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RESEARCH ARTICLE

COMPARATIVE PHARMACEUTICO-ANALYTICAL STUDY OF SWARNAMAKSHIKA BHASMAS.

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Abstract

Swarnamakshika has been described in the treatment of Panduroga in almost all the classics of Ayurveda. Presently India is leading in the world in the context of iron deficiency anaemia because more than 50% of its population is suffering from it. Swarnamakshika Bhasmas prepared by different shodhana (RT 21/7-11, RRS 2/83 and RT 21/18) and marana processes (RT 21/21-22, RT 21/19-20 & RT 21/23-25) were analyzed and compared on physico chemical parameters, XRD, SEM, ICP-MS etc conducted at IIC, IIT, Roorkee and Science College, Patna. It could be a drug of choice for the treatment of anaemia due to easy availability and cheaper price.

Introduction:-

Presently India is leading in the world in the context of iron deficiency anaemia because more than 50% of its population is suffering from it[i]. This silent killer is very common among Indian rural population due to poor socioeconomic status, inadequate dietary habits, worms infestation and GI bleeding[ii]. The IFA programme was launched way back in 1970. Despite this incidence of anaemia in India during pregnancy has been noted as high as 40-80%. 15-22% of maternal mortality has been estimated due to anaemia during pregnancy *(Source- Health Information of India, 2004).* A 2007 Indian government "12 by 12 initiative", aimed at ensuring that all Indian adolescents have 12 g/dL haemoglobin by 2012, listed the main causes of anaemia in India as low dietary intake, poor availability of iron, chronic blood loss due to hookworm infestation, and malaria[iii]. Iron deficiency causes defective haemoglobinasation leading to Microcytic Hypochromic Anaemia[iv].

Rasa Shastra, as rightly called the "**Back Bone of Ayurveda"** deals with the knowledge of alchemical and pharmaceutical processes. Here, *Rasaushadhies* (herbomineral drugs) made of metals, minerals and different poisonous herbal substances are used for treating diseases. These are preferred over *Kashthaushadhies* (herbal drugs) because of their certain innate qualities like instantaneous therapeutic action even when used in low doses, tastelessness (not unpalatable)[v].

Swarnamakshika (Chalcopyrite or $CuFeS_2$), mentioned in the *Maharasa Varga* in *Rasa Shastra*, is a compound of copper, iron and sulphur. It has been described for the treatment of *Pandu Roga* i.e. Iron Deficiency anaemia in

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various classics of *Ayurveda*[vi]. It contains extrinsic factors[vii] such as copper and iron required for the formation of haemoglobin. Copper is an essential trace element exists in the diet and is needed to absorb and utilize iron[viii]. The importance of copper as a supplement to iron for haemoglobin regeneration in anaemic rats has already been established[ix]. This discovery revealed the utility of small amount of copper in the treatment of Microcytic Hypochromic Anaemia. Being a ***Saumyakalpa***[x] of iron it is easily digestible and hence widely used in infants, pregnant, lactating women and frail old people. Easy availability and cheaper price makes it a drug of choice for the treatment of *Pandu Roga* i.e. IDA.

In *Rasa Shastra*, *Shodhana* (Purification/ Detoxification/ Potentiation) is the process of removing the impurities and toxicities of metals and minerals[xi] by means of *Swedana, Bharjana, Bhawana, Mardana, Prakshalana, Avapa, Nirvapa* etc and potentiating the efficacy by adding the qualities of liquid media in which it is done. So in this study, two different methods of *Shodhana* (i.e. *Swedana in Kadalikanda Swarasa and Bharjana in lemon juice)* have been done.

