

Review Article

MATERIALS STUDIES ON HERBO-MINERAL PREPARATIONS (*BHASMAS*) FROM INDIAN MEDICINE

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Materials study of medicinal substances used in Indian system of medicine is an interesting interdisciplinary research area which has been scarcely explored. The contribution of modern scientists from various disciplines to this novel field will help to throw light on the complex problem of standardization of these medicines. A *Bhasma* is a special mineral formulation in which the qualities of organic matter are imparted to an inorganic substance by processing it with herbal substances. A literature review of research-work on *Bhasmas* and their compound preparations is presented with special reference to analytical studies. Need for systematic and planned efforts to investigate a medicine on its various aspects is emphasized.

Key Words: Material Science; Analytical Studies; Ayurvedic Herbomineral Medicine (*Bhasma*)

Introduction

Ayurvedic medicines – New field for interdisciplinary research

Ayurveda is the ancient Indian system of medicine which has stood the test of time¹. In recent years, a renewed interest has been shown by common people and scientists alike throughout the world to know more about the contributions that have been made or that can be made in future by this Indian system of medicine towards the advancement of Medical Sciences as whole².

The study of medicinal materials used in Indian system is an important interdisciplinary research area in need of contributions from Materials Science, Chemistry, Pharmacology, Medicine etc. Such a research will help in their characterization and standardization which is a very complex and vital problem. This will open a novel field for modern scientists. A literature survey of the previous research studies presented here is expected to help in creating a background for future studies.

Materials used in the Ayurvedic System of Medicine

Ayurvedic medicines broadly fall into two categories: (i) Herbals (ii) Minerals. Each has its own specialities. Herbal medicines are universally used, safe and easy to administer, cheap etc; while mineral medicines are long-lasting, more effective and need smaller doses than herbal medicines. The present review is

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concerned with mineral medicines. Hence the discussion henceforth is restricted to mineral medicines only.

Mineral Medicines

The minerals³ used for medicinal purpose include *Rasa* or *Parada* (Mercury), *Abhraka* (Mica), *Maksika* (Pyrites), *Silajatu* (Bitumen), *Gandhaka* (Sulphur), *Kasisa* (Ferrous sulphate), *Sindura* (Red oxide of lead), *Hingula* (Red sulphide of mercury), *Svarna* (Gold), *Rajata* (Silver), *Loha* (Iron), *Tamra* (Copper), *Varga* (Tin), *Jasada* (Zinc), *Pravala* (Coral), *Mukta* (Pearl), *Hiraka* (Diamond). These minerals are used in the form of '*Bhasmas*' as medicines.

Concept of Bhasma in Ayurveda

'*Bhasma*' may be described as a special formulation in which the qualities of organic matter are imparted to a nonorganic (inorganic) substance by processing it with substances of herbal/animal kingdom.

General Process of Making a 'Bhasma'

Many (nearabout 11) different steps have been described for making *Bhasmas*. However, the whole process may be broadly divided into 2 stages³: (i) *Shodhana* (ii) *Marana*. *Shodhana* is a composite process to eliminate undesirable contents from a substance, to regulate or eliminate its side-effects, to develop and augment its beneficial qualities⁴.

Marana is a process which aims at making the substance very minute. It mainly consists of trituration (*Mardana*) of purified mineral in juices of medicinal plants (*Putana*) and heating it to very high temperatures. The resulting product is *Bhasma* which is useful for medicinal purpose⁵.

Review of the Reserch Work in Ayurvedic Field

Voluminous research work has been conducted⁶⁻¹⁸ so far on Indian medicinal plants. They have been screened more extensively as compared to mineral preparations. The publications so far on mineral preparations are less but they include studies on various aspects viz. Analytical studies, standardization, experimental studies performed in the laboratory: like microbiological, pharmacological, pharmaceutical, biochemical studies and clinical studies on human beings etc. A short literature survey follows:

Analytical Studies on Ayurvedic Mineral Medicines

Literary Analytical Studies

Some literary (conceptual) analytical studies are as follows:

(a) A study for the identification of *Vaikranta Maharasa* has been carried out¹⁹ in which inventory of antient texts including physical properties, types etc. of *Vaikranta* has been presented. Alongwith it, modern minerology of 5 minerals (Tourmaline, Felspar, Flurspar, Manganese and Rock crystal) which have been quoted by authorities as equivalent to *Vaikranta* in various schools

of Ayurveda in India is presented. Correlation of the textual properties of *Vaikranta* with the properties of 5 minerals is also been sought. Thus an attempt has been made to resolve the controversy that exists about the actual mineral to be equated with *Vaikranta*¹⁹.

