Research Article

Pharmaceutical standardization of Swarna Makshika Bhasma (Processed Copper Pyrite): A traditional medicine of Indian subcontinent

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Abstract

Objective: The pharmaceutical practice in Ayurveda is Rasa Shastra. The consistency of the medicines recommended for the patient is also a prerequisite for effective management. The Ayurvedic metallic preparations (*Bhasma*) made from metals and minerals are potent and efficient. The aim of this study was to standardize the pharmaceutical process of Swarna Makshika Bhasma (copper pyrites). **Material and methods:** In this study, pharmaceutical processing of *Swarna makshika Bhasma* (processed copper pyrites) was standardized as per *Rasa Tarangini* (classical text book of ayurvedic pharmaceutics). It was subjected to *Bharjana* (frying and roasting) containing lemon juice for 12 h at temperature range between 650°C-800°C. Further, triturated with lemon juice for impregnation of herbal constituents and subjected to the regulated quantum of energy in form of heat (*Marana*) and then in an earthen container and temperature was maintained at 600°C for 30 minutes in first step. Then continuously for next 10 similar steps 700°C temperature was maintained for 30 minutes unless all the consistency of metallic ash (*Bhasma*) with its classical and contemporary parameters was guaranteed. **Results**: The weight loss at full speed was on aggregate 14%. The finished product was Fe_2O_3 in maximum amount, copper sulphide (Cu_2S), $CuFeS_2$, $FeSO_4$ and Fe_3O_4. **Conclusion:** This study perceives the sights of scientific substantiation of ancient Ayurvedic pharmaceutical procedures in requisites of purification, impregnation of herbal constituents and thermodynamic principle.

Keywords: Makshika, Bhasma, Ayurveda, Chalcopyrite, Copper pyrite

Introduction

In the shape of elements, minerals and plants, nature has incredibly useful Medicines. The bulk of medications are not integrated into the biological system until certain improvements are made. Certain advanced procedures are introduced in order to make these medicines therapeutically acceptable and viable. Ayurveda drug processing processes include the Rasa Shastra and Bhaishajya Kalpana disciplines. The essential drug production processes include heating, boiling, quenching, dipping, grinding, distilling, cleaning, filtering etc. The aforementioned protocols are followed during classical operations of *Shodhana*, *Jarana*, *Marana*, *Bhavana*. These techniques play an important and crucial part in the manufacturing of pharmaceutical products. It is said that *Shodhana*(purifactory) process eliminates soluble impurities from the raw material, adds organic materials and significantly decreases toxicity (Rajput et al., 2013).

Swarna Makshika Bhasma (SMB) used as an Aphrodisiac, immunomodulation activity, targeted medication, vocal well-being, anemia and diabetes (Sadanand Sharma, 2012). This study was generated to provide basis for standard operative procedures for preparation of *swarna makshika bhasma*.

Material and methods

Gola Deenanath, Local ayurvedic market of Varanasi, Uttar Pradesh, was recommended by experts for finest quality of *Swarna Makshika* & *Gandhaka* collection. Mercury was obtained from M/s Merck Specialties Pvt. Ltd. The department of Rasa Shastra and Bhaishajya Kalpana, Faculty of Ayurveda, Institute of Medical Sciences, Banaras Hindu University had authenticated a sample of Raw *Swarna Makshika, Parada* & *Gandhaka.*

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Preparation of *Swarna Makshika Bhasma*

The process of *Swarna makshika bhasma* involves two important process namely *Shodhana* of *Swarna Makshika* and *Marana* of *Swarna Makshika.* In this pharmaceutical study we have formulated incinerated therapeutic ash of *Swarna Makshika* known as *Swarna Makshika Bhasma*, to assess the effects of these drugs on Experimental Diabetic Charles foster albino rats.

