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CHEMISTRY OF SATVAPATANA

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ABSTRACT

Satvapatana is often Miss-Understood as Metallurgy. When detailed study of the same is done it is understood that *satvapatana* is actually a method of concentrating all the therapeutic active trace elements, while metallurgy intends to concentrate the major element which is chemically pure. Various *satvapatana* techniques explained to get maximum benefit of the *rasadravya*

Key words: Metallurgy, *Satva,Satvapaatana*.

INTRODUCTION: *Satvapatana samskara* as elucidated in classics is achieving the essence of metals and minerals from their original source. These after extracting out is once again subjected for shodhana and marana techniques to convert them in to *sajatiya dravyas* from *vijateeya dravyas.* Recent time scholars have wrong notion about it and explain it to be a metal extraction technique. Lot of chemistry is hidden in the wake of its extraction which will be unveiled in further lines.

History: Nagarjuna was the first who mentioned the process of *satvapatana.* In *Rasendra mangala* [1] eight procedures of satvapatana are available for different minerals. In *Ananda kanda* thirtysix[2] method of satvapatana are given for thirteen minerals. In *Rasarnava*[3], descriptions of satvapatana are found for nine substances, 19 methods of satvapatana are found in *Rasaratnakara*[4] for thirteen minerals.

Definition: various meanings of the word satva are found in various texts but the specific meaning of the satva should have to taken here is extracted essence of metal from its ore.

Classification:

I. Based on source

Satvapatana

Dhaturupa (metal form)	*Adhaturupa*(non-metal form)
For eg; *Abraka satva*	for eg; *Haratala*,
Swarnamakshikasatwa etc	*Somala* etc

II. On the basis of Origin.

i. Mineral- *Abhraka, Vaikrantha*, etc
ii. Animal- *Bhunaga,Mayura piccha*.
iii. Herbal – *Kankusta.*

III. On the basis of Collection.

i. Sublimating form of satva; E.g.; Parada, Arsenic etc,

ii. Non-Sublimating form of satvas E.g.: Iron, Copper etc

Basic requirements for satvapatana:

a) Satvayukta materials: Not all the dravyas can be subjected for satvapatana. Metals and minerals which have satva in them only such dravyas are selected for satwapatana. Satva might be either metal or mineral in nature. The technique to displace it from its source varies.

For e.g. Herbal- by crushing and macerating in water and sediment

Of metals having lower M.P or Vaporizing point } By sublimation e.g. Parada

Of metals having Higher M.P – By using Dravaka gana.

b) Dravaka varga:[5] The Dravaka varga and Mitrapanchaka varga told in the classics include *Gunja, Madhu, Guda, Grutha, Tankana, Guggula*. They help in displacing the metals from the source. The critical study over these groups of drugs makes us understand the rationale behind their use.

Flux: During reduction, substance called flux is added to the ore. It combines with impurities to form easily fusible product known as SLAG. This is not soluble in the molten metal. Borax (tankana) is well known flux which acts either way i.e. reducing the melting point of the metal and by helping in the formation of slag.

Poling: In the refining of metals the green logs of wood are used to stir the molten metal. By this the metal oxides that are formed are reduced by reacting with hydrocarbon gases that are liberated. The ***Guggulu*** which is a plant material could help to accelerate this process.

Reducing nature of Carbon: Carbon is effectively used in different extractive metallurgy as reducing agents. Carbon reacts with oxygen in two ways-

$C + O_2 \rightarrow CO_2$ ------ (1) @ 938^0K.

$2C + O_2 \rightarrow 2CO$ ----------(2) @ $>983^0$K.

With the laws of thermo dynamics it can be concluded that below 983^0K carbon monoxide is energetically a better reducing agent than carbon. Above this temperature, the reduction with carbon becomes more favourable-

The organic compounds like guda, certain organic acids of gunja are turned to carbon in its purest form which further acts as a reducing agents as explained above.

Auto reduction: Some reduction reaction does not require the reducing agents. The cations of the least electropositive metals may be reduced without the use of any additional reducing agents. This is also called ***AIR REDUCTION*** e.g. extraction of mercury, lead, Cu etc. in the manufacture of mercury the sulphide ore (cinnabar) is heated in a current of air when following reaction occur-

$2HgS + 3\ O_2 \rightarrow 2HgO + 2\ SO_2$

$2HgO \rightarrow 2Hg + O_2$

$2HgO + HgS \rightarrow 3Hg + SO2$

Similarly, Copper where the sulphide and the oxide act together at an elevated temperature to give the metal.

$Cu_2S + 2Cu_2O \rightarrow SO_2 + 6Cu$

Catalyst: The organic acids of a plant source like that of Gunja might act as catalyst? As extracts of gunja are thermo stable.

c) Heat: Generally *satvapatana* is done in a closed Musha by applying intense heat. It is not mandatory that all the procedures require

strong heat. It again depends upon the dravya involved in the *satvapatana*. For e.g. the reactions between the solids generally involve high energies of activation.

