Int. J. Ayur. Pharma Research, 2014; 2(1): 55-67 **ISSN: 2322 - 0910**

International Journal of Ayurveda and Pharma Research

Research Article

PHYSICO - CHEMICAL STUDY OF DIFFERENT METHODS OF *PARADA SAMANYA SHODHANA*

T. Venkateshwar[1*], P. Bhadra Dev[2], P.H.C Murthy[3], G.K. Swamy[3]

[1*]P.G. Scholar, [2]Supervisor, [3]Co-Supervisor, Dept. of Rasashastra, Dr.N.R.S.Govt. Ayurvedic College, Vijayawada, Andhra Pradesh, India.

[3]Assistant Director, Scientist-4, National Ayurveda Research Institute for Vector Borne Disease, Vijayawada, Andhra Pradesh, India.

Received on: 09/02/2014 Revised on: 13/02/2014 Accepted on: 26/02/2014

ABSTRACT

Shodhana (purification) is an important concept in *Rasashastra*, it is said that every drug should be subjected to *Shodhana* before its internal use and Mercury is no exception. Owing to its origin or other causes, Mercury is likely to be associated with different types of impurities of various degrees. Though many *Doshas* are attributed to Mercury Naga (Lead), *Vanga* (Tin) *Doshas* are considered the major ones. With the help of advanced chemical analytical techniques, quantitative detection of lead and tin contents in Mercury is possible to-day. Chemical analysis for lead and tin contents in Mercury before *Shodhana* i.e. unprocessed and after *Shodhana* i.e. processed leads to conformation of Naga, *Vanga Doshas* in Mercury. At the same time efficacy of the purificatory methods can be assessed by observing the reduction in percentage of lead and tin content in processed Mercury. Keeping this idea in mind, the present study "Physico-Chemical Study of different methods of *Parada Samanya shodhana*" was under taken. All *Samanya shodhana* methods were screened to find out the most easy, quickest method and four methods were selected for this study. During the pharmaceutical work, time consumption, yield, and cost were taken into account in each selected purificatory methods.

Four purified samples of Mercury along with raw sample of Mercury were sent for chemical analysis to SASTRA University, Tanjavur and samples were analyzed by using Atomic absorption spectroscopy (AAS). Depending upon the practical observation and statistical analysis it is concluded that Naga and *Vanga*- lead and tin are same respectively. All purificatory methods are effective in reducing lead and tin content that contaminate Mercury. The fourth method which consisted of triturating Mercury with *Nagavalli swarasa*, *Ardraka swarasa* and *Triksara* is most efficacious, quick, economic and more yielding method among the four selected *Samanya shodhan* methods. Apart from the criteria of good yield, and economy the *Hingulotta parada* and second method in which Mercury is triturated with *Sudha churna*, *Lasuna kalka*, and *Saindhava lavana* are more viable methods.

KEYWORDS: *Parada*, Mercury, *Samanya Shodhana*, Purification, Atomic Absorption Spectrometry, *Naga*, *Vanga.*

INTRODUCTION

Parada is known to the mankind since time immemorial. Though it is an extract of ores like *Hingula*, etc. it was known to people earlier than the latter probably because of its occurrence in native form. It is a difficult venture to say in a clear cut way whether *Parada* processes were familiar to the mankind at the time of the Vedas. No exact hymns can be found but in *Atharvaveda*, there is a hymn saying about onset of diseases and their treatment, which suggests about the probable prevalence of knowledge of *Parada* (AV-7/50).

Origin

There is a popular mythological story attached to the origin of *Parada* in Rasa texts. This depicts the conjugal act of *Parvathi* and

Shiva resulting in the outcome of *Parada* as the semen of Lord Shiva[1].

Events of this mythological story resembles scientifically with the sequences of events that occur prior, during and after volcano-eruption, resulting in to the origin of the metals including Mercury.

Yougika Doshas

All most all *Rasacharyas* have considered *Naga*, *Vanga* as *Yougika doshas* of *Parada*.

