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TEMPERATURE STUDY OF *GAJAPUTA* AND *VARAHAPUTA* IN PREPARATION OF *SWARNAMAKSHIK BHASMA*

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ABSTRACT

All herbo-mineral formulations in *Ayurveda a*re subject of *Rasashastra* in concern of pharmaceutical preparation. These formulations have remarkable efficacy in curing chronic and degenerative diseases with a few side effect. For preparation of these herbo-mineral formulation there are various procedures are mentioned in *Rasa* classics. One of very useful and effective herbo-mineral preparation is *Bhasma.* It is prepared from herbs, minerals and metals by calcinations process (*maran*). The uniqueness of the *bhasma* is nano particle nature which make it efficient to treat ailments. In ancient time the procedure which used to convert hardcore material into such a fine form was called *Putapak* or *maran. Puta* was ancient method of incineration. In present study two types of *Putas, Gajaputa* and *Varahaputa* was studied in preparation of *Swarnamakshik Bhasma*. Aim of the study is to make an attempt to standardize the conventional pyrometery (*Puta*) in concern of temperature pattern.

Keywords: *Rasashastra, Puta, Gajaputa, Varahaputa, Bhasma*

INTRODUCTION: *Rasashastra* is one of very important branch of the *Ayurveda* which deals mainly with metals and minerals as well as formulations prepared by herbo-mineral composition. In old literatures of Rasashastra there are many procedures are mentioned to convert hardcore materials into therapeutically useful form e.g. *shodhana, jaran, maran, amrutikaran* and *satvanishkasan* etc. In all the conventional procedures mentioned in the texts, the important thing is "*Agni Samskar*" (fire process). By the means of *Agni Samskar* substances of various hardness can be converted in to such a form that it could be easily acceptable by the living beings. But "*Agni Samskar*" may vary as per the hardness and nature of the material. So it requires controlled heating device. In ancient time the device which was used to convert metals and minerals in the therapeutically useful form was called "*Puta*"."*Putas*" are one of the form of ancient pyrometery. It is an ancient device by which heat was measured and regulated in a controlled way[1]. There are various types of *Putas* are mentioned in literature of *Rasashastra, e.g. Mahaputa, Gajaputa, Varahaputa, Kukkutputa* etc[2]. All these Putas are varied according to their heating amount. *Bhasmas* are very unique and classical preparations of *Rasashastra*. In this preparation hard materials are subjected to heat to convert into ash. *Bhasmikaran* or *Maran* or *Putapaka* is not merely the procedure of calcinations but it also potentiates the material therapeutically[3]. In ancient era "*Putas*" are used for calcinations.To develop standard operative procedure (SOP) for preparation of *Bhasma* it is important to standardize the "*Putas*" (ancient heating device). In present days electrical muffle furnaces are used for *Bhasma* preparation. To set temperature pattern for preparation

of *bhasma* in muffle furnace it is important to study the temperature pattern in conventional method (*Puta*). Therefore in present study standardization of *Gajaput* and *Varahputa* was done in preparation of *Swarnamakshik Bhasm*a especially in concern of temperature pattern.

AIMS AND OBJECTIVE:

To study temperature pattern and standardize *Gajaputa* and *Varahputa* in concern of *Swarnamakshik bhasma* preparation.

MATERIALS AND METHODS:

Collection of raw materials: For the pharmaceutical preparation of *Swarnamakshik Bhasma*, Raw form of *Swarnamakshik* (Chalcopyrite) was collected from Khetari copper mines (Dist. Jhunjhunu Rajasthan, India). For the purpose of *shodhan* of *swarnamakshik*, *matulunga nimbu swarsa* (expressed juice of Citrus medica Linn.) were taken and processed through the described methods[4]. After *shodhan*, material was taken for *maran* (calcinations)by *putapaka*[5]. For the *putpak* artificially prepared cow dung cakes were used as a fuel. The cow dung cakes were standardized on the basis of average weight, average diameter and average thickness of the cake. It was purchased from local merchant. It was made by purely cow's dung.

