

Role of media in Shodhana process w.s.r to metals/minerals

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ABSTRACT

In Rasa Shastra almost all the drugs are advised to be processed with specific shodhana methods before their internal uses. As it has been observed that if metals/minerals are used in their impure form, these are likely to produce some harmful toxic effects or various diseases in the body. Thus shodhana processes are prescribed to each metal/mineral to remove physical & chemical impurities, as well as to convert mineral drugs into suitable forms for further treatment i.e. Marana process

Keywords: Media, Sodhana, Metals, Minerals.

INTRODUCTION

The metals form a big group of inorganic elements that make up the body tissues. In the present day medical practice, ayurvedic physicians profusely use metals, minerals, gems e.t.c., but due to ignorance some scientists always arises question about the rationality of using these metals for therapeutic purposes. Actually the metals available in nature are either in combination with undesired other elements or in improper and non consumable forms. These forms are not suitable for human body. All modifications and developments in Rasasastra are for the purpose of making these elements useful and body friendly.

The two basic processes adopted for this purpose are Shodhana and Marana. Shodhana is the preliminary and most important procedure adopted by Ayurvedic physicians to make metals

free from toxicity, potentiate them to achieve the therapeutic excellence & to make them easily digestible, absorbable and assimilable.

Shodhana process described in Rasa texts is not only a process of chemical purification but it is a specific process of addition and separation which cases physical, chemical and Biological changes in the metals. These changes depends on the structure, constituents, impurity and properties of particular substance.

Here in this paper an attempt has been made to enlighten the rationality behind Samanaya Shodhana of metals specially based on role of media and type of process adopted.

TYPES OF SHODHANA

Literally Shodhana means purification. Though references regarding Shodhana are available since the times of charaka Samhita (1000 B.C. to 500 B.C.). But the details about this treatment could be traced only after the development of Rasa Shastra i.e. from 8th cent AD and onwards. During that time number of processes were developed for purifying the minerals/ metal drug to remove their toxicity as these drugs have many superior qualities, the only disadvantage is that they have high toxicity and little absorption capacity. So after considering this

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view Acharya's developed different Shodhana treatments for different types of drugs depending on their different physical and chemical characteristics to make them suitable for the body.

In context of metals this process is grossly subdivided into two major categories.

SAMANYA SHODHANA

This procedure is used as a general procedure for shodhana of all drugs of a particular group. e.g. For metals.

Tailai Takrai Gavamutra Arnalai Kullathajai |
Kramanishaya — — — — | | (R.R.S5/13)

VISHESHA SHODHANA

It is used as a specific procedure for a particular drug material individually, not for a group. It can

be applied after Samanya Shodhana eg. Swarna Shodhana with panchmritika.

DEFINITION

Tadeva shodhanam karmam Dravya Dosha Nivaranam?(D.G.V.) i.e. Shodhana is a process of removal of impurities from substances by using different pharmaceutical processings of Swedana, Mardana etc with Particular drugs.

Udvidasthairoushdhai Sardham Kriytai Peshmadikama |

Malavishiyatai Tattu Shodhanam Hi Taduchayate | |?(RT2/52)

It is a process by which blemishes are separated from the substance by various processing like grinding etc with specific drugs.

Different methods of Shodhana

(1)	Swedana	Boiling with liquid	Sankha Shodhana
(2)	Mardana	Trituration	Parada Shodhana
(3)	Murchana	Trituration up to fine disintegration	Parada Shodhana
(4)	Patana	Sublimation	Parada Shodhana
(5)	Abhiseka	Sprinkling	Mandura Shodhana
(6)	Atapa	Drying	Lauha Shodhana
(7)	Acushana	Absorption	Bhallataka Shodhana
(8)	Bhavana	Levigation	Hingula Shodhana
(9)	Bharjana	Frying	Hingu Shodhana
(10)	Dhalana	Melting and quenching	Vanga Shodhana
(11)	Galana	Melting and pouring	Gandhaka Shodhana.
(12)	Nirjalikarana	Evaporation of water	Sphatika Shodhana
(13)	Nirvapa	Heating and Quenching	Samanya Shodhana of metals
(14)	Prithakikarana	Sepration	Gugglu shodhana
(15)	Vilayana	Elutriations	Silajitu Shodhana
(16)	Prakshalana	Washing	Godanti Shodhana

If we think about all these processes we can concise all these processes in to 7 types mainly.