Marana or *Bhasmikarana* (Incineration/ Calcination) is the process of converting the already purified metals and minerals into ashes i.e. *Bhasma*. The whole process of Marana can be summarised in the following manner. The purified material is subjected to *Bhawana* (Wet levigation in the specified liquid media) → formation of *Chakrika* (pelletization) → *Sharava Sampootikarana* (Drying and closing in between two earthen lids)→ *Putapaka* (specialised conventional heating system) → *Bhasma* formation. Through the process of *Marana*, the purified material becomes detoxified, easily digestible, absorbable, assimilable and finally excreted if consumed in extra quantity which are quintessential for any drug[xii]. Incineration of metals with mercury results in *uttama* (top quality) *bhasma*, with herbs results in *madhyama* (middle quality) *bhasma*, with sulphur and other substances results in *adhama* (low quality) *bhasma*[xiii]. Incineration with *arilohas* and other substances results in *durguna* (causing harmful effect) *bhasma*. Keeping this in mind, three different ways of *marana* were adopted here to evaluate their comparative pharmaceutical and analytical study.

Pharmaceutical study:-

Aims and Objectives:-

The prime objective of the present study was to develop a SOP (Standard Operative Procedure) for the preparation of *Swarnamakshika Bhasma* by adopting different methods of *shodhana* and *marana.* Further it was also aimed to produce a safe, effective and quality drug for the treatment of *Pandu Roga* i.e. Iron Deficiency Anaemia. The materials used and the methods adopted was decided on the basis of references in the classical literatures, easy availability of raw materials, cost feasibility of the methods, traditional experiences as well as expert opinions.

Material and Methods:-

Procurement- Raw *Swarnamakshika* was provided by the P.G. department of *Rasa Shastra & Bhaishjya Kalpana,* Government Ayurvedic College & Hospital, Patna.

Physical characteristics of *Swarnamakshika*-

Colour-Brownish black
Odour- Nil
Texture- Crystalline

The whole process has been divided in two parts- 1) Shodhana & 2) Marana

1) *Shodhana* of *Swarnamakshika* by two methods-

- *Swedana* (boiling under liquid bath) in *Kadalikanda Swarasa*[xiv-xv]
- *Bharjana* (roasting) in lemon juice[xvi]

2) *Marana* of *Swarnamakshika* by three methods-

Here, three different methods of *marana* of *Swarnamakshika* were adopted as mentioned in the book *Rasa Taringini*[xvii]. These three methods were selected on the basis of different processes of *marana* of metals and their quality/efficacy given in *Rasa Ratna Sammuccaya (Ref- RRS 5/14).* After final incineration comparative pharmaceutical study will be done-

- RT 21/ 21-22 *(Kanishtham gandhakadibhih)*
- RT 21/ 23-25 *(lohanam maranam shreshtham sarvesham rasabhasmana)*
- RT 21/ 19-20 *(moolibhih madhyamam prahuh)*

Observation and Results-

Table no- 1: Comparative study of the two processes of *Shodhana* of raw *Swarnamakshika*

S. No	Methods adopted for *shodhana*	Weight of *Makshika* (in gm)		%age Change		Time taken
		Before shodhana	After shodhana	%age gain	%age loss	
1	Swedana with kadalikand swarasa *(Ref- RT 21/ 18 and RRS 2/83)*	1250	1110	88.8	11.2	2hrs×3 times = 6hrs
2	Bharjana with nimbu swarasa *(Ref- RT 21/ 7-11)*	1250	1090	87.2	12.8	2 hrs

Table no- 2: Showing Marana of Swarnamakshika (Sample-I) *Ref- RT 21/ 21-22*

No. of Puta	Swarnamakshika (wt in gm)	Shuddha Gandhaka	Nimbu Swarasa (in ml)	Wt of Chakrika (before puta)	Wt of Chakrika (after puta)	Colour
1	250	250	100	520	223	Brownish red
2	223	223	100	500	205	Brownish red
3	205	205	80	440	190	Brownish red
4	190	190	80	400	182	Red
5	182	182	80	380	176	Red
6	176	176	60	350	170	Red