Refinement and preliminary pharmaceutical procedure of *Swarna Makshika* (*Shodhana* of *Swarna Makshika*

The procedure for the process of *swarna makshika shodhana* was followed as per *Rasa Tarangini. Shodhana* of *Swarna Makshika* was performed by preparation of the liquid media to perform *Bharjana* (Frying & Roasting) of *Swarna Makshika* and then *Shodhita Swarna Makshika* was washed and subjected for further process. For *Shodhana* process fresh lemons were collected from the Market of Sundarpur, Varanasi. The theory of *Nimbu swarasa*(lemon juice) extraction is as alluded to in the *Sharangdhar Samhita*, involving *Nishpidana* (expression)(Sharma, 2012). Lemon was washed properly under tap water. Outer covering, apex and cuticle part were discarded properly by knife. The internal pulp section was put between the two pressing wings and proper manual pressure was applied for maximum extraction. The extracted liquid material was collected in stainless steel vessels. Then the collected liquid material was sieved through cotton cloth and was measured. This measured liquid was used for further processing. Twenty kg of lemon yielded about 6.5 litres of juice used for *Bharjana* (frying and roasting).

By shredding it into a pestle mortar, *Swarna Makshika* (calcopyrite)was reduced to fine powder. The fine powdered *Swarna Makshika* was put in an iron pan over a heating system and extracted lemon juice and cooked on extreme heat (650°C to 800°C). Lemon juice was applied to the drying process intermittently. The stuff was constantly stirred. This process continues until the substance is turned in red bricks color. It took 3 days to do this (everyday 4-hour heating). In the centre of the cup, the substance was concentrated and heat intensified by four hours, using earthen saucer. After that material was left for self-cooling. On completion of 12 hours, next day it was cleaned with warm water and the bottom product was gathered and dried well. The *Shodhita Swarna Makshika* has been weighed and exposed to further substantial use after drying. The whole process of *Shodhana* has been depicted in figure 1 was following the aforementioned process, remaining two batches were prepared.

Marana* (incineration) of *Shodhita Swarna Makshika

Marana was done as the procedure mentioned in *Rasa Tarangini*. Fluid medium was formulated to execute *Bhavana Samskara* (levigation) of *Shodhita* (purified) *Swarna Makshika* was initiated. For incorporating the procedure of *Bhavana* fresh lemon were collected and same procedure was applied as mentioned above in *Shodhan* process. Initial weight of lemon was two kg and extracted juice obtained was 600ml. *Shodhita Swarna Makshika* was placed in a mortar & pestle and shredded well with lemon juice till it was smoothed. When the *subhavita lakshan* (desired properties) emerges, *Chakrikas* (circular disc shaped pellets) was prepared to form this small amount of levigated doughy mass. Diameter, thickness,

Figure 1. Pharmaceutical processing of Swarna Makshika (Shodhana Process)

weight of *Chakrika* (pellet) were 2.0 -2.5 cm, 0.5 - 0.7 cm, 5 -7 gm respectively. Later on, they were dried. Dried pellets in a *Sharava* (earthen saucer) was coated with another *Sharava* (earthen saucer), were measured and arranged. Clay smeared cloth was used for sealing and dried. Total seven-layer coating was followed after drying the preceding coating. The arranged smeared *Samputa* (Closed earthen saucer with another one) was subjected to heat in Electric Muffle Furnace (EMF) at temperature 600°C maintained for 30 min duration. The *Samputa* was taken out of the oven after self-cooling, cleansed and opened. Same process was repeated eleven times to obtain desirable *Swarna Makshika Bhasma.* Bhasma passed every desired completion test mentioned in the classics for the Swarna Makshika Bhasma consistency test after Eleven Putas. i.e., *Varitar* (final product should float on water), *Rekhapurnata* (*bhasma* should enter into the ridges of fingers), *Amla pariksha* (Curd test) etc. Total eleven *putas* were given in this process required to obtain *Swarna Makshika Bhasma* with all desired characteristics mentioned in classics. Prepared *Bhasma* was subjected to Trituration (*mardana*) for one hour in mortar and pestle. Then it was filtered with a cotton cloth, weighed and collected in an air tight container for further procedure (Figure 2).

Results and discussion

Initial amount of *Swarna Makshika* taken for *Shodhana* was 1 kg and 2800 ml of lemon juice was utilized for the *Bharjana* (frying and roasting) for twelve hours duration. The summary of *Shodhana* of *Swarna Makshika* has been mention in table 1, Loss in weight after *Shodhana* was 12.5% and it was due to removal of impurities in form of dust/vapour/fumes.