(b) Special features of 'Ayurvediya Rasashastra in *Bhasma* preparation (*Prakriya*)' are stated in a study²⁰. It is explained why the properties of *Bhasmas* are different from those of mere oxides of the same minerals. It is reported to be due to the various processes called *Sanskaras* in which minerals are treated by various organic substances of plant & animal kingdom. They eliminate the toxicity of substances like mercury and impart them an organic form which is assimilable to human body.

Experimental Analytical studies using Conventional/Classical methods

Following analytical studies have been carried out experimentally using conventional methods²¹ of physical and chemical analysis e.g. qualitative and quantitative analysis for the determination of the presence of various elements and radicals, percentage solubility, melting point etc.

(a) Ayurvedic *Gandhaka* (Sulphur) has been analysed²² and a comparative evaluation of two varieties of *Gandhaka* used in therapeutics (*Amalasarā* and *Nanusarā*) before and after *Shodhana* has been carried out. The study supports the claim that process of *Shodhana* aimed at purifying and rendering the substance suitable for medicinal use is of positive value.

(b) Chemical changes like solubility, antacid character etc. involved in *Abhraka bhasma* by giving different number of *Putas* have been studied²³. It is found that metals are more and more converted to oxides with the increasing number of *Putas*.

(c) A comparative study employing chemical analysis has been done²⁴ on *Abhraka bhasma* and *Abhraka satva bhasma*, to verify the claim in ancient classics that *Satva* is hundred times more effective than the initial form of *Bhasma*.

(d) Market samples prepared by different pharmacies of *Tamra bhasma*²⁵ and *Mandura bhasma*²⁶ were investigated and their composition was determined.

(e) With a view to evolve certain standards for Ayurvedic *Bhasmas*, *Tamra bhasma* was investigated²⁷. In addition to the standards laid down in the texts, *Tamra bhasma* was tested for its fineness, loss on drying, specific gravity and by Infra red studies. It was analysed for its constituents, subjected to pharmacological and clinical evaluation and toxicity studies²⁷.

(f) Two important mercurial preparations (*Rasaparpati* and *Panchamruta parpati*) were investigated²⁸ to find out the precise changes in the starting materials taking place during the classical preparation. The ultimate compositions of the finished products were studied using chemical, physical and spectroscopic studies²⁸.

(g) *Rasasindura* and *Sameerapannaga*, two types of mineral preparations, are analysed chemically²⁹. Possibility of preparing these drugs using modern chemical processes is debated. An attempt is made to correlate various pro-

properties of these drugs to their chemical composition as detected by chemical analysis²⁹.

(h) An attempt has been reported³⁰ to find out the possibility of preparing *Rasabhasma* (incinerated mercury) by a method quite different from the methods described in the old Ayurvedic texts, and which are impracticable at present.

However, there are instances in which chemical examinations of sophisticated nature have failed to detect the presence of Gold in preparations from Gold³¹. Sometimes, traces have been found and sometimes nothing was detected in chemical analysis. Then more and more advanced techniques have also been adopted for the analysis of *Bhasma* as follows:

Experimental Analytical Studies using Advanced Techniques

(a) Ultrastructure study (using Philips 200 Electron Microscope) of *Swarna Basant Malti* showed that the elements Gold and Zinc do not mix with each other during the various processes of *Bhasma* and they maintain their crystalline character also. Further their mode of action in the body is explained³².

(b) Various ingredients of *Swarna Basant Malti* have been detected by employing appropriate techniques viz. Sulphur by gravimetric method, Calcium by Flame photometry, Zinc by polarography, Gold by Atomic absorption spectroscopy and X-ray Diffraction (XRD) spectroscopy³¹.

(c) The spectroscopic study of B.T. Powder (Proprietary Ayurvedic preparation from minerals) revealed that it has elements like Gold, Calcium, Magnesium, Chromium, Zinc, Manganese even in the final stage and their structure is almost similar to standard crystals of these elements³³.

(d) X-ray Diffraction examination of 2 varieties of *Gandhaka* before and after *Shodhana* process³⁴ revealed that this process brings about appreciable changes in the physical characteristics such as crystal structure, grain size as well as refinement in the X-ray pattern in both varieties of *Gandhaka*.