Table no- 3: showing Marana of Swarnamakshika (Sample-II) *Ref- RT 21/ 21-22*

No. of Puta	Swarnamakshika (wt in gm)	Shuddha Gandhaka	Nimbu Swarasa (in ml)	Wt of Chakrika (before puta)	Wt of Chakrika (after puta)	Colour
1	250	250	100	550	220.8	Brownish red
2	220.8	220	100	470	200.5	Brownish red
3	200.5	200	80	446	186	Brownish red
4	186	186	80	405	178.6	Red
5	178.6	178.6	80	365	171.2	Red
6	171.2	176	60	350	163.7	Red

Table no- 4: showing Marana of Swarnamakshika (Sample-III) *Ref- 21/23-25*

No. of Puta	Swarnamakshika (wt in gm)	Shuddha Hingula (wt in gm)	Nimbu Swarasa (in ml)	Wt of Chakrika (before puta)	Wt of Chakrika (after puta)	Colour
1	750	93.75	250	890	670.8	Reddish Brown
2	670.8	84	220	810.2	648.9	Reddish Brown
3	648.9	81	200	780.4	621.5	Brownish red
4	621.5	77	180	743	595.6	Brownish red
5	595.6	75	180	710	575.1	Brownish red
6	575.1	72	150	662	543.2	Brownish red
7	543.2	68	150	630	521	Brownish red
8	521	65	150	598	505	Brownish red

Table no- 5: Showing Marana of Swarnamakshika (Sample-IV) *Ref- 21/19-20*

No. of Puta	Swarnamakshika (wt in gm)	Nimbu Swarasa (in ml)	Wt of Chakrika (before puta)	Wt of Chakrika (after puta)	Colour

1	750	250	810	670.8	Brownish red
2	670.8	200	730	630.5	Brownish red
3	630.5	200	720	605.8	Brownish red
4	605.8	200	700.5	584	Red
5	584	180	680	570.2	Red
6	570.2	180	650.6	550	Red
7	550	180	640	538.6	Red
8	538.6	180	605.2	511	Red
9	511	150	580	493.2	Red
10	493.2	150	550	470	Red

Flow Chart showing Pharmaceutical study of Swarnamakshika bhasma Raw Swarnamakshika

↓ ↓

Shodhana by Swedana (with *Kadalikanda swarasa* for 2hrs) | *Shodhana by Bharjana* (with *Nimbu swarasa* for 2hrs×3times)

↓

Shuddha Swaranamakshika obtained and used for *Marana* through

↓ ↓ ↓

(Ref- RT21/21-22) *Bhawana* (with *Nimbu Swarasa*) **Added-** (Equal amount of *Shuddha Gandhaka)*

(Ref- RT21/23-25) *Bhawana* (with *Nimbu Swarasa*) **Added-** (*Shuddha Hingula* 1/8th part)

(Ref- RT21/19-20) *Bhawana* (with *Nimbu Swarasa*) **Added-** (only *Nimbu Swarasa*)

↓

Pelletized and dried

↓

Sharava Samputikarana

↓ ↓ ↓

Subjected to *Puta* (6) | Subjected to *Puta* (8) (By conventional method) | Subjected to *Puta* (10)

↓ ↓ ↓

Sample I & II Red | **Sample III** Red | **Sample IV** Brownish Red

Swarnamakshika Bhasma obtained

Analytical study:-

Analytical study of a product provides some standards to judge its quality as well as interprets the pharmacokinetics and pharmacodynamics of the same. Main aim of this study is to find out the physico-chemical changes and interpret the effect of different samskaras (*shodhana, marana etc*) during the pharmaceutical processing.

In *Ayurveda,* use of metallic and herbomineral preparations for therapeutic purposes were mainly based on clinical observations. Ancient scholars had scientific vision regarding safe use of these preparations. So different parameters for examining the purity of bhasma have been mentioned in Textbooks of *Rasa Shastra* e.g.*Varitara, Rekhapurnatwa, Apunarbhava, Uttama, Niruttha, Mrtaloha* etc[xviii].

