



Review Article

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Significance of *Parad* in *Rasashastra* - A review

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ABSTRACT

Ayurveda is a traditional system of medicine with historical roots in the Indian subcontinent. In Ayurveda, materials from natural sources are being used for the preparation of Ayurvedic formulation. This includes plants, minerals/metals and animals. *Rasashastra* is a branch of Ayurvedic medicine which deals with formulations containing minerals/metals and significantly *Parad*. From the fact that the name of this branch has been given after *Parad* (*Rasa* in *Rasashastra*) indicates the emphasis laid by the then health care professionals on the use of Mercury or *Rasa* or *Parad* in the use of therapeutics. According to Ayurvedic Formulary of India, mercury and lead are reported to be the widely used heavy metals. But nowadays, modern scientists are concerned with the use of heavy metals in Ayurvedic preparation. According to Ayurveda, before these metals are used for the treatment, purification process should be carried out so that the possibility of adverse effects gets eliminated. In this review article, we are dealing with the Ayurvedic methods used in purification of *Parad* (Mercury) and the evaluation parameters used.

Keywords: Ayurveda, *Parad*, *Rasashastra*, Purification, *Kajjali*.

INTRODUCTION

Ayurveda refers to *Ayur* = life and *Veda* = science. Ayurveda is concerned with the prevention rather than cure of diseases^[1,2]. Materials from the three natural sources of herbal, mineral/metal and animal origin have been chosen in Ayurveda^[1]. The present review is mainly dealing with mineral/metals used in the formulation of a medicine.

Rasashastra is a branch of Ayurveda, dealing with the formulations involving drugs of metal/mineral origin. The various aspects covered under this branch are their origin, varieties, physical and chemical characteristics, therapeutic properties and their uses. Hence this branch is also described as 'Ayurvedic Pharmaceutics'^[3]. The study of *Rasashastra*, deals with metals like Gold, Mercury, Silver, Copper, Iron, Tin, Lead, Zinc etc. These have their traditional names as *Swarna*, *Parada* or *Rasa*, *Rajata*, *Tamra*, *Lauha*, *Vanga*, *Naga*, *Yasada*. These metals play a vital role in human physiology and form the essential components within the human body^[4]. According to Ayurvedic Formulary of India, mercury and lead are reported to be the widely used heavy metals^[4]. From the fact that the name of this branch has been given after *Parad* (*Rasa* in *Rasashastra*) indicates the emphasis laid by the then health care professionals on the use of *Parad* or *Rasa* in the use of therapeutics.

Rasashastra is existing since vedic period^[5]. It has also been reported that Buddhist sages were the first to use mercury and believed to be one of the creators of treatment by using metals and minerals in their appropriate form^[5]. Many drugs used for *rasayana chikitsa* (rejuvenation therapy) contains *Parad* (*rasa*) along with other metals. These are classified as *rasaousadhies*^[1]. Since *rasaousadhies* are effective in small doses and gives quick relief as compared to pure herbal formulations, they have gained significance tremendously^[3].

Great caution should be taken while using metals. In the text it is suggested that they should be reduced to micro-fine powder^[6]. Before these metals are being used in the formulation, they should be treated in an appropriate manner by different processing techniques like *Shodhana*, *Marana*, *Amritikarana*, etc. This is responsible for the elimination of the possible adverse effects^[3].

In ancient *rasa* literature it is reported that ancient *rasaacharyas* have recognized *doshas* in almost all drugs including metals, minerals, etc. To remove these *doshas*, certain techniques and procedures were prescribed like *shodhana* and *marana*^[7]. For purification, samanya *shodhana* and *vishesha shodhana* methods are carried out. But if not performed properly then it may lead to many complications like loss of vision, skin diseases, vomiting and even death.

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In Ayurveda, heavy metals are converted into non-metallic form^[1,8]. These compounds should be initially detoxified. From review of literature, it is revealed that detoxification can be done by various heat and cool cycles along with oil, buttermilk, rice gruel, cow's urine, herbal decoctions, etc.^[1,8,9,10]. From the ancient times, garlic has been useful for purification of *Parad*^[1]. Thousands of such purification procedures are mentioned for all the minerals and metals. It is now agreed that manufacturing of Ayurvedic preparation as per ancient scripts and using modern techniques in combination will lead to non-toxic formulations^[1].