The study was divided into following manner:

1. Preparation of *Gajaputa* and *Varahaputa*.
2. Preparation of *Swarnamakshik Bhasma*.

1). Preparation of *Gajaputa* and *Varahputa*: For construction of *Gajaputa*[6] and *Varahputa*[7] two square shaped pit of *rajhasta pramana* (size LXDXB- 55.88 (56 approx)X56X56 cm and *aratni pramana* (size LXDXB- 41.91 (42 approx)X42X42cm) were dug in the earth respectively. Internal surface of the pit was coated evenly with fine mud paste (black soil was used) and allowed to dry.

2). Preparation of *Swarnamakshik Bhasma*: Preparation of *Swarnamakshik Bhasma* was divided into following manner:

A). *Shodhan* of *Swarnamakshik*: First *Swarnamakshik* stone was broken with hammer into small pieces. These pieces were converted into coarse powder form with pounding apparatus manually. Then this powder was sieved to get fine powder. This fine powder was taken in an iron container and Lemon juice was mixed in sufficient quantity. Then intense heat was given and stirred continuously till the powder become red hot and juice was evaporated completely. This similar process was repeated for 2-3 days approx 20 times (total 22hrs). After completion of the process, *Swarnamakshik* had become purified.

B). *Bhavana* and *Putapak* of *shodhit Swarnamakshik/ Marana-* After completion of purification, *Maran* was started[8]. *Shodhit Swarnamakshik* was divided into two equal parts/ batches and incinerated by *Gajaput* and *Varahaputa* separately.Following steps were taken to follow SOPs for *marana*.

1. ***Bhavna & mardana*** – Purified *Svarṇamākṣika* was triturated (*mardana*) with freshly prepared and filtered lemon juice in both batches. Required time for mardan in *Varahaputa* and *Gajaputa* was 12- 14 hrs. (3-4 hrs per day). Electric end runner was used for the *mardan* process.
2. ***Chakrika* (pallets) preparation** – After the *mardan*, material was converted

into small round slice (pallets) & it was allowed to dry in sunrays.

3. ***Sharava samputa*** – Dried *chakrikas* were put into earthen vessels (*sharava*). Separate vessels were taken for *Gajaputa* and *Varahaputa* (two for each). These vessels were covered with earthen lids and sealed with clay-smeared cloth. Then both vessels were allowed to dry. For identification symbol of "V" & "G" was made on vessels of *Varahaputa* and *Gajaputa* respectively.

4. ***Puta* arrangment** – Cow dung cakes were used for *Putapaka*.After *sharava samputana* 2/3rd part of *varaha* and *Gajapta* were filled properly with cow dung cakes. Then both *sharava* were put above the cakes in both separate *Putas*. An iron pipe was placed in a manner that lower end of the pipe should be in contact with outer surface of the *sharava* . Then both *sharava* were covered with cow dung cakes by all sides. So remaining 1/3rd part of *Varahaput* and *Gajaputa* were filled with cakes. Upper end of the pipe was free for insertion of pyrometer rod to record temperature variation.

5. ***Putapaka*** – After proper arrangement of *Puta*, pyrometer rod was inserted into the pipe to record initial temp. Then fire was ignited. Temperature was recorded half hourly till cow dung cakes were burnt completely and *Puta's* temperature returned to normal room temperature. After achieving normal room temperature, vessels were taken out of *Puta* and seal was opened, *chakrikas* were collected and weighed.

There were 10 times, process of incineration were repeated in both *Gaja* and *Varah putas*. In each *Putas* temperature pattern was recorded by pyrometer. Changes in incinerated *Swarnamakshik* were observed after each *putapak*.

OBSERVATION AND RESULTS:

The observation and results of *Swarnamakshik shodhan* (table 1), Cow dung cake (table 2), *Marana* of *shuddha Swarnamakshik* by *Varahaputa* (table 3) and by *Gajaputa* (table 4) are documented. Comparative temperature chart is mentioned in table 5. Results of organoleptic and classical *bhasma* examinations of the raw material, intermediate product and finished products are also given in table no. 6 and 7 respectively.