Mere efficacy without safety is of no use. In this scientific era, people have become quite concerned regarding the safety of the drugs consumed by them. Hence it is necessary to know the nature of the drug, which we prescribe to our patients. For knowing whether it contains any harmful substance or not, analytical study of the metallic or herbomineral drugs is mandatory. Detection of the presence of any free metal in *Bhasma* is quite essential as free metals are considered highly toxic for the vital organs of the body.

Plan of study:-

The samples were evaluated on classical as well as modern analytical parameters. For modern analytical study, parameters mentioned in Protocol for Testing (Ayurvedic, Siddha & Unani Drugs, published by department of AYUSH, Government of India in collaboration with Pharmacopoeial Laboratory for Indian Medicine, Ghaziabad),

were followed. *Swarnamakshika Bhasma* prepared by two different Shodhana (RT 21/7-11, RRS 2/83 and RT 2/18) and three different Marana processes (RT 21/ 21-22, RT 21/ 19-20 & RT 21/ 23-25) were analyzed and compared on the basis of physico-chemical parameters, XRD, SEM, ICP-MS studies etc conducted at Institute Instrumentation Centre, Indian Institute of Technology, Roorkee and Science College, Patna.

Table no-6: Organoleptic Characters of Swarnamakshika Bhasma

S. No	Parameters	Textual References		
		RT 21/21-22	RT 21/ 19-20	RT 21/ 23-25
1	Varna	Red	Red	Red
2	Sparsha	Smooth	Smooth	Smooth
3	Rasa	Tasteless	Tasteless	Tasteless
4	Gandha	Not specific	Not specific	Not specific

Table no-7: Classical analytical tests of different samples of Swarnamakshika Bhasmas

S. No	Parameters	Textual References		
		RT 21/21-22	RT 21/ 19-20	RT 21/ 23-25
1	Gatarasatva	++	++	++
2	Rekhapurnatva	++	++	++
3	Varitara	++	++	++
4	Slakshnatva	++	++	++
5	Dantagre kachkachabhawam	++	++	++

Table no-8: Showing the pH of different samples of Swarnamakshika Bhasmas

	Sample I	Sample II	Sample III	Sample IV
pH value	6.1	6.0	5.8	6.2

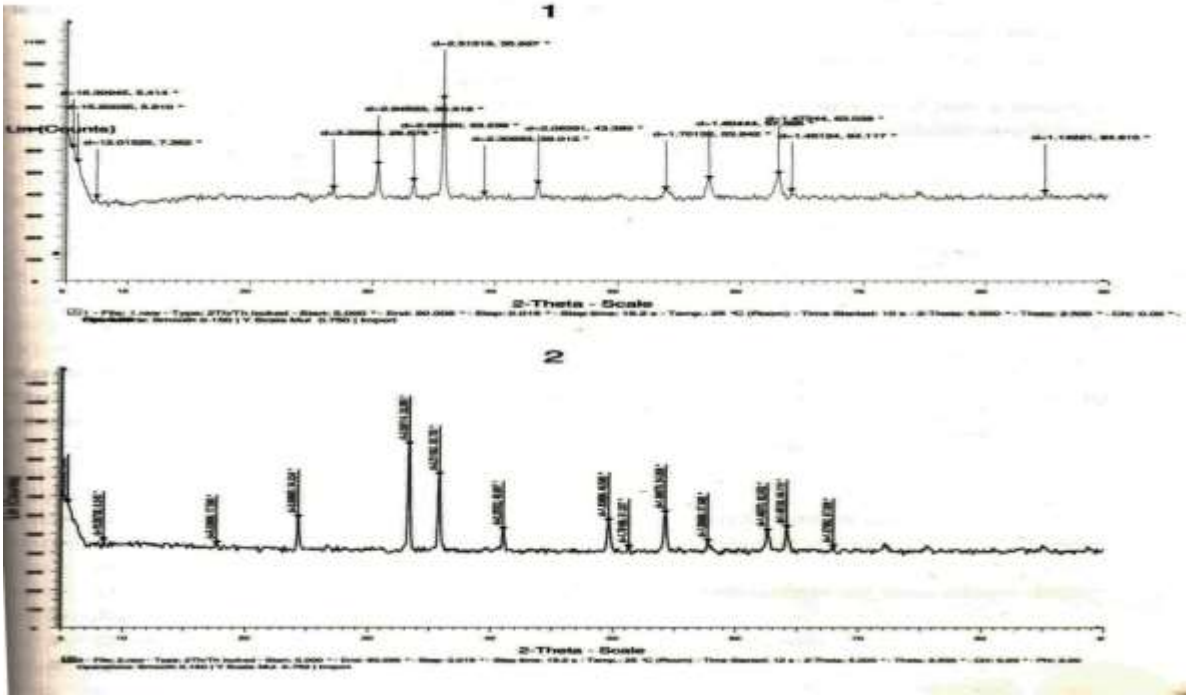
Table no-9: Showing the analytical data on physicochemical parameters of different samples of Swarnamakshika Bhasmas