(e) Comparative analytical studies have been carried³⁵ out on some Calcareous *Bhasmas* e.g. *Bhasmas* of *Shankha* (*Turbinella rapa*: Conch), *Muktashukti* (*Pinctada vulgaris*: mother of pearls), *Mukta* (*Pinctada margari*: pearl) and *Pravala* (*Corallium rubrum*: Coral). Their constituents were estimated using atomic absorption spectroscopy, spectrophotometry and complexometric titration. In addition to Calcium, Magnesium and Iron reported earlier, Zinc and Strontium have also been detected and estimated. It was also found that some Carbonate remains undecomposed³⁵.

(f) A comparative study has been carried out on a group of six *Bhasmas* (*Kapardi*, *Mrigashringa*, *Muktashukti*, *Pravala*, *Shankha*, *Mouktika*)³⁶. These contain calcium predominantly, but it has not been possible to establish methods of standardization from their calcium content alone. To lay standards for discriminating between the various analytical techniques were employed e.g. XRD for detection of phase of calcium, spectrography for detection of Magnesium, Iron, Aluminium, Nickel, Silicon, Tin (content ~ 50 ppm); X-ray Fluorescence spectroscopy for determination of Magnesium (content > 5000 ppm).

It was concluded that the 6 *Bhasmas* (which resemble in external appearance) can be distinguished mainly by differential content of Magnesium and secondarily by Silicon and possibly also by Aluminium content³⁶.

(g) An extensive study sponsored by Ayurveda Rasashala, Pune 4 has been carried out on *Tamra bhasma*³⁷ at the University of Poona, India. In it following aspects were studied.

- (i) Various steps involved in making *Bhasma* were investigated using different techniques e.g. '*Shodhana*' oil used for *Tamra bhasma* was studied using Electronic spectra. *marana* (Micro refining process) by method of particle size analysis; *Putana* (Pyrolysis) by TG/DTA by observing % conversion to oxide at different temperatures.
- (ii) Chemical analysis of 4 samples indicated that there was variable % of constituents such as Copper, Iron, Calcium, moisture, and acid insoluble material.
- (iii) Comparison of commercial sample and personally prepared sample using IR spectra.
- (iv) Biochemical role of copper was found as a good chelating agent, and which performs some of the fastest reactions in biochemical system.
- (v) Pharmacology: Copper has beneficial therapeutic effect in inflammatory diseases.

Studies Other Than Analytical

Analytical studies have been reviewed since they are relevant in the context of the present paper. A brief outline of studies other than analytical (experimental, toxicity, clinical studies) follows only to get an overall picture of the problem.

Experimental Studies on Animals

Experimental studies carried out on laboratory animals mostly are accompanied by histopathological investigations with microphotographs. Illustrations are cited as follows:

(a) *Vanga Bhasma* on oral administration to Alloxan induced diabetic albino rats as well as to normoglycaemic rats revealed in the subsequent blood sugar tests its beneficial role in the management of diabetics³⁸.

(b) Effect of *Yasada Bhasma* (Zinc preparation) on the healing patterns of abdominal wounds was studied by biomechanical, biochemical, and histopathological parameters. Oral treatment was found to give quick healing in healthy rats while local treatment along with oral gave better results in rats having infected wounds.

(c) *Vanga Bhasma* on oral administration to albino rats showed better preventive role in cadmium induced testicular degeneration than parenteral $ZnSO_4$ (modern control drug). Not only that, it could regenerate testicular tissue in partially degenerated cases⁴⁰.

(d) *Rajata Bhasma* on oral administration in linctus form to albino rats showed, tranquilising property in a barbiturate hypnosis test and positive effect

in a test of conditioned avoidance response to electric shock. These prove that it has positive control over nervous system depressant action and corroborates its use in mental diseases since ancient times⁴¹.

(e) In a study on *Makaradhvaja*, its adjuvants viz. honey, juice of ginger and juice of betel leaves were found to contain amino functions. Chemically *Makaradhvaja* being red sulphide of mercury, might be forming complexes with these amino functions. This explanation throws light on the role of adjuvants in the absorption process of *Makaradhvaja* in the body⁴².

(f) *Makaradhvaja*, unlike the standard control drug, was found to improve body resistance of puppies enabling them to survive from severe endotoxin shock and well balance neurohumoral and neuroenzymatic levels in the blood. The biochemical, physiological, histological and microangiographic findings revealed its prophylactic, antitoxic and tonic effect⁴³.