Table 1. *SM Shodhan*

Media used for *shodhan*	Approx quantity of the media	Name of the procedure	Weight of SM (in grams)		Loss/ gain after procedure	Total required time	Color / luster / odor	
			Before	After			before	After
Lemon juice	9.5 liter	*Nirvapana* (immersion) and bharjan (roasting)	1000 gms	870 gms	130 gms	Total 23 hrs (7- 8 hrs per day) completed in 3 days	-Brownish black, -Lustrous -Sulfur odor	-Brick red -no luster -odor-less

Table 2. Standardization Cow dung Cakes

Material used	Made by	Average/ mean weight (in gm)	Average/ mean diameter (in cm)	Average/ mean thickness (in cm)
Pure Cow's dung	Hand made	228	18.8	3.1

Table 3 *SM Marana*: Temperature study of *Varaha Puta*

Puta number	Used Cow's Dung Cake	*Bhavna dravya*	*Mardana* kal in (hrs)	Peak of temperature	Peak achieved at hrs (after ignition of fire)	Temp. at 21st hrs (after ignition of fire)
Varaha puta I	80	Fresh Lemon juice	13	886°C	4.35 hrs	49 °C
Varaha puta II	65	--,,--	14	854 °C	3.30 hrs	47 °C
Varaha puta III	65	--,,--	13	840 °C	2.40 hrs	57 °C
Varaha puta IV	65	--,,--	12	887 °C	2.27 hrs	48 °C
Varaha puta V	65	--,,--	12	882 °C	3.30 hrs	57 °C
Varaha puta VI	65	--,,--	12	897 °C	3.03 hrs	50 °C
Varaha puta VII	65	--,,--	12	879 °C	2.38 hrs	72 °C
Varaha puta VIII	65	--,,--	12	902 °C	2.45 hrs	81 °C
Varaha puta IX	65	--,,--	12	889 °C	2.05 hrs	69 °C
Varaha puta X	65	--,,--	13	876 °C	2.30 hrs	62 °C

Table 4 *SM Marana*: Temperature study of *Gaja Puta*

Puta number	Used Cow's Dung Cake	*Bhavna dravya*	*Mardana* kal in (hrs)	Peak of temperature	Peak achieved at hrs (after ignition of fire)	Temp. at 21st hrs (after ignition of fire)
Gaja puta I	150	Fresh Lemon juice	13	1049°C	5.38 hrs	78°C
Gaja puta II	135	--,,--	12	997°C	3.12 hrs	60 °C
Gaja puta III	135	--,,--	14	1180°C	3.15 hrs	58 °C
Gaja puta IV	135	--,,--	14	1007 °C	3.39 hrs	49 °C
Gaja puta V	135	--,,--	12	1011 °C	3.33 hrs	44 °C
Gaja puta VI	135	--,,--	12	997 °C	3.10 hrs	76 °C
Gaja puta VII	135	--,,--	12	1017 °C	3.07 hrs	78 °C
Gaja puta VIII	135	--,,--	12	1002 °C	3.05 hrs	66 °C
Gaja puta IX	135	--,,--	12	1006 °C	3.04 hrs	70 °C
Gaja puta X	135	--,,--	12	991°C	2.55 hrs	64 °C

Table 5-a: Loss or gain in *Marana*

Puta	Weight of Shodhit SM (before Putapak) (in gm)	Weight of obtained SM *Bhasm* (after Pu-tapak) (in gm)	Loss (in gm)
Varaha puta	430	405	25
Gaja puta	430	390	40

Table 5-b: Average temperature study of *Varah Puta & Gaja Puta*

Time (Hr.)	Average VP	Average GP
0.00	33	34
0.30	203	134
1.00	460	371
1.30	595	564
2.00	690	707
2.30	769	851
3.00	818	928
3.30	794	930
4.00	755	884
4.30	708	815
5.00	650	746
5.30	608	703
6.00	574	652
6.30	541	592
7.00	509	535
7.30	491	494
8.00	457	459
8.30	428	427
9.00	403	399
9.30	377	372
10.00	352	349
10.30	325	329

Time (Hr.)	Average VP	Average GP
11.00	304	315
11.30	287	296
12.00	266	279
12.30	248	261
13.00	234	244
13.30	220	230
14.00	204	215
14.30	187	198
15.00	171	182
15.30	158	167
16.00	147	154
16.30	136	139
17.00	124	124
17.30	114	111
18.00	104	101
18.30	95	92
19.00	87	85
19.30	80	78.1
20.00	72	72.3
20.30	65	67.9
21.00	59	64.3

Table No. 6: Classical organoleptic examination of these samples.