HEATING AND DIPPING

It is a common method applicable specially for metals, gems, minerals etc. this method of

purification is applicable for the drugs which are very hard in nature as Copper, Mica, Mandura, Diamond etc.

HEATING, MELTING AND POURING INTO LIQUIDS

This method is indicated for the drugs having low melting point e.g. Zinc, vanga, Sulphur etc.

BOILING WITH LIQUIDS

It is a common methods of purification called as Swedana. This method is applicable when drug is having impurities soluble only in hot acidic, alkaline or oily media eg Mercury, Manasila,

Hartala, drugs of Sudha varga etc.

DISTILLATION

This method is applied when drug is having low vaporization point e.g., Mercury, Sulphur Nausadara etc.

TRITURATION WITH HERBAL DRUGS (BHAVANA)

When drugs are soft in nature this process is applied. Actually this process exposes the surface area of drug and each particle comes into direct contact with purifying drug e.g. in Parada, Garika, Hingula, Manasila etc.

Literary review-Samanaya Shodhana of metals

	Reference	Sodhana categorization and media	Activity
1	Rasa Ratnakara (Rasa Khanda)	Samanya for Dhatus: Taila - Takra - Gomutra - Aranala - Kulattha Kwatha	Quenching / Dhalana 7 times each
2	Rasa Ratnakara (Rddhi Khanda)	Samanya for Dhatus: Taila - Takra - Gomutra - Kanji - Arka Dugdha - Kulattha Kwatha - Jambira Swarasa	Quenching / Dhalana 7 times each
3	Sarangdhara	Samanya for Dhatus: Taila - Takra - Kanji - Gomutra - Kulattha Kwatha + Arka Dugdha	Quenching / Dhalana 3 times each
4	Rasendra Cintamani	Samanya for Dhatus: Taila - Takra - Gomutra - Kanji - Kulattha Kwatha	Quenching / Dhalana 7 times or 3 times each
5	Yoga Ratnakara	Samanya for Dhatus: Taila - Takra - Gomutra - Aranala - Kulattha Kwatha	Quenching / Dhalana 7 times each
6	Bhaisajya Ratnavali	Samanya for Dhatus: Taila - Takra - Gomutra - Kanji - Kulattha Kwatha Naga - Vanga: Arka Dugdha	Quenching / Dhalana 7 times each Quenching / Dhalana 3 times each
7	Rasa Tarangini	Yasada: Curnodaka OR Nirgundi Swarasa OR Sudha Dugdha OR Godugdha Samanya for all Dhatus: Kanji - Takra - Kulattha Kwatha - Gomutra - Til Taila	Quenching / Dhalana 7 times 7 times 7 times 21 times 3 times each

SOAKING IN LIQUIDS

Mainly applicable in case of vegetable drugs and poisons eg. vatsanabha, Kuchala, Guggulu, Silajitu etc.

FRYING

This method is applied when drugs either contain water of Crystalization or volatile impurities. eg Tankana, Spatika, Maksika, Hingu etc.

IMPORTANCE OF SHODHANA

1. Physical Changes

1. Elimination of physical impurities
2. Reduction in Hardness
3. Increased brittleness – due to repeated heating and quenching micro cracks are seen on the surface of metals.
4. Reduced particle size

2. Chemical Changes

1. Elimination of chemical impurities
2. Formation of chemical compounds e.g. During Red hot stage oxidation occurs and oxides are formed.

3. Biological changes

These physico-chemical changes ultimately increases bioavailability. Reduction in particle size helps in absorption. Smoothness leads to non irritability and all chemical changes makes metal body friendly and suitable for further proceeding.

through the lattice. Thus Metal consists of an ordered array of positively charged ions between which the valence electron move in all directions with high velocities.