In the modern metallurgy, the selection of reducing agents, the method for metal extraction is done by calculating the free energy change of the reactants and the reducing agent.

d) Musha: (Crucibles)

In simple language they can be explained as the containers which resist the high temperature. They are prepared with different temperature resistant organic and inorganic materials. Varity of musha for different temperature pattern are available. To the most intense heat *vajramusha* while to the mild to moderate heat *samanya* musha is opted.

The mushas are generally inert in their nature. Hence do not disturb the system.

e) Kosti: The fire place also equally important as it provides the necessary temperature in the system. *Angara kosti* is for *Katinadravyas*. *Patala kosti* is for *Mrudu* dravyas. And *Gara* kosti is for *Mishra dhatu* satvapatana.

Nature of satva:

Swarna makshika satva:[6]

…….mrudulam <u>*ravilohabham*</u> satvam munchati shobanam.!

…….evam nati chideva satvam shulbam pateth !

Vimala satva[7]

…….*satvam tararkasamkasham prayachati na samshayaha*!

Sasyaka satva[8]

.....indragopena samkasham satvam patathi shodanam!

Shilajatu satva[9]

.....satva seesasamam tasya patate gunasagaram!

By seeing description of different *satva* we learn that *satva* is not exactly the metal of its source but it is something different from it. No where our acharyas have committed by saying that, for e.g., *tamra* is *satva* of *makshika*.

It cannot be denied that definitely satva contain the dhatu of its source, but in major proportion. It might include many other dhatu along with it in trace.For some satvas there is mention of shodhana and marana and later to use it for therapeutics. This determines that all satvas are not safe to use directly. They are usually in powder form.

Shuddavarta laxana: In Rasarnava characteristics of flame during satva extraction has been elaborated as;

For, *Swarna satva* – Yellow flames

Rajata satva - White flame.

Tamra satva - Bluish flame

Teekshna loha satva – Black flame

Naga satva- Black flame

Shilajatu satva - Gray flame.

Loha satva - Kapila colour.

Sasyaka satva – Red flame.

AIM OF SATVAPATANA:

1. To obtain the active principle of the ore, this is free from all blemishes.
2. To minimize dose of dhatu without lowering its efficacy in treatment.
3. It is used in parada grasa.

Modern techniques of metal extraction: In modern metallurgy there are different phases prior to the metal extraction. In brief these phases are mentioned. These phases mainly aim at enhancing metal percentage in the ore.

1. ***Concentration of ore***- by hand picking, gravity separation, magnetic concentration, electrostatic concentration, froth flotation process
2. ***Calcinations***: to expel organic matter, volatile matter, moisture.
3. ***Roasting***: to oxidize the ores.
4. ***Reduction to free metal***:Smelting, Heating in air, Reduction by aluminium,Electrometallurgy,Amalgamation method, Hydrometallurgy.
5. ***Refining/Purification***:Liquation,Distillation process, oxidation process, electro refining

Satvapatana v/s Metallurgy

Satvapatana	Metallurgy
Aims at extracting the therapeutical active material	Aims at extracting the purest form of metal for commercial purpose, i.e. elemental purity is the criteria
The metal? Extracted is not subjected to refining. Instead is subjected to shodhana and marana.	The reduced metal is subjected for refining process.
The properties of live metal (*Jivayukta*) (therapeutically) are obtained from its ores. [*Jivayukta* means to say it is active therapeutically which when administered produces desired efficacy as per its attributes. Further it can be justified by analyzing it for the presence of Additional trace elements which are not seen in Pure metal]	The metal is a dead (therapeutically) form of ore. [The elemental pure metal is devoid of many trace element. Presence of Trace element is considered to be substandard metal. Such metal if used for therapeutics may not perform as per its attributes. Hence it can be explained as therapeutically dead, further it lacks in Samskara given for Dhatus.

DISCUSSION:

- By the description on satva by our acharyas they clearly meant that satvas are different from metals.
- The selection Mitra panchaka also varied according to the nature of satvayukta dravyas.
- It seems that satvapatana technique was practiced in small scale with a therapeutic motto behind it. This procedure does not explain the large scale extraction of metals of that time. The ancient metallurgy might have hade different extraction procedures along with this.
- The aim of satvapatana is entirely different from the aim of metallurgy. Hence both cannot be the same.
- For the purpose of reducing ores in to their satvas the acharyas used mitrapanchaka varga though in the same text the dravakas which is reducing chemically Sulfuric acid etc. are explained which are strong reducing agents than mitra panchaka. This explains that our seers needed the satva of the jeeva

loha. Hence organic reducing agents which helped to retain the properties of the ore.

- Thermodynamically satvapatana is an isochoric (unchanged volume) and to some extent Isobaric process (unchanged pressure), based on this principle the whole satvapatana procedures can be scientifically studied and explained.
- The satvapatita substance as it contains many other substances along with the chief metal. They alter the pharmacokinetic profile of a drug.
- Satva obtained is again processed to make it therapeutically fit.

CONCLUSION:

- Satvapatana procedure was ment to extract the therapeutically active principles from the ore.
- Satvapatana aims at extracting substances which is pharmacologically effective than metallurgically pure.
- Satvapana technique has faded in recent years. This should be unveiled and it becomes the responsibility of current research scholars.
- The end point of satvapatana is when shuddhavartha is attained.

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