Samples	Loss on drying (% W/w)	Ash Value (% w/w)	Acid insoluble ash (%w/w)
Swarnamakshika (Raw drug)	4.5	74.8	24.2
Shodhita Swarnamakshika (by Swedana)	2.2	88.6	19.5
Shodhita Swarnamakshika (by Bharjana)	2.1	90.6	18.3
Swarnamakshika Bhasmas (RT 21/21-22) Sample I	0.88	97.2	19.0
Swarnamakshika Bhasmas (RT 21/21-22) Sample II	0.82	98.2	14.6
Swarnamakshika Bhasmas (RT 21/ 23-25) Sample III	0.45	96.5	23.2
Swarnamakshika Bhasmas (RT 21/19-20) Sample IV	0.56	98.8	22.3

X-Ray diffraction study (XRDS):-

X-ray diffraction is a tool for investigation of the fine structures of the crystals. When a focussed X-ray beam interacts with planes of atoms, some part of the beam is transmitted, some is absorbed, some is refracted and some part is diffracted. X-rays are diffracted by each mineral differently, depending upon the atoms that make the crystal lattice and how these atoms are arranged.

This resulting analysis is described graphically as a set of peaks with one percent intensity on the Y-axis and goniometer angle on X-axis. The exact angle and the intensity of a set of peaks are unique to the crystal structure which is under examination. XRD characterisations of different samples of *Swarnamakshika Bhasma* are given below-



- **Figure no- 1**: Showing the XRD pattern of **Sample III** i.e. *Kadalikanda swarasa shodhita Swarnamakshika Bhasma* in which trituration is done with *Hingula & Nimbu Swarasa* (Ref- RT21/23-25)
- **Figure no- 2:** Showing the XRD pattern of **Sample IV** i.e. *Nimbu swarasa shodhita Swarnamakshika Bhasma* in which triturition is done with only *Nimbu Swarasa* (Ref- RT21/19-20)
- All peaks of XRD results were identified Fe_2O_3 which shows strong peaks with high intensity in both the samples.

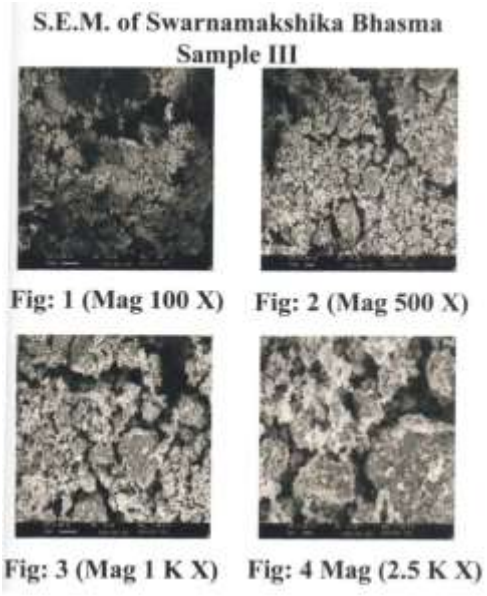
Results:- *Swarnamakshika* which is chalcopyrite basically shows different complex compounds which completely get turned into oxides of iron and copper (Fe_2O_3) finally and this comparison observed in XRD results of final *Bhasma* in both the samples.