- The binding forces that hold a metallic crystal together can be assumed to come from the attraction of positively charged ions for the cloud of negative charge that lies between them.
- In ionic crystals, the cations and anions are held together very tightly in their allotted positions by very strong electrostatic forces of attraction, very high amount of energy (in the form of heat) is required to separate the cations and anions from one another due to this reason metals are hard, having high M.P. and B.P. along with high density.
- Metallic luster is always due to metallic oxides. Not due to carbonate, silicates, phosphate sulphates etc.

BASIC STRUCTURE OF A METAL

Metals are solid crystalline in structure. The normal metallic object consist of an aggregate of many small crystals thus metal are polycrystalline. The crystals in metals are normally called as grains. These can be defined as an orderly array of atoms in space.

CRYSTAL LATTICE

In order to occupy minimum space, the ions arrange themselves systematically in an alternating cation- anion pattern called crystal of lattice.

The manufacturing processes tend to align the grains in a metal so that their orientation are uniformly distributed and it is known as textured or preferred orientation.

Crystalline solids are grouped into (1) Ionic (2) Van der Waals (3) Covalent (4) Metallic

- In a metal valence electrons are able to move

NIRVAPA

Taptayapsu vinikshapo Nirvapa Snapanam chata (R.R.S.8/56)

Solid Raw material → Red hot stage → Quenching in liquid media at room temperature.

Unit operations in the process of Nirvapa

1. Phase of heating
2. Phase of quenching
3. Post quenching interaction between solid hot material and liquid media

PROBABLE MODE OF ACTION OF NIRVAPA (BASED ON KINETIC THEORY OF MATTER) PHASE OF HEATING

- Metals are solid, closed, packed crystal structure the number of atoms occupy equilibrium positions and vibrate in fixed positions.
- When temperature is applied, the particles gain energy and vibrate strongly and displacement of equilibrium occurs, intra

atomic distance increases and solid get expanded.

- Due to increase in intra atomic distance electrostatic forces get weakened.
- Due to continuous heating partial get enough energy to break forces and can move around, this expansion is called linear expansion.

During red hot condition metal react with atmospheric oxygen and compounds are formed on surface, generally expansibility of compounds are less than metals and leads to separation of compound part.

PHASE OF QUENCHING

After heating immediate cooling in liquid media leads to decrease in tension and increase in compression force. The media immediately penetrates inside & media soluble impurities get dissolved.

Repetition of heating and cooling causes disruption in equilibrium, leads to increased brittleness, reduction in hardness and finally particle size get reduced.

POST QUENCHING INTERACTION

After Nirvapa and during instant cooling recrystallization occurs along with reformation of grain boundaries. Each grain is surrounded by the molecules of liquid media imposing its properties on that purified metals.

ACCORDING TO GRIFFITH THEORY

All solids contain flaws and microscopic

cracks. When heat is applied initially it is taken on the high portion of surface as a result high stress occurs. the bonds at this place get weak, which is responsible for creating cracks. The particle with weakest flaw fracture most easily, by this way particle size gets reduced.

ROLE OF MEDIA IN SAMANYA SHODHANA OF METALS

Media plays an important role in Shodhana Process that is the reason of using specific media for a particular substance.

Media can act in different ways.

- Sometimes media acts as solvent to dissolve insoluble impurities.
- Sometimes media acts to eradicate toxic substance from the drug.
- Media provides some organic and inorganic principles to the material which have important role in the body.
- Sometimes helps in physical transformation of some metals and minerals.
- Fate of metal deformation depends on the nature of liquid used for quenching

ACCORDING TO AYURVEDIC VIEW

In Samanya Shodhana of metals, material taken for Shodhana are heated to red hot and dipped into various types of cold liquids i.e. Tail, Takra, Gomutra, Arnal and Kulitha respectively for 7 times in each liquid.

The order of these Medias for Shodhana is important. Intensity of Tikshnatva increases in rising order in case of these Medias from Tail up to Kulltha. These media Nullify Mala, Kathinata, Jadta etc.