With a view to achieve the object of removing the sufferings and miseries of all living subjects, in the world, different types of drugs that are found in nature have been used by ancient scholars. The use of metals and minerals come later in the series. The use of mineral drugs in therapeutic drugs has been started from the period of classical texts but the usage is limited to certain diseases only. Their frequency has started only after the development of *Rasashastra* as a separate branch of Pharmaco-therapeutics around 8th century A.D.

Metals and minerals recognized for their therapeutic value, Mercury was given prime importance. It is because of its power to influence the properties of other drugs to such an extent, that sometimes they completely lose their original identity. Thus a specialized branch of learning and therapy known as *Rasashastra* or *Rasachikista* has emerged in the field of Indian medicine in the name of Mercurial system.

In *Rasashastra* all the drugs cannot be adopted for therapeutic purposes without purification. Mercury is no exception. Owing to their origin all the metallic and mineral drugs are likely to be associated with different varieties of impurities up to various degrees. Hence, they are advised to be processed with certain specific methods before their internal use. These methods are called *Shodhana* and they occupy a major portion of *Rasashatra* processing. These *Shodhana* procedures play a very important role in making metallic and mineral preparations free of toxicity and highly absorbable for quicker therapeutic effects even in minute doses.

Mercury being one of the metallic drugs possesses variety of impurities like all other drugs of metallic and mineral origin. These impurities produce different toxic effects in the body ranging from fever to death. Since Mercury is invariably a major constituent in most of the rasa preparations, it needs thorough purification and detoxification to render it fit for internal use.

Some questions have been making scholars restless since many years. Whether *Naga*, *Vanga doshas* which were mentioned in Rasa texts are same to Lead (Pb), Tin (Sn) or different? Can these tin, lead be removed or reduced by mentioned *Shodhana* procedures. Except some theoretical and hypothetical explanations were made by some authors in their Rasa texts, no work has been observed to resolve this ambiguity experimentally.

As a matter of fact there is no need to establish the Ayurvedic basics once again on the modern methodology of scientific exploration, since there are in practice and in action since times immemorial but time has come to validate these ancient methods on modern parameters to attract the modern generation to its fold. It is quite desirable to a certain extent to try out these principles on modern methodology, which can only further strengthen the system in the long run.

Atomic Absorption Spectroscopy (AAS) and inductively coupled plasma mass spectroscopy (ICPMS) are the most accurate and sensitive elemental analytical methods available for the quantitative determination of metals and metalloids down to absolute amounts as low as 10^{-14} g. hence, the present study titled "Physico-Chemical study of different methods of *Parada Samanya Shodhana*" has been under taken.

Aims and objective of the study

1. To understand the concept of *Shodhana* of *Parada*.
2. The quantitative determination of the impurities Lead (Pb), Tin (Sn) in both market (raw) and purified samples of *Parada* on modern analytical methods.
3. To confirm the impurities in *Parada*.
4. To highlight the efficacy of *Parada Samanya Shodhana*.
5. To find out the most effective, economic, easy and quick procedure among the selected methods of *Parada Samanya Shodhana.*

METHODS AND MATERIAL

- Purification of *Parada*
- Purification of *Hingula*
- Extraction of *Parada* from *Hingula*
- Analytical study of Raw *Parada* and Purified *Parada to* quantitative determination of Lead (Pb), Tin (Sn) in market (raw) and purified samples of Mercury at concern research centre.
- Obtained results are formulated on statistical principles and methods in accordance with the efficacy, expenditure, time consumption and yield of the purificatory methods.

PHARMACEUTICAL STUDY

Parada possesses impurities because it occurs in the mines in which large quantities of ores of other metals like Lead, Tin etc. are present. The drugs prepared from such *Parada* definitely produce bad effects. According to *Rasa* texts, only *Shodhit Parada* is recommended for use in the manufacturing of medicines. For that ancient scientists and metallurgists had developed and devised many such procedures to obtain *Parada* free from impurities and to make it effective in combating diseases. These all procedures collectively called as *Parada shodhana* methods.

At early stages in the development of *Rasashastra*, *Ashta samskaras* were only means of purifying *Parada*, but later on easy techniques were invented and named as *Parada Samanya shodhana*. Many of such *Samanya shodhana* procedures are found in various Rasa texts. These procedures are easy, comfortable, economic, quick and fast (less time taking), having minimum loss after shodhana.