Pre-Treatment

Pre-Treatment is the processing of different *rasaushadhies* which would enable them to be used therapeutically. During these processes, the metals/minerals are subjected to different types of treatments using various ingredients like betel leaf juice etc and also subjected to different techniques like heating and incineration. This would modify and enhance the core properties for better curative or palliative use. The different types of pre-treatment procedures are *Shodhana* (purification), *Marana* (incineration), *Jarana* (polling), *Murchana*^[11].

Sodhana

It is the purification and detoxification process wherein toxic materials are eliminated and substances are subjected to further processings^[12,13,14]. In this process, metals/minerals after mixing with drugs used for certain purpose, they are treated with various *peshanadi* (grinding, etc.) *karmas*. The main aim of this process is to enhance its physico-chemical properties so as to increase its availability in our body and to remove malas (toxins) from the drugs. Also reducing the particle size enhances absorption and all the chemical changes makes the material friendly.

The procedures followed for the purpose of *shodhana* are *Abhisheka* (sprinkling), *Achushana* (absorption), *Atapa/Agni shoshana* (drying), *Bharjana* (frying or roasting), *Bhavana* (levigation), *Dhalana* (melting and quenching), *Galana* (melting and straining), *Mardana* (trituration eg. *Paradshodhana*), *Nimajjana* (dipping), *Nirjalikarana* (evaporation of water), *Nirvapa* (heating and quenching), *Parishravana* (straining), *Patana* (sublimation), *Prakshalana* (washing), *Prithakikarana* (separation), *Swedana* (boiling under liquid bath) and *Vilayana* (elutriation)^[12].

Bhavana

In the process of *bhavana*, the materials are grinded by adding specific liquid media. The minute particles of the material comes in contact with liquid media and hence coarse powder converts into finer state. It transfers the properties of the media to the materials and leads to unique and suitable physicochemical properties. It also helps in increasing the efficacy of the materials and helps in further processing of *marana*. The organic components of the liquid media gets transferred to the material forming organo-metallic or organo-mineral compound which are favorable to the body^[12,15].

Marana

The impure form of metals like that of *Parada*, *Swarna* and other metals may produce harmful effects or various diseases in our body. Therefore metals/minerals should be converted into suitable form. This can be achieved by using *marana* process^[7].

In this process, a paste is made by adding various drugs or juices to the metals and minerals and then subjected to heat treatment (*puta*) so as to convert it into *bhasma* (ashes). Advantage of *marana* process is that when metals/ minerals are converted into *bhasma*, they will be absorbed into the system, mix with blood and produce their desired effect without having harmful side effects.

Jarana

It is the process in which *Parad* reverts back to its original state without being subjected to processes like *galana*, *patina*, etc. It is useful for *Dhatuwada* and *Rasayana* purpose. However without *Agni Samskara* it is not possible. The *Rasa Shastra* texts claim that *Parada* treated with *Gandhaka Jarana* process becomes highly potentiated and many pharmacological and therapeutic properties. This potentiation depends on the proportion of Sulphur made burnt during *Jarana* process^[16].

Murchhana

Murchhana is the process in which the mercurial compounds exhibit a certain property called *Vyadhighatakatva* (definite disease curing capacity) or potency. In this process, the mercury with or without sulphur gets converted into a suitable compound. This could be used in the body for curing diseases without being reduced to *bhasma* (ashes). There are 2 types of *murchhana*:

1. *Sagandha murchhana* (performed with *Gandhaka* (sulphur) and other drugs)
2. *Nirgandha murchhana* (performed without using *Gandhaka*)^[16]

Description of Parad

Parad (Fig No. 1) is silver coloured liquid metal also called as '*Hydrargyrum*' or 'Quick silver' denoted as Hg and having atomic weight of 200.6 and boiling point of 357°C. It can dissolve in inorganic acids. It can also form amalgams with other metals^[17].



Figure 1: *Parad*

Sources of Parad

Parad is obtained in two forms:

1. *Mukta swarupa* (Native or free mercury)
2. *Yougika swarupa* (In the form of ores)

Different types of ores present are cinnabar (*Hingula*), meta cinnabar (*CarmaraHingula*), hepatic cinnabar (*darada hingula*), coral ore (*Pravalabha hingula*), red oxide of mercury (*Girisindura*), calomel (Hg_2Cl_2), montrodite (HgO), living stonite, steel ore of mercury (*Jeklenka*), liver ore of mercury (*Jetrenka*)^[17].

