matter or minerals present in a sample. Total ash value of Pushpa was 98.09% and bhasma was 97.52%. This showed that the organic matter present in both the samples were negligible. Acid insoluble ash of Yashada pushpa was 1.92% and Yashada bhasma was 2.89%. The decreased acid insoluble ash values showed that most of the inorganic matter or mineral content in the samples were soluble in hydrochloric acid which was used as solvent in the test. Comparatively increased acid insoluble ash value of Yashada bhasma may be due to the presence of some components in bhasma which were insoluble in hydrochloric acid. Water soluble ash of Yashada pushpa was 1.49% and Yashada bhasma was 7.82%. Decreased water soluble ash values showed that the inorganic matter present in the samples was insoluble in water. Comparatively increased water soluble ash value of Yashada bhasma may be due to the presence of water soluble inorganic matter.

Discussion on Xray diffraction analysis

2θ values of both the samples correspond to that of standard zinc oxide. This showed that the major content of Yashada pushpa and Yashada bhasma is Zinc oxide.

Discussion on heavy metal analysis

Both the samples had Zinc as its major component. But pushpa had 98.239% and bhasma had 92.019% Zinc in it. The presence of Ca in both the samples may be due to churnodaka which was used for visesha shodhana. Both the samples had Mg, Fe, Cu, Co and Mn in it. But there is a difference in concentration of these elements in pushpa and bhasma. Bhasma had increased Fe, Mg and Cu contents than pushpa. The Fe content in both the

samples may be due to the use of iron vessels during preparation. The other elements like Mg, Cu, Co and Mn may be added from the herbal sources like kumari swarasa[15] and the drugs used in samanya shodhana like butter milk, gomutra, tila taila etc.

Table 6: showing metallic and mineral contents of drugs used in processing of YP and YB

Sl No	Drugs	Metals and minerals present
1.	Kumari swarasa (Aloe vera juice)	Na, K, Ca, Mg, P, Fe, Cu, Zn, Cd, Pb
2.	Takra (butter milk)	Fe, Pb, Cu, Cd
3.	Gomutra (cow'surine)	Ca, Mg, Na, K
4.	Tila taila (sesame oil)	Zn, Fe, K, Na, Cu, Pb, Mn

Discussion on Scanning Electron Microscopy

Yashada pushpa had crystalline and polyhedral particles in it. But bhasma particles had no definite shape and were amorphous in nature. Pushpa had a particle size range of 1.73 to 11.6 µm and yashada bhasma had a range of 340 nm to 1.31 µm. Particle size of Yashada bhasma was lesser than that of Yashada pushpa. Repeated trituration and incineration processes helped in reducing the particle size of Yashada bhasma. As trituration and incineration processes are absent in Yashada pushpa, it can retain its polyhedral and crystalline structure.

Discussion on Ayurvedic parameters

Both the samples when rubbed between the fingers, entered into the grooves (rekhapurnata). When the samples were sprinkled on the surface of water, most of the pushpa particles floated on the surface of water. But bhasma particles sank to the bottom. Some more puta may be needed to make it lighter enough to float on the surface of water. Absence of shining particles showed that there were no metallic particles in Yashada pushpa and Yashada bhasma.

CONCLUSION

Yashada pushpa was prepared by giving high temperature (800^0C) to vishesha shodhita Yashada. And bhasma was prepared by giving bhavana to vishesha shodhita Yashada with kumari swarasa and it was incinerated till it attained fine bhasma form. Eventhough on external appearance both the samples were entirely different, XRD identified both the samples as Zinc oxide. Yashada bhasma was more basic than Pushpa. Both the samples had less volatile and water contents in it. Organic matters present in both the samples were also less. Compared to pushpa, bhasma had more water and volatile contents and organic matter in it. Bhasma had increased acid insoluble ash and water soluble ash values than pushpa. This revealed that metallic and mineral contents present in both the samples were almost insoluble in water, but soluble in strong acids like HCl. Heavy metal analysis by atomic absorption spectroscopy showed that both the samples had Zinc as its major component. Pushpa had 6.22% increased Zinc content. Bhasma had increased iron content in it. As the particle size of bhasma was comparatively lesser than pushpa, bioavailability of Yashada bhasma was greater than pushpa. So Yashada bhasma can be considered better for internal administration. Since the pharmaceutical processing of pushpa is comparatively easier and less time consuming than bhasma, Yashada pushpa can be used instead of bhasma where ever ZnO is used as external medicine.

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