So, for this present study, the *Samanya shodhana* procedures were carried out in four different methods mentioned in *Rasashastra* text.

All the raw material was procured from local market of Vijayawada and the experiments were carried out in P.G Dept. of Rasashastra, Dr. NRS Govt. Ayurvedic College, Vijayawada, Andhra Pradesh, India.

First method

Hingulottha Parada (Extraction of mercury from *Hingula*)

The whole procedure was divided in to two stages

1. *Hingula shodhana*
2. *Hingulottha rasa*

1. Hingula shodhana (purification of cinnabar)

Raw *Hingula* is taken in a clean and dry *khalva yantra* and pounded well to prepare fine powder and this fine powdered *Hingula* was subjected to *Bhavana* with *Ardraka svarasa* (juice of *Zingiber officinalis* ROXB.) until whole mixture gets completely dried. The same procedure is repeated for seven times to get purified *Hingula*[2] .

Table 1: Showing result of *Hinguala Shodhan*

S.No	Details	Result
1.	Quantity of raw *Hingula* taken	1 Kg
2.	Quantity of the *Ardraka swarasa* taken	Q.s
3.	Quantity of obtained *Shodhita Hingula*	942 gms
4.	Difference	58gr (loss)
5.	Duration	40 Hrs
6.	Expenditure	1850 Rs
7.	Date of commencement	4-1-07
8.	Date of completion	7-1-07

2. *Hingulottha Parada*

Shodhit Hingula is taken in a *Khalvayantra* and is rubbed with *Ardraka svarasa* to make paste. Then the paste is coated on the inner surface of the bottom of the lower pot of *Urdhwapatana yantra* and is allowed to dry in sunlight. The second pot of *Urdhwapatana yantra* is kept on the first one inversely, so that two mouths of the pots are closely associated with one another. Then the joint is sealed with a cloth piece soaked in *Multani mitti* for seven times and is allowed to dry in sunlight. A circular wall of 4 inches height (*Toyadhar*) is arranged over the upper surface of the top pot with mud, for pouring water in it.

The total apparatus is kept on the hearth and is subjected to slow process heating for six hours. After *Svangasita* (self cooling) of apparatus, *Sandhi bandhana* is opened. A thin layer of *Parada* is obtained on the inner surface of upper pot and is collected by scratching with the help of brush[3].

Table 2: Showing result of process *Hingulottha ras*

S.No	Details	Result
1.	Quantity of *Shodhit Hingula* taken	942 gms
2.	Quantity of *Ardraka swarasa* taken	Q.s
3.	Quantity of obtained *Parada*	470 gms
4.	Weight of the black powder in the bottom of lower pot	325 gms
5.	Duration	38 Hrs
6.	Expenditure	100 Rs
7.	Date of commencement	8-1-07
8.	Date of completion	9-1-07

Table 3: Showing result of 1st method

S.No	Details	Result
1.	Quantity of *Hingula* taken	1 Kg
2.	Quantity of *Parada* obtained	470 gms
3.	Difference	530 gms
4.	Total duration	40+38=78 Hrs
5.	Total expenditure	1850+100= 1950 Rs

Second method

Parada is taken with equal quantity of *Sudha churna* (lime powder) in a granite *Khalva yantra*. It is subjected to *Mardana* (grinding) for eight hours in a day for three days. Then it is filtered through a double folded cloth to obtain the Parada. Obtained mass from above step is taken in a *Khalva yantra*, equal amount of *Lashuna kalka* (paste of *Allium sativum* L.) and half the amount of *Saindhava lavanaa* (rock salt) is added. *Mardana* is again done until the mixture become black. Then washing and decanting is applied with the help of lukewarm water for several times to get a clear *Parada*[4].