Field Emission Scanning Electron Microscopy (FESEM) study:-

It provides topographical and elemental information at magnification of 10x to 3,00,000x, with virtually unlimited depth of field. Compared with Scanning Electron Microscopy (SEM), it produces a clearer less electrostatically distorted images with spatial resolution down to 1.5 nm. It is 3-6 times better than the conventional SEM. So it is used for ultra high magnification imaging. The high resolution reached by FESEM (~ 2nm) allows the study of very small structural details. There is various application of this instrument but as far as *Rasa Shastra* is concerned, it is mainly used in the morphological analysis i.e. in knowing the shape and size of particles and qualitative elemental analysis. Besides this it is used in the localization of boundaries between regions of different atomic number.

Results:-

The results of SEM of the two samples of *Swarnamakshika Bhasmas* (prepared by two different Shodhana & Marana processes) are shown in the Plate no. 1 & 2. These samples were analyzed at IIC, IIT, Roorkee.



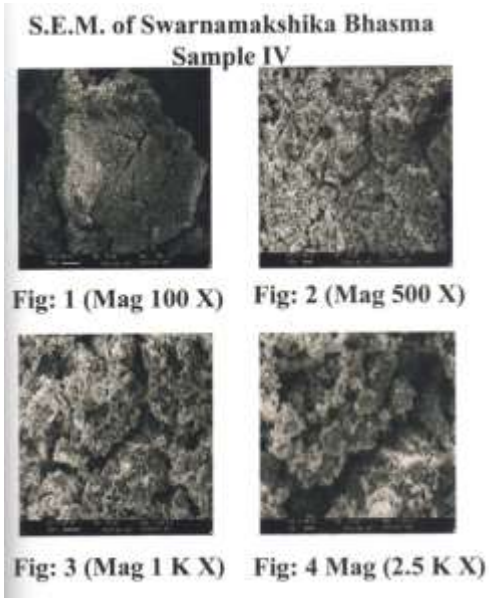


Plate no 1 & 2:- Showing Comparative SEM Study of Swarnamakshika Bhasma of Sample- III *(Ref- RT 21/21-23)* & Sample- IV *(Ref- RT 21/19-20)*

Figure no-1 SMB at 100× magnification
Figure no-2 SMB at 500× magnification
Figure no-3 SMB at 1000× magnification
Figure no-4 SMB at 2500× magnification

After going through the SEM study of both the samples (as received by the IIC, IIT, Roorkee) it was observed that-

- Most of the particles in all the photographs are in the range of 100nm-5µ.
- There is large amount of 2-5µ sized homogeneous particles.
- There are also very fine particles observed which are in the range of nano particle size.
- Most of the particles are in the nano range less than 80nm.
- There is agglomeration of fine nano particles.

Result:-

The methodology employed for the preparation of Swarnamakshika Bhasma by different methods yields nano particles in general.

Inductively Coupled Plasma Mass Spectrometry (ICP-MS):-

It is considered as the most reliable and latest method for the quantitative elemental analysis available till date. The primary goal of ICP is to get elements to emit characteristic wavelength specific light which can then be measured. The intensity of wavelength specific light is compared to previous measured intensities of the known concentration of elements and the concentration is computed. This method is used to determine Arsenic, Cadmium, Lead, Mercury, Copper etc in any herbomineral or metallic drug.

Observation and Results:-

The concentration of different elements (in %age) in the two samples of *Swarnamakshika Bhasmas* are given here. This analytical study through ICP-MS was done at IIC, IIT, Roorkee.