Role of Parad

Parad is a very effective drug. It is one of the important core ingredients in *rasaousadhies*. It balances all the three *doshas* (*vata*, *pitta* and *kapha*) of the body when processed properly. It exerts soothing effect on our body and hence prevents diseases. Some of its actions are - acts as *vrishya* (aphrodisiac), *balya* (tonic), *snigdha*, *rasayana* (rejuvenate), *vrana shodhana* and *ropana* (wound healing), *krimighna* (antimicrobial) and *yogavahi*. The medicinal properties of certain herbs increase when compounded with *Parad*. It helps in achieving a stable mind and believed to be the best destroyer of the diseases. Preparations containing *Parad* can be given with sugar, powder of amla, ginger, lemon juice, like suitable vehicle [18]. It is the only metal in liquid state which makes it unsuitable for use. So as to overcome this problem, scholars have mentioned certain procedures called as *RasaBandha* (mercurial bonds).

There are about 25 types of *Rasa Bandha* (mercury bonding procedures) given in *Rasa Ratna Samucchaya*[11,19]. One of such important procedure is *Kajjali Bandha*.

Kajjali

When *Parad* is compounded with metals, sulphur and other substances, a fine black powder is obtained[11,20]. At this point mercuric particles disappear, hence this marks the formation of *Kajjali*. The trituration time and saturation of mercuric particles with sulphur

leads to formation of *KajjaliBandha*. *Kajjali* should pass *Rekhapurnatva* and *Varitaratva* test as mentioned in the *Rasashastra* texts. Sulphur can be added to mercury in equal quantity in general or as mentioned in the text it should be added. *Kajjali* acts as *rasayana*, catalyst, antimicrobial, broad spectrum. These properties enhance efficacy, and potency of prepared drug. When *Kajjali* is mixed with other medicines, they become more potent and act at low doses. It also helps in increasing bioavailability of the drugs added[11].

KajjaliBandha

Purified *Parad* alone cannot be used since it is liquid in nature and difficult to embrace, this makes it difficult to assimilate in the body. Hence it is necessary to convert mercury in bonded form to increase its therapeutic efficacy. *Kajjalibandha* is one type of mercury bonding process where mercury is combined either with sulphur, plant, animal products or oceanic products in various ways and can be converted into solid or compound form[11].

Types of Kajjali

Depending on the ratio of mercury and sulphur, there are different types of *Kajjali*. The different types of *Kajjali* along with the proportions of *Parad* and *Gandhaka* are enlisted in the Table No. 1 [11]. However, use of even more quantity/ proportion of *Gandhaka* has been reported in the classical texts of *Rasashastra* to prepare *Kajjali*.

Table 1: Types of *Kajjali* (Black Sulphide of Mercury)

Sr no.	Nomenclature	Ratio	
		Mercury (Hg)	Sulphur (S)
1	<i>Sadamsa</i>	1	1/6
2	<i>Chaturthamsa</i>	1	1/4
3	<i>Tritiyamsa</i>	1	1/3
4	<i>Ardhaguna</i>	1	1/2
5	<i>Samaguna</i>	1	1
6	<i>Sapada Samaguna</i>	1	1 1/4
7	<i>Sardha Samaguna</i>	1	1 1/2
8	<i>Dviguna</i>	1	2
9	<i>Triguna</i>	1	3
10	<i>Chaturguna</i>	1	4
11	<i>Panchaguna</i>	1	5
12	<i>Shadguna</i>	1	6

Characterisation And Evaluation Parameters

Analysis of *Kajjali* can be done by various Ayurvedic and modern techniques. The various Ayurvedic parameters include: *Shabda*, *Rupa*, *Rasa*, *Gandha*, *Sparsha* (these represent the basic morphological evaluation according to Ayurvedic principles). The modern techniques include: composition and the structure of *Kajjali* using X-ray diffraction (XRD), Scanning electron microscopy (SEM), X-ray photoelectron spectroscopy (XPS), Particle size analyzer, Thermo-gravimetry analysis (TGA) and X-ray fluorescence (XRF), Atomic Absorption Spectroscopy (AAS)[1], Detection of mercury, detection of sulphur[21], loss on drying, powder X-ray diffraction, a transmission electron microscope (TEM), X-ray photoelectron spectra (XPS)[12], Thermograms DTA and TGA. Some of the biological parameters include: In vitro lethality test, Osmotic Fragility Test are also performed.