Table 4: Showing result of 2nd method

S.No	DETAILS	Result
1.	Quantity of raw Parada taken	1 Kg
2.	Quantity of *Sudha churna* taken	1 Kg
3.	Quantity of *Lasuna kalka* taken	1 kg
4.	Quantity of *Saindhava lavana* taken	500 gms
5.	Quantity of obtained *Shodhit Parada*	840 gms
6.	Difference	160 gms (loss)
7.	Total duration	40 Hrs
8.	Total expenditure	1200 Rs
9.	Date of commencement	16-1-07
10.	Date of completion	21-1-07

Third method

Take 1 part of *Parada*, 1/16th part *Haridra churna* (*Curcuma longa* L.) and *Kumari svarasa* (juice of *Aloe vera* L.) each in a *Khalva yantra*. The mixture is subjected to *Mardana* for 8 hrs. Then the paste is coated on the inner surface of the bottom of the lower pot of *Urdhwapatana yantra* and is allowed to dry in sunlight. Second pot of *Urdhwapatana yantra* is kept on the first one inversely, so that the two mouths of the pots are closely associated with one another. Then the joint is sealed with a cloth piece soaked in *Multani mitti* for seven times and is allowed to dry in sunlight. A circular wall of 4 inches height (*Toyadhar*) is arranged over the upper surface of the top pot with mud, for pouring water in it. *Urdhwapatana* yantra is kept on the hearth and is subjected to *slow* heating process for six hours. After *Svangasita* of *Urdhwapatana yantra, Sandhi bandana* is opened. A thin layer of *Parada* is obtained on the inner surface of upper pot. A considerable amount of black powder was got in the bottom of the lower pot. Obtained *Parada* is silvery white[5].

Table 5: Showing result of 3rd method

S.No	Details	Result
1.	Quantity of raw *Parada* taken	1 Kg
2.	Quantity of *Haridra churna* taken	53 gms
3.	*Kumari swarasa*	Q.s
4.	Quantity of obtained *Shodhit Parada*	940 gms
5.	Weight of the black powder obtained in the bottom of the lower pot	20 gms
6.	Difference	60 gms (loss)
7.	Total duration	40 Hrs
8.	Total expenditure	1100 Rs
9.	Date of commencement	20-2-07
10.	Date of completion	23-2-07

Fourth method

Parada is taken with *Nagavalli swarasa*, *Ardraka swarasa* and *Triksar* in a clean *Khalwa yantra*. The mixture is subjected to *Mardana* for eight hours in day for three days. Then washing and decanting is applied with the help of lukewarm water for several times to get purified *Parada*[6].

Table 6: *Showing result of 4th method*

S.No	Details	Result
1.	Quantity of raw *Parada* taken	1 Kg
2.	*Nagavalli svarasa, Ardraka swarasa*	Q.s
3.	*Triksara*	600 gms
4.	Quantity of obtained *Shodhit Parada*	940 gms
5.	Difference	60 gms (loss)
6.	Total duration	26 Hrs
7.	Total expenditure	1100 Rs
8.	Date of commencement	3-3-07
9.	Date of completion	5-3-07

ANALYTICAL STUDY

This section of the study deals with the methodology adopted for analyzing Lead, Tin contents in Mercury. 5 grm of Mercury is taken from the four purified and raw samples in separate clean glass bottles and were labeled. Analytical study was carried out in SASTRA University, Tanjavur, Tamilnadu by using Atomic absorption spectroscopy.

Quantitative chemical analysis of raw *Parada* and *Sodhitha Parada*:

Atomic absorption spectroscopy

Four purified samples of Mercury along with raw sample of Mercury were sent to the laboratory to find the amount of elements in ppm level.

Aim

To analyze the pure and impure mercury by using AAS technique to determine the impurities present in the mercury and rule out the quantity of these impurities.

Instrument: Atomic Absorption Spectrometry

Atomic absorption spectrometry (AAS) is an analytical technique that measures the concentrations of elements. Atomic absorption is so sensitive that it can measure parts per billion of a gram (g dm^3) in a sample. The technique makes use of the wavelengths of light specifically absorbed by an element. They correspond to the energies needed to promote electrons from one energy level to another higher energy level.

Principle

Atomic absorption is the process that occurs when a ground state atom absorbs energy in the form of light of a specific wavelength and is elevated to an excited state. The amount of light energy absorbed at this wavelength will increase as the number of atoms of the selected element in the light path increases. The relationship between the amount of light absorbed and the concentration of analysis present in known standards can be used to determine unknown sample concentration by measuring the amount of light they absorb.