Sample	*Shabda*	*Sparsa*	*Rupa*	*Rasa*	*Gandha*
Raw SM	*Dantagre Kacakaca*	*Khara*	*Swarnabh dhusar Varna* (Slightly metallic lustre)	*Isat kasaya or nirasa*	Lohagandhi (slightly sulpher smell)
Pure SM	*Dantagre Kacakaca*	*Khara*	*Raktabh kṛashṇa*	*Nirasa* (tasteless)	*Nirgandha*
III VP	*Dantagre Kacakaca*	*Khara &Slakshṇa*	*Raktabh krashna*	*Nirasa* (tasteless)	*Nirgandha*
III GP	*Dantagre Kacakaca*	*Ishat Khara*	*Kṛashṇabh rakta*	*Nirasa* (tasteless)	*Nirgandha*
VI VP	*Dantagre Kacakaca*	*Slakshṇa*	*Raktabh*	*Nirasa* (tasteless)	*Nirgandha*
VI GP	*Dantagre Kacakaca*	*Slakshṇa*	*Raktabh (arunabh)*	*Nirasa* (tasteless)	*Nirgandha*

Sample	*Shabda*	*Sparsa*	*Rupa*	*Rasa*	*Gandha*
X VP	*Dantagre kacakaca bhava*	*Slakshṇa*	*Raktabh*	*Nirasa* (tasteless)	*Nirgandha*
X GP	*Dantagre kacakaca bhava*	*Slakshṇa*	*Raktabh*	*Nirasa* (tasteless)	*Nirgandha*

Table No. 7: Classical bhasma pariksha-

Sample	*Rekha-purṇatva*	*Varitara*	*Slakshṇatva*	*Apunar-bhava*	*Nishchandra*	*Amla pariksha*
Raw SM	-ve	-ve	-ve	Not done	-ve (metallic luster pre-sent)	Not done
Pure SM	-ve	-ve	-ve	Not done	+ve	bluish tinge appeared
III VP	Partially +ve	-ve	Partially +ve	Not done	+ve	Not done
III GP	Partially +ve	-ve	-ve	Not done	+ve	Not done
VI VP	+ve	-ve	+ve	Not done	+ve	Not done
VI GP	+ve	-ve	Partially +ve	Not done	+ve	Not done
X VP	+ve	+ve (par-tially)	+ve	+ ve (not found any free metal)	+ve	No bluish tinge ap-peared
X GP	+ve	+ve (par-tially)	+ve	+ ve (not found any free metal)	+ve	No bluish tinge ap-peared

DISCUSSION : Specifications of *Gajaputa* was square shaped pit of size LXDXB- 55.88 (56 approx)X56X56cm and *Varahaputa* was square shaped pit of size LXDXB- 41.91 (42 approx)X42X42cm[9]. Due to less availability of the natural cow dung cakes (*aranyopala*), handmade cow dung cakes were used for *Putapaka*. So the specifications of handmade cow dung cakes were established on the base of mean weight (228 gm), diameter (18.8 cm /19 cm approx)and thickness (3.1 cm)of the cakes. After purification hard, stony, lustrous and golden gray raw *Swarnamakshik* converted in to brick red color, non lustrous and powder form. In *marana* by *gajaputa* and *varahaputa* temperature was recorded for 21 hrs. at half hour interval. Temp. reading was showing the temperature of surroundings of the *sarava* in respective Putas. Minimum peak temp. was observed in 3rd *Varāhapuţa* (840^{0}C) & 10th *Gajaputa* (991^{0}C) where as maximum

peak was observed in 8th *Varāhapuţa* (902^{0}C) & 3rd *Gajaputa* (1180^{0}C). Time duration for achieving the peak temp. shows variation in every *Putas*. This variation may be due to difference in consistency of dung cakes or little bit difference in pattern of arrangement of the dung cakes during puţapāka. More cow dung cakes was used in first *Varāhapuţa* and first *Gajaputa* so peak was achieved at 4.35 hrs and 5.38 hrs respectively. Apart from these factors, some other factors like environmental temperature, air ventilation, humidity etc may also responsible for little bit variation to achieving the peak temperature in every *Puta*. Cooling pattern are almost similar in all *puta*.