(g) *Vanga Bhasma* on oral administration to albino rats was studied for acute and subacute toxic effects on gastrointestinal tract, pancreas and liver, by behavioural, macroscopic and microscopic examinations. But for local irritation, no significant toxicity attributable to *Vanga Bhasma* was observed even in eight times higher dose than therapeutic dose⁴⁴.

(h) *Rasasindura* (a compound of mercury and sulphur) was prepared by carrying out a special processing with sulphur (called as *Gandhaka Jarana*), in equal and six times proportions⁴⁵. It proved to play a definite role in reducing the toxicity of mercury proportionately, in experimental animals.

Clinical Studies

Clinical studies have been undertaken on single and compound preparations of minerals to test their efficacy in different disorders. Examples are as follows:

(a) *Vanga Bhasma* was tested in patients of dysentery⁴⁶ recorded in outpatients and inpatients departments. The clinical findings showed that the results were statistically satisfactory.

(b) Incinerated Zinc, in a clinical study, showed encouraging results in checking the excessive secretions, specifically white discharges from uterus (i.e. leucorrhoea) which is a common gynaecological problem⁴⁷.

(c) *Abhraka Satva* (Essence of Mica) prepared according to procedures in Ayurvedic texts and tested in known cases of diabetes mellitus showed symptomatic improvements and significant reduction in fasting, post-prandial and urine sugar⁴⁸.

(d) In anaemia *Kasisa Bhasma* (which contains mainly ferric oxide) was found very effective⁴⁹ in bringing about the reversal of clinical signs and symptoms like pallour, weakness, anorexia, dyspnoea, vertigo, puffyness around eyes etc. and favourable changes in Haemoglobin and other haematological findings. The response was quick and vivid denoting free absorption of *Kasisa Bhasma*.

(e) *Lauha Bhasma* (Incinerated Iron), in a two years' clinical and pharmaceutical experiment, showed its clinical efficacy in the management of anaemia. It indicated that the qualities of Bhasma depend upon the media of preparation thus corroborating the descriptions in the ancient classics⁵⁰.

(f) A comparative study was carried out in patients of Iron deficiency anaemia. The assessment of results done on the basis of symptomatic relief,

general improvement of health and improvement in haematological record revealed that the efficacy of improved *Navayasa Lauha* was better than classical *Navayasa Lauha* and was more or less similar to Ferrous Fumerate, a modern iron preparation⁵¹.

(g) *Saptamruta Lauha* was tested in patients of Timir⁵² (Error of Refraction in the eye) including myopia, hypermetropia, presbopia etc. Clinical assessment by standard vision tests revealed its beneficial effect which was due to changes in refractive index irrespective of change in the shape and size of the eye-ball.

(h) *Sameerapannaga Rasa* (which contains mercury, sulphur and arsenic) was tested in patients of tropical pulmonary eosinophilia⁵³. It gave complete cure in 70% cases (some of which were refractory to previous allopathic drug treatment), improvement in 10% cases and good response to combined therapy (with an allopathic drug) in the remaining cases. No complications as well as relapse of the complaints during follow-up period of 9 months were observed.

(i) A compound containing *Svasakuthara* as main ingredient was tested in patients of tropical pulmonary eosinophilia⁵⁴. As compared to modern control drug Hetrazan, it caused complete relief from most of the clinical signs (e.g. ronchi, crepitations, bronchial spasm etc.), and symptoms associated with the disease and significant reduction in ESR, in haematological and other examinations.

(j) *Chandraprabhavati* in patients of urinary tract infection without obstructive uropathy⁵⁵ appeared to produce some non-specific beneficial changes in urinary tract besides its urinary antiseptic property. It produced significant reduction in severity of symptoms (e.g. burning micturition, increased frequency of urine, phosphaturia etc.), marked favourable changes in urinary findings and also in systemic changes (e.g. body-weight and blood-pressure etc.).

(k) *Brihat Vatachintamani* has been found to show hypotensive as well as other effects in hypertensive encephalopathy. Two types of preparations (with and without gold) were tested to ascertain the utility of gold in *Brihat Vatachintamani*⁵⁶.

(l) Importance of metal ions is emphasized⁵⁷ in case of imbalance of naturally occurring metal ions which is responsible for protein and hormone disorders in the living system. An attempt has been made to correlate the role of metal ions with yoga in life functioning and welfare of human beings.