Table no- 10:- Showing the comparative data of %age of different elements present in the two samples of Sarnamakshika Bhasma as obtained through ICP-MS studies.

Elements	Swarnamakshika Bhasma (RT 21/ 23-25) Sample III	Swarnamakshika Bhasma (RT 21/19-20) Sample IV
Sodium (Na)	0.178	0.156
Potassium (K)	0.267	0.245
Arsenic (As)	0.128	0.690

Iron (Fe)	18.899	16.534
Copper (Cu)	0.031	0.031
Lead (Pb)	0.040	0.461
Zinc (Zn)	0.318	0.252
Cromium (Cr)	0.013	0.016
Manganese (Mn)	0.034	0.039
Magnesium (Mg)	0.292	0.192

It can be concluded from the above data that %age of heavy metals are within the permissible limit as per the GMP guidelines in both the samples of Swarnamakshika Bhasma.

Discussion:-

In the pharmaceutical study, a SOP (standard operative procedure) for the preparation of *Swarnamakshika Bhasmas* by adopting different methods of purification and incineration has been taken. Here two different methods of purification (Shodhana) and three different processes of incineration (Marana) have been undertaken for the final preparation of Bhasma. The hypothesis behind the selection of these different methods was made on the basis of easy availability of raw materials, minimum labour involvement, less total time in the whole procedure, cheap cost of processing. There was also a thought to increase the iron content in the manufactured drug. Finally its easy absorption through the gut was also kept in mind behind adopting these Shodhana and Marana procedures.

In the present study, two methods of purification were adopted (Table no-1). In the first method of *Shodhana* through *Swedana* (heating under liquid bath), total 1110 gms of *shuddha Swarnamakshika* was obtained from 1250 gms of *ashuddha* one. In this method 11.2% weight loss was observed. Total time taken was approximately 6 hrs. In the 2nd method of *Shodhana*, 1090 gm *shuddha swarnamakshika* was obtained from 1250 gm *ashuddha* one. Here 12.8% weight loss was observed. The loss might have occurred due to the hammering of *ashuddha Swarnamakshika* to make it coarse powder before the initiation of the process of *Shodhana*. More loss was observed in the *Bharjana* process. The cause of it might be the total time taken in the procedure is more compared to the *Swedana* procedure. Further the acidic media of lemon juice in might have caused more loss in the *Bharjana* process. Some amount of the material might have been lost during the repetition of the process.

Marana (Incineration) of *Swarnamakshika* (Sample I, II, III & IV):
In sample I (Ref- RT 21/21-22), 250 mg gm of *Shuddha Swarnamakshika* (*Swedita with Kadlikanda Swarasa*) was mixed with 250 gm of *Shuddha Gandhaka* and triturated with sufficient quantity of *Nimbu Swarasa*. In sample- II (Ref- RT21/ 21-22), 250 mg of *shuddha Swarnamakshika* was mixed with 250 gm of *Shuddha Gandhaka* triturated with sufficient quantity of *Nimbu Swarasa*. In both the samples, trituration was done for two hours till it became thick paste to prepare pellets (*Chakrikas*). These *Chakrikas* were made having diameter 2cm and thickness 1cm so that every particle of it get equal and adequate amount of heat for incineration.

After drying of *chakrikas*, *sharava sampootikarana* was done and subjected to *Puta*. Conventional method of heating was done to prepare all the samples. 10-12 kgs of *Vanyopal* were taken for *Puta*. *Bhasma* collected after each *puta* was subjected to triturition with *Nimbu Swarasa*. *Chakrikas* prepared after triturition were subjected to *puta*. Total 6 *putas* were given in both the samples.