After completion of pharmaceutical preparation intermediate products and finished product were analyzed by classical method (*bhasma pariksha vidhi*)[10]. Classical orgenoleptic examination shows changes in physical properties of the *bhasma*, on the basis of *shabda*, *sparsha*, *rupa*, *rasa* and *gandha*. Test of *dantagrekachakachabhava* shows almost negligible sound was present in the *bhasma* of 10th *gajapuţa* and *varahapuţa*. Final *bhasma* of both puta was very smooth (*slakşņa)* than intermediate sample. In both putas blackish brown powder was converted into reddish brown *bhasma*. All intermediate samples and finished product were tasteless and without any peculiar odour. Classical test for *bhasma* showed significant changes. Intermediate sample (of 6th *Gajapuţa* and *Varāhapuţa*) showed rekhapurna pariksha partially positive. Where as both finished products (*Bhasma* after 10th *Gaja* and *Varahaputa*) show complete positive *rekhapurnatva*. *Varitar* test is partially positive for both finished product. *Apunarbhava* test of both finished product successfully accomplished, no any free metallic particle was observed. In *amla pariksha* no any bluish tinge was appeared in both finished products, where as slightly bluish tinge was observed in the test of purified *Swarņamakshika. Bhasma* obtained after 10th *gaja* and *varahaputa* has the quality of *slakshņatva* (smoothness), *mŗadutva* (softness) and *nishcandŗatva* (free from lustre). So all the classical organoleptic and bhasma examination have been successfully accomplished. Both finished product has shown satisfactory results. Though all these classical tests are based on only physical properties of the *bhasma*, but the significance of these tests is that, *bhasma* can be obtained in such a form that it could be easily acceptable for body system without any toxic effects.

CONCLUSION: After completion of the temperature study, it can be conclude that there are variation in achieved peak temperature in both *putas*. In *varaha Puta* peak temperature could be vary from 840^{o}C to 902^{o}C and in *Gajaputa* 991^{o}C to 1180^{o}C. Study also shows after performing classical *bhasma pariksha* that the *bhasma* prepared by both *putas* passes tests positively.

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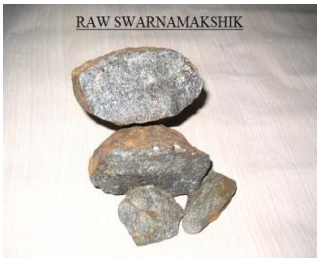
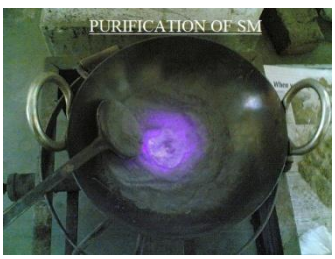


RAW SWARNAMAKSHIK)

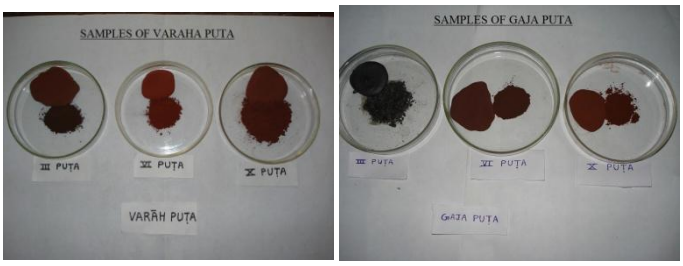
(VARAHAPUTA)

(GAJAPUTA)



(PURIFICATION OF SM)

(PUTA ARRANGEMENT



(SM SEMPLES)

(REKHAPURNATA)

(VARITARATVA)

(AMLA PARIKSHA BEFOR MARAN)

(AMLA PARIKSHA AFTER 10th PUTA)