Media of Sodhana	Properties	Effect
(1) Tila Tail	Sukshma Ashukari	- Rapidly enters into material - Makes film coating - Further heating causes compound formation and breaking of material
(2) Takra	Tikshna Sathilikaran	- Softening of material - Breaking
(3) Gomutra	Dahana, Pachana	- Separates oxides from material - Eradication of undesired substances
(4) Arnala	Tikshna Shaithilikaran	- Softening and breaking
(5) Kulltha Kwatha	Bhedana	- Breaking of material

All the media used for Samanya Shodhana Contain one or more than following properties.

1. Weak / Strong acids
2. Weak / Strong bases
3. Enzymes
4. Solvent property
5. Inorganic content

CONCEPT OF BIOBENEFICIATION

It is a recent research to use micro-organisms in the beneficiation of various minerals. According to this theory many autotrophic and heterotrophic bacteria as well as fungi are known to interact with sulphide and oxide mineral in such fashion so as to remove selectively one or more mineral constituents in an ore. When micro organism interact with minerals, several consequences results.

Adhesion of micro organism to mineral surface.

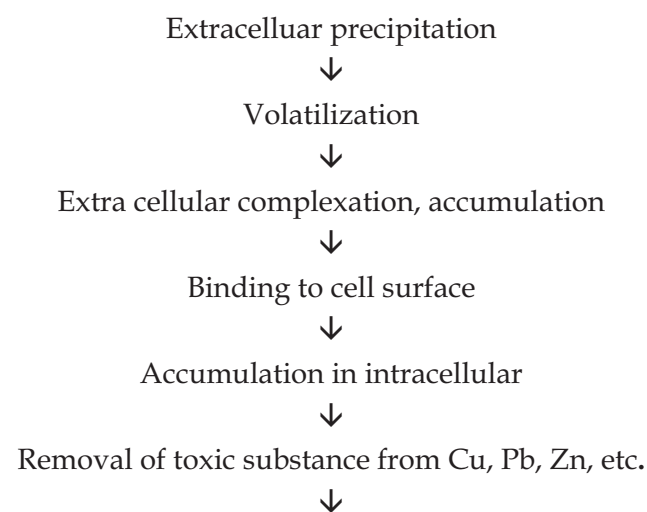
- Oxidation / Reduction reactions catalyzed by organisms
- Adsorption / Chemical interaction of bacterial metabolic products onto mineral surface.

This may result in microbe- mineral interactions, may be manifested as Biomineral conversion, biosurface modification, bioaccumulation and bio absorption, which causes.

- Mineral Surface modification
- Selecting removal of undesirable constituents
- Enrichment of desired mineral in ore body.
- Sorption and accumulation of metal constituents by biomass.
- Generation of biosurfactants.

BIOSORPTION & BIOACCUMULATION

Micro organisms are capable of concentrating metals from aqueous solutions. The major mechanism is:



Both living and dead biomass could be used for this purpose but metals uptake capacity of biomass depends on

1. Nature, type and amount of biomass

Table: Showing some Microorganisms capable of metal accumulation

Sr.No	Organisms	Metal ions
1	Thiobacillus ferrooxidans	Cd ⁺² , Co ⁺² , Cu ⁺² , Cr ⁺³ , Fe ⁺³ , Ni ⁺²
2	Cyanobacteria	Au ⁺³
3	Chlorella pyrenoidosa Chlorella Regularis	Cd ⁺² , Co ⁺² , Ni ⁺² , Zn ⁺² , UO ₂ ⁺²
4	Bacillus subtilis	Cd ⁺² , Co ⁺² , Cu ⁺² , Zn ⁺² , UO ₂ ⁺² , Au ⁺³ , Fe ⁺³
5	Pseudomonas sp.	Cd ⁺² , Co ⁺² , Ni ⁺² , UO ₂ ⁺² , radionucleides
6	Yeast	Cd ⁺² , Co ⁺² , Ni ⁺² , Zn ⁺² , Cu ⁺²
7	Aspergillus niger	Co ⁺² , Zn ⁺² , Cu ⁺² , radionucleides

2. Solution chemistry i.e. PH and type of ions. Thus it may be that microorganisms present in specific media used for Samanya Shodhana of metals at specific PH act on biomass and removes toxic elements by the process of biobeneficiation. Yet there is a need to prove it on scientific grounds. That why acharya have mentioned specific media for Shodhana of metals.