The absorption of light is proportional to the concentration of free atoms in the flame. It is given by Lambert-beer law.

Absorbance (A) = $\log_{10} I_0/I_t = k.c.l$

Where,

I_0 = intensity of incident radiation emitted by the light source

I_t = intensity of transmitted radiation

c = concentration of sample (free atoms)

k = consent

l = path length

Methodology for Metal Analysis

a. Sample collection

5 gms of Mercury is taken from the four purified and raw samples in separate clean glass bottles and were labeled as Sample 1, 2, 3, 4, 5.

b. Reagents and apparatus

All the reagents such as HNO_3, HCl, H_2O_2, Sodium Borohydride ($NaBH_4$), Sodium Hydroxide (NaOH) etc. are purchased from MERCK. Millipore water is used for all analytical works. All the digestion vessels, Polyethylene bottles (sample container) Micro Pipette tips and others are washed with 10 % HCl, rinsed with de-ionized water before preparing standards, reagents and samples.

c. Digestion of samples (Sample Preparation)

A Multiwave 3000 Micro oven system (from Anton paar, USA) with 16 position teflon vessels with capping was used for digestion

process. The digestion vessels are provided with a controlled pressure, temperature and release valve. Before use, all Teflon vessels are soaked with 10% HNO_3. The system is initially programmed by giving gradual rise of 20%, 40%, and 50% power for 5, 15 and 20 minutes, respectively for the due warming up. The powder samples are being used without any further treatment for sample preparation. 0.2 gm of sample is weighed into the Teflon vessels, followed by digestion mixture of HNO_3, HCl & H_2O_2 in the ratio of 3:1:1 according to the nature of samples is being applied.

The resulting solution after microwave digestion is filtered through whatman # 40 filter paper (if necessary) and diluted to 50 ml with Millipore water. A sample blank containing only acid mixture is prepared at the same time. The method of standard addition is generally adapted to calibrate the instrument before going for the observation of the samples.

Determination of Metals

All the atomic measurements are carried out with Perkin Elmer model 400/HGA900/AS800 coupled with Mercury Hydride System-15 (MHS-15). Electrode-less Discharge Lamp (EDL) for Cd, Pb, Hg & As and Hollow Cathode Lamp for Sn Fe, Cu, Zn etc analysis are used as a light source to provide specific wavelength of the elements to be determined and high purity (99.999 %) Acetylene is used to provide constant thermal energy for atomization process. Argon gas is used as carrier gas for purging purposes of Graphite furnace to the analysis of As and Hg by Mercury Hydride System (MHS-15).

Calibration of instruments

More than three working standard solutions of the respective element to be determined have to be prepared. Before the analysis of samples, the instrument is calibrated with prepared working standard solution. The calibration curve is obtained for concentration vs. absorbance data by statically analyzed mode. Calibration of the instrument is repeated periodically during operations and blanks are carried with each set of 10 samples or aspirate any one of the prepared working standards for every 10 samples to check the instrument drift and to validate analytical procedures and performance. Reagent blank reading is taken and necessary correction is made during the calculation of concentration of various elements.

Standard Certified Reference (SRM) of National Institute of Standard and Technology (NIST) is used for day-to-day evaluation of methods of analysis or test and for long-term quality assurance of measurements.

Sn, Fe, Cu, Zn, Cd, Pb, As etc., analysis by Flame AAS/Graphite furnace

After calibrating the instrument with prepared working standard, the digested liquid sample solution is subjected to analysis of Sn, Fe, Cu, Zn Cd, Pb, As etc by flame/Graphite furnace with specific instrumental conditions as given by instruments manufacturer. Introduce the solution into flame, record the reading, using the mean of the three readings. The quantity of the concentration of the respective metal is provided after verifying the programmed calibration of the reading with the standard calibration curve of the respective element obtained from Concentration vs. Absorbance of the prepared known concentration on the day of the analysis.