After 1st puta, it was observed that *Swarnamakshika chakrikas* were brownish red in colour and soft. The brownish red colour of *chakrikas* was observed after 2nd & 3rd *puta* but the hardness comparatively decreased. After 4th, 5th & 6th *puta Swarnamakshika chakrikas* became red like vermillion in colour. 170 gm in Sample I and 163.7 gm in Sample II *Swarnamakshika Bhasma* was obtained from 250 gm of *shuddha Swarnamakshika*. It meant average yield of *Swarnamakshika Bhasma* was 68% in Sample I and 65.48% in Sample II (Table no-2 & 3).

As per Table no- 4, 750 gm of *shuddha Swarnamakshika* (*kadalikand swarasa shodhita*) was taken and 1/8th part of it *shuddha hingula* was added in it. This mixture was triturated by adding sufficient quantity of lemon juice in into it. Same process was repeated after each *puta* for total 7 times and total 8 *putas* were given in this method. Ultimately, 505 gm *bhasma* obtained from 750 gm of *shuddha swarnamakshika*. It meant the yield was 67.33% through this process.

In preparation of Sample no IV (Table no- 5), 750 gm of *shuddha Swaranmakshika Bhasma* (*bharjita* in lemon juice) was taken and triturated with adding 250 ml lemon juice in it. Pellets prepared after triturition, were dried, kept in *shrava samputa* and finally subjected to *puta*. Same process was repeated for 9 times and total 10 *putas* were given in similar fashion. After 10th *puta, Swarnamakshika bhasma* thus obtained, passed all the classical parameters and colour of *bhasma* finally changed to red. 470 gm *bhasma* obtained from 750 gm *shuddha Swarnamakshika* that meant the average yield in this process was 62.66%. So as far as yield is concerned, methods adopted in Sample III is better than in Sample IV. This proves that *marana* through adding *Rasa Bhasma* (as done with adding *hingula* in sample III) is best method of *marana*.

As per Table no-6 and Table no-7, it can be said that Swarnamakshika Bhasma prepared by all the three methods were fulfilled the organoleptic and classical analytical parameters. pH of all sample was in slightly acidic (Table no-8) due to use of lemon juice in levigation, purification and incineration stages. Table no- 9 depict the LOD, ash value and acid insoluble ash of different samples which was done in the Dept. of Chemistry, Science College, Patna. Chemically, *Bhasma* of *Swarnamakshika* is a mixture of Copper and Iron Oxide in both the samples as proved by the XRD study shown in figure no-1 & figure no-2. Further The methodology employed for the preparation of *Swarnamakshika Bhasma* by different methods yields nano particles in general as shown by the FESEM study in Plate no-1 & Plate no-2. ICP-MS study proved that percentages of Iron, Sodium, Potasium, Magnesium and Zinc were more in the Sample III as compared to Sample IV. Percentages of Arsenic, Lead, Cromium and Manganese like heavy were less in Sample III as compared to Sample IV. Percentage of Copper was found to be equal in both the samples. Percentage of Mercury could not be detected in both the samples (Table no-10). *Swarnamakshika Bhasma* (Oxides of Iron and Copper) if taken in empty stomach (increased amount of gastric acids) with *Amalaki Churna* (richest source of Vitamin C) would convert ferric iron to soluble and easily absorbable ferrous form. This will lead to increased uptake by membrane trasnferrin receptors[xix] which will increase iron absorption and distribution in body. This increased Haemoglobinisation will ultimately cure IDA i.e. *Microcytic Hypochromic Anaemia.*

Conclusion:-

It can be concluded from the present study that *Shodhana* by *Swedana in kadalikand Swarasa*) and *Marana* by *Rasa Bhasma* i.e. *higula* & lemon juice is ideal way of making Swarnamakshika Bhasma. *Bhasma* obtained through above method (in sample III) will be quite effective in treating iron deficiency anaemia because it contains higher percentage of iron and negligible percentages of As, Pb, Mn, Cr like heavy metals. If used with amalaki churna, this could be the ideal drug of treating IDA because of easy availability and cheaper price. It is further suggested to evaluate haematological effect of these drugs by conducting Serum Ferritin and TIBC investigations.

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