(m) *Rasasindura* which is considered as one of the best invigourating drug in the classics is tested in patients suffering from lack of spermatozoa, one prime sexual disorder. Two different preparations containing equal proportion and six times proportion of sulphur to mercury were tested with a view to assess their effect on motility and count of spermatozoa⁵⁸.

Compilation of Previous Studies

From this review a few medicines are selected on which at least two studies have been performed. They are tabulated according to the nature of their studies in Table I. From the table it can be seen that:

- (i) There is not a single medicine which has been investigated on all the 4 aspects.

Table I
Compilation of the studies on some Ayurvedic medicines

Mineral substance	Analytical studies (Ref. No.)	Experimental studies on (Ref. No.)	Clinical studies on (Ref. No.)	Toxicity studies (Ref. No.)
1 Vanga bhasma	×	i) Diabetes ³⁸ ii) Testicular regenerative potential ⁴⁰	i) Dysentery ⁴⁶	i) No ⁴⁴
2 Abhraka bhasma	i) No ²³ ii) No ²⁴	×	i) Diabetes ⁴⁸	×
3 Jasada(Zn) bhasma	×	i) Healing of wounds ³⁹	i) Leucorrhoea ⁴⁷	×
4 Tamra bhasma	i) No ²⁵ ii) No ²⁷ iii) No ³⁷	×	×	×
5 Sameer pannaga	i) No ²⁹	×	i) Tropical pulmonary eosinophilia	×
6 Rasasindura	i) No ²⁹	×	i) Spermatogenic effect ⁵⁸	i) No ⁴⁵
7 Swarna basanta Malti	i) No ³² ii) No ³¹	×	×	×

- (ii) There are medicines viz. *Abhrak bhasma*, *Tamra bhasma*, *Suvarna basanta malti* for which there is repetition of analytical studies by different research workers.
- (iii) There are medicines viz. *Vanga bhasma*, *Jasada bhasma* on which experimental and clinical both the studies have been carried out. However, these two studies do not aim to evaluate the same therapeutic activity.
- (iv) There are some medicines viz. *Vanga bhasma*, *Rasasindura* which have been screened for two or more aspects. However, they have not been performed by the same research worker. Hence, the fact of exploration of more than two aspects may be attributed only to chance factor.

The review is illustrative to bring out clearly that the studies have been at random. There is an urgent need to carry out a comprehensive programme to investigate systematically a particular medicine on its various aspects and establish a correlation between them.

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Explanatory Notes

Rasashastra: The mineral therapeutics. The science describing methods of processing and uses of herbomineral preparations.

Rasa: The term 'Rasa' is generally preserved for mercury (Parada) though it is equally applicable to any mineral or metallic salt. Parada is the principal rasa.

Maharasa: Precious or important minerals like Abhraka (mica) etc. The compound herbo-mineral preparations from the various minerals and processed in the juices of herbs like lemon, Marica (*Piper nigrum*) etc. and animal products like milk, butter, buttermilk etc. are indicated in the disorders as follows:

<i>Name of Medicine</i>	<i>Indications</i>
Rasasindura	Anuria
Sameerpannaga	Chronic respiratory diseases e.g. Asthma
Svarnabasantamalti	Tuberculosis, Asthma
Makaradhvaja	Diabetic ulcer, debility
Svasakuthara	Asthma, Eosinophilia
Panchamruta Parpati	Sprue, Diarrhoea, Dysentery
Rasa Parpati	Sprue, Dysentery
Brihatvaticintamani	Nervous disorders, Asthma
Navayasa Lauha	Anaemia
Saptamruta Lauha	Eye complaints
Gandhaka rasayana	Skin diseases, septic conditions

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Abbreviations used in References:

- (1) 'IInd World Congress' * implies Book of 'Proceedings of the II World Congress on Yoga and Ayurveda held at Varanasi during 2-7 January 1987 published by A B Ray 1987. All the references mentioning 'IInd World Congress' * have this book as reference
- (2) *J Res Ayu Sid* → Journal of Research in Ayurveda and Siddha
- (3) *J Res Indian Med Yoga Homoeo* → Journal of Research in Indian Medicine Yoga and Homoeopathy
- (4) *J Res Indian Med* → Journal of Research in Indian Medicine
- (5) *Indian J Exp Biol* → Indian Journal of Experimental Biology