Hg analysis by Cold Vapour Method using Mercury Hydride System (MHS-15)

After calibrating the instrument with prepared working standard, the 10 ml of digested liquid sample is pipetted out to a specific container of Mercury Hydride system analyzer followed by adding 10 ml 1.5 % of HCl as diluent for each flask and blank, 3 % of NaBH4 solution in 1 % of NaOH in reaction flask. The digested sample is run through the reaction flask to quartz cell. It is done without any heating. As there is a standard curve already calibrated in the programmed, the values are printed out after calibrating with the standard curve obtained from concentration vs absorbance of the prepared known concentration on the day of the analysis.

Interferences and matrix modification

Other chemicals that are present in the sample may affect the atomization process. For example, in flame atomic absorption, phosphate ions may react with calcium ions to form calcium pyrophosphate. This does not dissociate in the flame and therefore results in a low reading for calcium. This problem is avoided by adding different reagents to the sample that may react with the phosphate to give a more volatile compound that is dissociated easily. Lanthanum nitrate solution is added to samples containing calcium to tie up the phosphate and to allow the calcium to be

atomized, making the calcium absorbance independent of the amount of phosphate. With electro thermal atomization, chemical modifiers can be added which react with an interfering substance in the sample to make it more volatile than the analyzed compound. This volatile component vaporizes at a relatively low temperature and is removed during the low and medium temperature stages of electro thermal atomization.

RESULTS

After purification of Parada the whole study correlate with the statistical analysis of obtained values, in accordance with efficacy, expenditure, time consumption and yield of the purificatory methods.

Table 7: Showing Heavy metal (Pb, Sn) analysis result

S.no	Label	Lead (Pb) in ppm	Tin (Sn) in ppm
1.	Sample 1	6.3400	6.7560
2.	Sample 2	1.6130	3.9230
3.	Sample 3	1.3130	3.5220
4.	Sample 4	1.1750	10.930
5.	Sample 5	0.9036	2.6090

Table 8: Showing time consumption, expenditure, yield of each purificatory method

S.No	Method	Time consumption	Expenditure	Yield
1.	Method-1	78 hrs	Rs 1950	470 gms
2.	Method-2	40 hrs	Rs 1200	840 gms
3.	Method-3	40 hrs	Rs 1100	940 gms
4	Method-4	26 hrs	Rs 1100	940 gms

Table 9: Showing statistical analysis of purificatory methods in reducing Pb Content in Mercury

	IMPS	PS	D
MGS	6.340	1.2512	5.088
S.D.	± 1.453	± 0.645	± 1.302
S.E.	0.727	0.323	0.651
t			7.814
P			< 0.001

Table 10: Showing statistical analysis of purificatory methods in reducing Sn Content in Mercury

	IMPS	PS	D
MGS	6.756	5.246	2.416
S.D.	± 3.001	± 2.644	± 1.418
S.E.	1.501	1.322	0.709
t			3.405
P			< 0.01

IMPS = Impure Sample

PS = Pured Sample;

D = Difference between IMPS & PS

M.G.S. = Mean Grade Score;

S.D. = Standard Deviation;

S.E. = Standard Error;

t = Student's Paired 't' Test;

P = Probability

DISCUSSION

Due to the power of enhancing the properties of other drugs and also influencing the bodily tissues to a greater extent in order to bring about normalcy in their activity, Mercury has been placed on the top of all therapeutic agents. In the present study, a careful analytical observation of Mercury before and after certain purificatory measures has been planned. Accordingly, it has been carried out in a renowned center of excellence in the study of pharmaceutical sciences i.e. SASTRA University, Tanjavur.

The initial *Shodhana* analytical studies of the market sample has led to conformation of presence of impurities like Lead, Tin etc. In the pharmaceutical study of the present dissertation it is observed that *Hingulottha Parada* of *Rasaratna Samucchaya*-3/153-154, *Samanya shodhana* as per Rasatarangini-5/27-29, *Samanya shodhana* as per 1/164 of *Ayurved Prakash* and *Samanya shodhana*-5/34-35 of *Rasatarangini* have been finalized after careful review for practical purposes.

Purified *Hingula* was taken for *Hingulottha* rasa practical, after purification *Hingula* was seen turning from hard-rough-brownish red crystalline form to orange red, soft powder. The technique of *Urdhwa patana yantra* has been adopted for extracting Mercury from *Hingula* as per *Rasaratna Samucchaya*. At the end of the practical, it was observed that Parada got sublimated as blackish grey powder depositing in the inner surface of the upper pot.