Before *Shodhana* process Raw *Swarna Makshika* was powdered and evolution of fumes was observed in initial two hour during *Bharjana* (Roasting and frying) process and then fumes subsided. *Makshika* turned into fine powder and brown in colour with shining particle. Sulphur odour was observed when *Swarna Makshika* was heated. On heating up to five-hour colour changed to brick red. The temperature of system observed through pyrometer was 800°C and the temperature of upper surface of pan was around 650°C. Loss was observed due to evaporation of Sulphur. Lemon juice was added as per the requirement during the intermediate procedure. The whole process was on mild heat and stirring was done constantly while roasting.

In roasting and frying phase there is some kind of electrostatic attraction or surface creation of citrate complexes with copper pyrites. The positive charge of metallic ion is decreased by citric acid, thereby suggesting

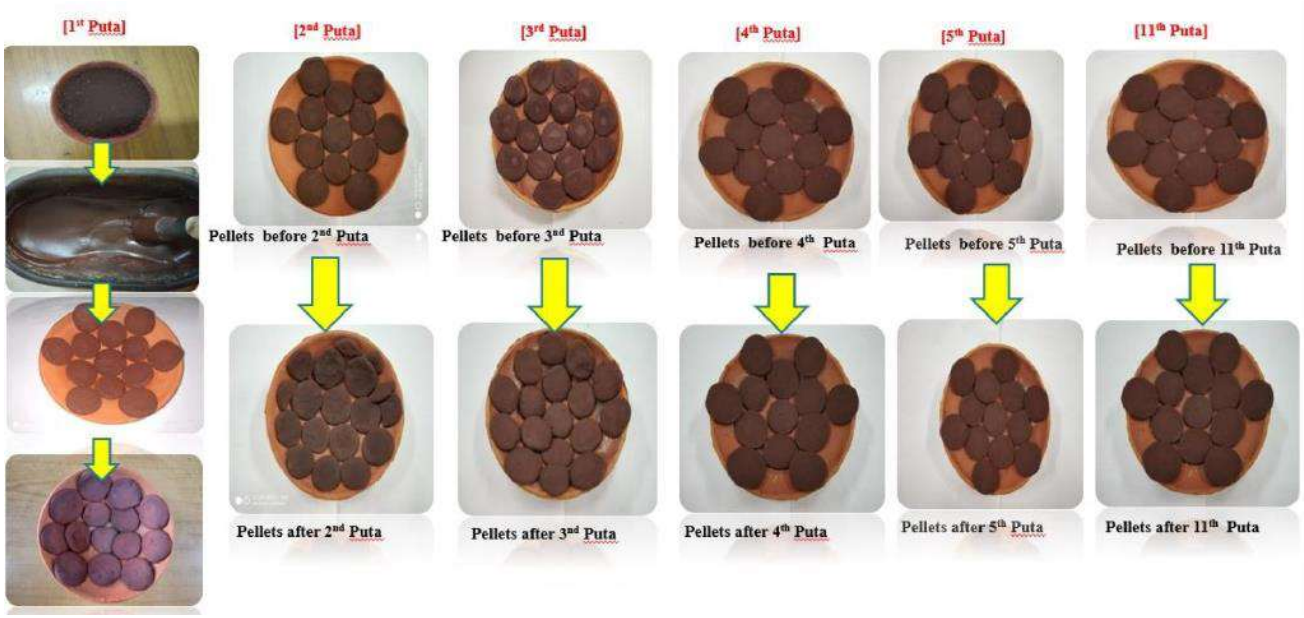

Figure 2. Pharmaceutical processing of Makshika Bhasma (Marana Process)

Table 1. Summary of *Shodhana* of *Swarna Makshika*

Name of media	Quantity of media	Duration of *Bharjana*	Wt. of *Swarna Makshika* before *Shodhana* (g)	Wt. of *Swarna Makshika* after *Shodhana* (g)	% loss
Lemon juice	2800 ml	12 hours	1 kg	875	12.5