Purification Of Parad

Shuddha Parad (purified mercury) can be obtained by various techniques. Two such processes are *Shodhana* and *Hingula Sattvapataana*.

Parad Samanya Shodhana

Equal quantity of *Parad* and *chuna* (lime powder) was added to *khalva yantra* (mortar pestle) and grinding was done for 8 hours for 3 days. *Parad* was then separated from *chuna* and washed with water. Lime purified *parad* was then triturated with equal quantity of *rasona kalka* (garlic paste) and half quantity of *saindhava lavana* (rock salt) until blackish colour was obtained. *Parad* was then separated from the mixture washed with water until clean *Parad* was obtained[22]. (Fig No. 2)

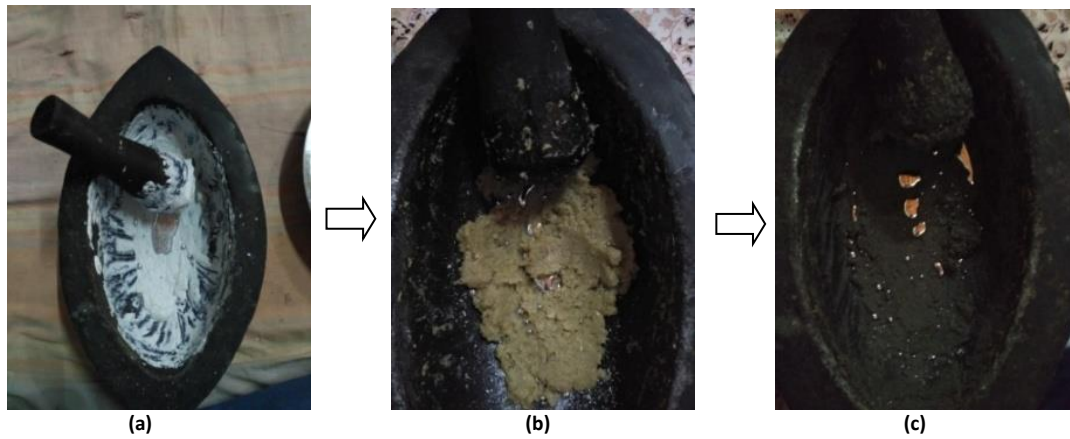


Figure 2: (a) Parad trituated with chuna (b) trituated with garlic (c) trituated till blackish mass

Hingula Sattvapataana

Parad in its purest is considered to be extracted from Hingol (Fig No. 3) (ore of Mercury sulphide). It is said that pure mercury can be extracted from Hingul (ore of HgS) does not require further purification. Hence for extracting mercury from Hingulata following methods are used.



Figure 2: Hingol

In Adhahpatana (Fig No. 4) method (sublimation and distillation) the material to be purified is mixed with lemon juice and applied to an Adhahpatana yantra. Upon applying heat to the upper earthen pot containing the mixture, Parad gets separated and gets collected in the pot below (Adhah) containing water. Hence the purified material gets accumulated in the lower surface of the earthen pot.

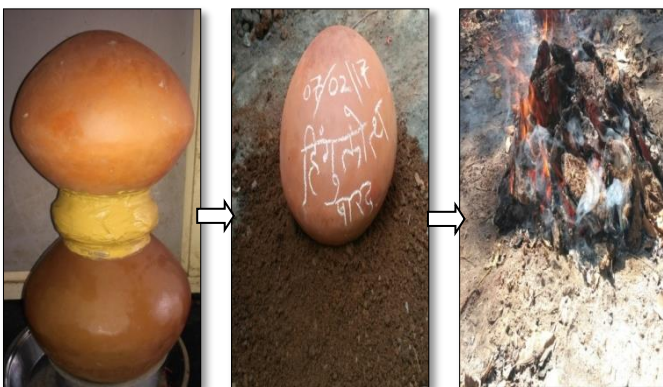


Figure 4: Adhahpatana Method

Urdhvapatana (Fig No.5) (sublimation and distillation) method is similar to Adhahpatana method. Here the mixture is applied to the earthen pot and the heat is applied below and the purified material gets accumulated on to the upper earthen pot^[23].



Figure 5: Urdhvapatana Yantra

In both the procedures, upon heating the compound vapors are formed without converting it into liquid state. This principle is therefore used for purification of compounds.