A considerable amount i.e.325 gms of black powder was left at bottom along with residue.

In the *Samanya shodhana* as per *Rasatarangini* 5/27-29, after *mardana* with *Sudha churna* the colour of *Sudha churna* was turned to grey. Mercury has become small globules when ground along with *Lasuna kalka* and *Saindhava lavana*. After washing with warm water, Mercury became blemish less, pearly and lustrous.

Another method of *Samanya shodhana* has been carried out on Parada as per *Ayurved Prakash* 1/164 in which *Mardana* with *Haridra churna* and *Kumari swarasa* has been done followed by *Urdhwa patana*. In this grinding process Mercury was divided into small globules, in the process of *Urdhwa patana* the sublimate was like a thin layer silvery grey in colour with very small globules in the inner side of the upper pot was formed. There was also some amount of black powder left in the lower pot. The Mercury after collection was bright and silvery white in colour.

In another method of *Samanya shodhana*, the process adopted was as per Rasatarangini-5/34-35, in which grinding with *Nagavalli swarasa, Ardraka swarasa* and *Triksara* was done followed by washing with warm water. Mercury has readily disintegrated into small globules during *mardana* with the above drugs. For external looks Mercury appeared in silvery white colour.

In the analytical study with the help of Atomic absorption spectroscopy (AAS) heavy metals (Pb, Sn) are analysed. In the sample-1 which is raw Mercury, lead is 6.3400 ppm while tin is 6.7560 ppm, in *Hingulottha parada* as per Rasaratna samucchaya of sample-2, the lead content is 1.6130 ppm and tin is 3.9230ppm. In *Samany shodhita* Mercury as per *Rasatarangini* 5/27-29 i.e., sample-3 the lead content came up to 1.3130 ppm and tin was 3.5220 ppm, in sample-4 which was purified of *Haridra churna* and *Kumari swarasa* as per *Ayurved Prakash* 1/164 the lead content is 1.1750 ppm while tin is 10.930 ppm, in sample-5 which is also reference of *Rasatarangini* the lead content is 0.9036 ppm while tin is 2.6090 ppm. Lead and tin contents in all samples of Mercury considerably decreased except tin content in fourth sample.

The mean difference in reduction of lead content in Mercury was found highly significant ($P < 0.001$) in all four purificatory methods.

The statistical diagram-1 shows high significance in reduction of lead content in Mercury in the fourth method of purification while compared with other methods of purification. Gradually decreasing pattern in reduction of lead content were seen in third, second and first purificatory methods in the order.

The mean difference in reduction of tin content was found significant ($P < 0.01$) in all the purificatory methods except third method of purification.

The statistical diagram-2 shows highly significant reduction of tin content in the fourth method of purification, second and first methods of purification stand in second and third position in the reduction of tin content in Mercury. But increased levels of tin content rather than the raw sample of Mercury is seen in third method of purification.

The statistical diagram-3 shows the time consumption of each purificatory method. Fourth method of purification was found lowest in duration of the time i.e.26 hrs. Second and third methods were completed each in 40 hrs, where as the first method was completed in highest duration i.e.78 hrs.

The statistical diagram-4 shows analysis of expenditure of each purificatory method. Fourth and third methods were of least expenditure i.e. Rs 1100. Expenditure of second method was Rs1200 and the first method was highly expensive with the cost of Rs 1950.

The statistical diagram -5 shows the analysis of yield for 1000 gms of Mercury. Third and fourth methods of purification were found highest in yield i.e. 940 gms each. 840 gms of yield was found in second method of purification and first method of purification was found least in yield analysis, out of 1000 gms of *Hingula* only 470 gms yield of Mercury was obtained.

CONCLUSION

Basing on the observations made during the collections of the samples and carrying out the purificatory procedures of Mercury and also the analytical study the following concluded.