Table 2. Summary of *Marana* of *Shodhita Swarna Makshika*

Puta	Amount of Liquid Media	Triturating time	Set temperature (°C)	Reaching duration on ST (Min)	Maintaining time on ST (Min)	Initial wt. of *Swarna Makshika*	Final wt. of *Swarna Makshika*	% loss/Gain
1st	350 ml	6 hour	600	40	30	865	820	5.2
2nd	350 ml	6 hour	700	60	30	820	796	2.9
3rd	400 ml	6 hour	700	65	30	786	772	1.7
4th	450 ml	6 hour	700	55	30	772	768	0.5
5th	400 ml	6 hour	700	60	30	768	759	1.1
6th	400 ml	6 hour	700	54	30	759	760	0.13 G
7th	450 ml	6 hour	700	58	30	760	765	0.65G
8th	500 ml	6 hour	700	60	30	765	752	1.6
9th	450 ml	6 hour	700	45	30	752	746	0.7
10th	450 ml	6 hour	700	48	30	746	743	0.4
11th	450 ml	6 hour	700	45	30	743	743	-

the adsorption on positively charged sites (Di Palma and Mecozzi, 2007). Unpurified *swarna makshika* may contain physical impurities, such as undesirable rock or gangue minerals, standard silicates, or oxides (Baba et al., 2012). Thermal expansion principle indicates that expansion ranges from metal and mineral to heating materials. The expansion of the compound is generally smaller than that of metal. Consequently, continuous heating leads to the splitting into rough to fine powder. By reacting with ambient oxygen, copper and iron are converted to oxide form at a red-hot condition (Faris et al., 2017). For *marana* process 875 g of *shodhita swarna makshika* was taken, the temperature had been fixed at 600°C and sustained for 30 minutes. On completion of first *puta* (regulated quantum of heat in a system), *Chakrikas* were dark brown in color and pellet became harder. Later on, it became light brown and softer after 2nd puta. Pellets prepared more compact, lighter in colour and smoother after 3rd *puta.* Pellets were hard in consistency initially gradually became soft. Till sixth puta decrease in weight of *Swrana Makshika* was noted but after 6th *Puta* and 7th *Puta* increasing in weight was observed. On completion of 11th *Puta* weight remains same.

During the process of bhavana with lemon juice which contains citric acid, it has been stated in some studies that some sort of magnetic coupling is happening among them forming copper and iron complexes with some specific magnetic behavior (anti ferromagnetic or ferromagnetic property), which might be conducive for cellular uptake for better therapeutic activity (Mastropaolo et al., 1976).

The mechanism induces biochemical alteration and the biological media function as selective donor ligand. Changes can be represented in terms of reduction of particle size, conjugation of trace elements, the creation of beneficial compounds, and therapeutic receptor activation of therapeutic components. Puta is a system which is closed in which a heat quantum is generated to induce oxidative addition, reduction and insertion between ingredients present on the system at a given temperature and pressure, volume etc. In chemical thermodynamics, thermodynamic entropy is fundamental to the Clausius equation and the Gibbs free energy equation for reactants and products to be quantified. The second thermodynamic rule notes that entropy in an isolated system increases in all random processes (Today, 2001). Heat can be perceived in accordance with Fourier's law in chakrikas (pellets). Under these laws, a uniform material flow rate is proportional to the surface and the temperature decreases and is reciprocal to the length of the flow line. Thus, instead of circular mass the pellets should be smooth and the diameter of the pellets should be shorter than possible to allow the heat transfer (Law, 1996). Citric acid leaching can be successfully used in order to produce desired treatments from copper pyrites at higher temperatures and normal pressure (Meshram et al., 2020).

Conclusion

The first step in standardizing every medicinal product is pharmaceutical standardization. In the advancement of Ayurvedic pharmaceutical technologies to ensure efficiency, effectiveness and safety, we propose the implementation of this entire central scientific theory involved in the manufacturing process. This study led to an improved interpretation of *Swarna makshika Bhasma's* medicinal preparation in accordance with the Ayurvedic Regimen. The pharmaceuticals in Ayurvedic preparation approaches should be used to consider current ideas and techniques.

Conflict of interest

None

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