DISCUSSION & CONCLUSION

Thus by considering all these concepts. It can be well understood that Shodhana techniques described by our acharya's have scientific basis. These treatments not only remove impurities of drug but also add some materials with them which, from chemical point of view may be taken as impurities but from pharmacological or therapeutic point of view they are beneficial to the great extent. Ayurvedic Shodhana is not only a chemical purification but something more than it, which may lower the chemical purity but improves efficacy of the material. Ayurvedic Shodhana process also impregnate organic material and their properties to drug to facilitate their utilization by body tissues and organs. From pharmaceutical point of view these process helps in converting material in such state which is suitable for further proceedings e.g. Marana etc.

REFERENCES

1. Shastry Ambikadatta Bhaisajya Ratnavali, Govindadasa, 13th Ed, Vidhyotini Comm. Chaukhamba Sanskrit Sansthana, 1999.
2. Natarajana K.A, Deptt of Metallurgy, Biobeneficiation -potential & prospects, Indian institute of science, Bangalore, India.
3. Busscher, H J.Sjollemaj., Van der Mei, H.C, in Doyle.RJ & Rosenberg.M.(Eds):microbial cell surface Hydrophobicity. Washington D.C: American society for microbiology, 1990; 335-346.
4. Sharma PV, Dravya Guna Vigyana, 5th ed., Vol.2. Chaukhamba Bharati Academy, 1981.
5. Durgan.P.R & Apel,W.A: In Murr.L.E, Torma,A.E & Brierley, J.A(Eds): Metallurgical application of bacterial leaching & Microbial phenomena, Newyork. Academic press 1978.
6. Interactive workshop between students & teachers of Ayurveda in Rasa Shastra & Bhaishajya Kalpana, under the aegis of W.H.O & Deptt. of Ayush, Ministry of health & F.W, Govt. of India., Organizing secretary Dr.V.V Prasad, New Delhi. Feb 26-27 2005.
7. Karavaiko, G.I & Rossi,G. (Eds): Bio Geotechnology of metals. Moscow centre for int. projects, 1988.
8. Karaviko,G.L, Avakyana,Z.A, Ogurtsova,L.V & Safonova,O.F; in Salley.Ottawa: CANMET, 1998; 93-102.
9. Mehta A.P,Torma,A.E & Murr, L.E:Biotech.Bioengg, 1979; 21: 875-885.
10. Natarajana,K.A:IN Enrich, H.L, Brierley, C.L & Brierley,j.A, (Eds): microbial mineral recovery, New York: McGrew Hill, 1990; 79-106.
11. Setty, Subrahmanyam,j.Thimma,KusumSarasija Suresh,V. Pharmaceutical engineering, Principles & practices, C.V.S., 170 .
12. Kulkarni,Duttatrey,Rasa ratna Sammuchaaya,Vigyana Bodhini tika.
13. MishraSwaminath1st Ed.1991 RasaRatnakara (RasaKhanda), Nityanatha Siddha, com., Chaukhamba Orientalia.
14. Mishra Swaminath,Rasa Ratnakara (Rddhi Khanda) 1st Ed, Chaukhamba Orientalia,
15. Sharma, Sadananda Rasa Tarangini, 11th Ed., 2001., Edited by Pt. Kashinath Shastry, Motilal Banarasi Das, 1991.
16. Tripathi Indradevo & Bhagirithi,Rasarnava, Comm. Rasachandrica Hindi comm., 3rd ed, edited by P.T. Tarradatta Panta Ayurvedachayarya & Dr. Shri Krishna Dixit, Chaukhamba Sanskrit series, 1995.
17. Nath Âcârya Dhundhuk Rasendra Cintamani, 1st Ed, Hindi Comm. Prof. Siddhinanda Mishra, Chaukhamba Orientalia, 2000.
18. Sarangdhara Samhita with Dipika comm, 3rd ed, by Adhmalla, Gudhartha Dipika & by Kashirama, Chaukhamba Orientalia, 1983.
19. Rao Yelloji, Natarajana.M.K. K.A & Somasundarana. Mineral & Metallurgical processing, 1992; 105-120 .