Role of Parad In Druti

Druti means liquification. In Rasashastra, it is one of the most important steps in the processing of metals/minerals. By this process, the metals/minerals which are in the solid state are usually converted into a permanent and stable liquid form. Reason for liquification is when metals/minerals are heated upto certain temperature, they melt. But after heating is stopped, temperature falls down and the material reverts back to its original state i.e. it solidifies^[21].

Parad being in the liquid state is used for the liquification of other metals/minerals (Garbhadruti) or for the mixing of the minerals/metals after their liquification done separately (Bhahyadruti). Druti is about maintaining or keeping the material in molten state permanently without any change in its desired properties. In short, it may be defined as the process of maintaining hard (solid) materials in the molten state. Methods used are Gandhadruti, Ratnadruti, Abhrakdruti and so on^[21].

Examples

Many formulations incorporating Parad are available in the market. Table No. 2 depicts the examples of formulation containing Parad^[24, 25].

Table 2: Formulation containing *Parad*

Name of The Formulation	Ingredients	Uses
<i>Rasa Sindur</i>	<i>Shudha parad, Shudha gandhak, Green Vitriole, Vatankura- Ficus benghalensis</i>	Rejuvenation, Good for heart, cardiac stimulant, Syphilis, Genital disorders, urinary problem Cough, cold, asthma, chronic respiratory problem, Weakness
<i>Jwaramurari Rasa</i>	<i>Shodita Hingula, Shodhita, Vatsanabha, Shodita Tankana, Shodita jayapala, Pippali, Maricha, Shunti, Abhaya, Nagara</i>	Jwara (Fever)
<i>Tarakeshwara Rasa</i>	<i>Mritasuta- Rasabhasma, Shudha parad, Shudha gandhak, Abhakra Bhasma, Madhu (quantity sufficient for grinding for one day)</i>	Treatment of polyurea – frequent urination.
<i>Panchavakta Ras</i>	<i>Shudha parad (mercury), Shudha gandahaka (sulphur), Tankana (borax), Pippali (Piper longum), Marica (Piper nigrum)</i> Process: mardhana with juice of <i>Datura metel leaves</i>	Treatment of rheumatoid arthritis
Sutshekhar Rasa	Shuddha Parada, Tankana bhasma, Shuddha vatsanabha, Shunti, Maricha, Pippali, Datura, Gandhaka, Tamra bhasma, Ela, Twak, Patra, Nagakeshara, Fruit pulp of bilva, Kachura, Juice extract of bhringraja	Treatment of Dyspepsia, gastritis, vomiting, abdominal colic, cough, cold, diarrhoea, dysentery, bloating and indigestion.

Toxicity Determination^[26]

The different methods of determining toxicity of *Parad* in using various biological parameters are as follows:

1. Determination of toxic dose
2. Effect of antioxidant enzymes
3. Estimation of glutathione
4. Experimental Animals
5. Determination of Biochemical Parameters
6. Toxicological studies
7. Estimation of superoxide dismutase
8. Estimation of TBARS
9. Experimental Design
10. Blood Samples Collection and Preparation of Plasma

These tests are conducted *in-vivo* in experimental animals and also *in-vitro* using simulated laboratory setups.

CONCLUSION

Human body is a complex entity and the understanding of its organization is done in a number of ways such as structural, biochemical, functional, etc. Allopathic system of medicine orients itself towards the structural perspective of the human body whereas the ancient Ayurvedic system considers the perspective of functions / *tridoshas (vata, pitta and kapha)*.

The separate branch of Ayurveda i.e. *Rasashastra* has been designated following the use of metals/ minerals. Nevertheless these have to undergo various types of pre-treatments to lose their toxicity and increase their potency. In the recent past, some research publication indicated that these preparations are anti-oxidants, fighting free radicals and diseases causing organisms and also help in developing immunity. One of these important metal/ mineral is mercury – *Rasashastra/ Parad*. The very fact that the branch *Rasashastra* has been named after *Rasa/ Parad* indicates its effectiveness. The description, role, purification of *Parad* along with the various examples of formulation, safety concern and toxicity determination have been discussed in the review.

We can conclude that, it is incorrect to defame Ayurvedic system of medicine with mere reports those of unacceptable levels of heavy metals in Ayurvedic preparation. We can reap benefits from age-old remedies only by utilizing and adopting sophisticated technology for exploring the knowledge there in.

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Author Contribution

All the authors have authored and technically reviewed the paper.

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