1. Naga and *Vanga doshas* which are attributed to Mercury are same to lead (Pb) and tin (Sn) respectively.

2. All selected purificatory methods are effective in reducing the lead content in Mercury,
3. Excepting the process in which Mercury is triturated with *Haridra churna* and *Kumari swarasa,* all selected purificatory procedures are effective in reducing tin contents in Mercury.
4. The process of grinding Mercury with *Nagavalli swarasa, Ardraka swarasa*, and *Trikshara* is the most efficacious, quickest, economic and more yielding method respectively among the four selected *Samanya shodhana* methods.
5. Apart from the criteria of good yield, economy the *Hingulotta parada* and the method in which Mercury is triturated with *Sudha churna, Lasuna kalka,* and *Saindhava lavana* are more viable methods.
6. Since there is possibility of contamination in *Haridra churna*, the purificatory method in which Mercury is triturated with *Haridra churna* and *Kumari swarasa* followed by *Urdhwapatana*, does not seem to be viable.

ACKNOWLEDGEMENT

The authors are highly acknowledgeable to Dr. G. Victor Rajamanickam, Dean, Mr. Subbu Moscow, Tech. Asst. Dept of AAS, Centre for Advanced Research in Indian System of Medicine (CARISM), SASTRA University, Thanjavur, Tamilnadu, for their timely help in completion of A.A.S. and Chemical analysis study.

I express my sincere gratitude to my Guide Dr. P. Bhadra Dev and Co-Guides Dr. PHC. Murthy and Dr. G. K. Swamy, M.D (Ayu), Assistant Director RRI, Vijayawada, for his prolific, expedient and invulnerable suggestions.

I would like to acknowledge the support extended by our principal Dr. Bhushanam M.D (Ayu) in all aspects of the present study.

REFERENCES

1. Rasaratna samucchaya by Vaghata, English translation by Dr. Ashok D. Satpute, Chaukhambha Sanskrit Prakashan, Delhi 2003; 11-12
2. Rasaratna samucchaya by Vaghata, English translation by Dr. Ashok D. Satpute, Chaukhambha Sanskrit Prakashan, Delhi 2003; 82
3. Rasaratna samucchaya by Vaghata, English translation by Dr. Ashok D. Satpute, Chaukhambha Sanskrit Prakashan, Delhi 2003; 82
4. Rasa Tarangini by Pranacharya Sri Sadananda Sharma edited by Pandita Kashinath Shastry published by Motilal Banarasidas, New Delhi. Reprint: 2004; pp. 79-80
5. Ayurveda Prakash of madhava edited by gulrajsharma mishra chaukhamba bharathi academy Varanasi. Reprint: 2007 92
6. Rasa Tarangini by Pranacharya Sri Sadananda Sharma edited by Pandita Kashinath Shastry published by Motilal Banarasidas, New Delhi. Reprint: 2004; pp. 81

Cite this article as:
T. Venkateshwar, P. Bhadra Dev, P.H.C Murthy, G.K. Swamy. Physico - Chemical Study of Different Methods of Parada Samanya Shodhana.Int. J. Ayur. Pharma Research 2014; 2 (1): 55-67

Source of support: Nil, Conflict of interest: None Declared

***Address for correspondence**
Dr. T. Venkateshwar
Assistance Professor
Department of Rasashastra and Bhaishajya Kalpana, Shree Vageshwari Ayurved Medical College, Beside LMD Police Station Ramkrishna Colony, Karimnagar, Andhra Pradesh, India.
Email: tiruvengala2@gmail.com
Phone: +919848657906

INGREDIENTS USED FOR *PARADA* PURIFICATION METHODS

1. *Parada* (Mercury)

2. *Hingula* (Cinnabar)

3. *Ardraka* (Ginger)

4.*Sudha churna* (Lime)

5. *Lasuna* (Garlic)

6. *Saindhava laivana* (Rocksalt)

7. *Kumari* (Aloe)

8.*Haridra* (Turmeric)

9.*Nagavalli* (Betel leaf)

10. *Tankana* (Borax)

11.*Svarji ksara*

12. *Yava ksara*

13. *Hingula urdhwapatana*

14. *Hingulottha parada*

15. *Parada Urdhwapatana*

16. *Urdhwapatita parada*

17. *Parada Mardana* with *Sudhachurna*

18. *Parada Mardana* with *Nagavalli rasa*

Diagram-1: The bar-diagram showing the Lead content in Mercury samples

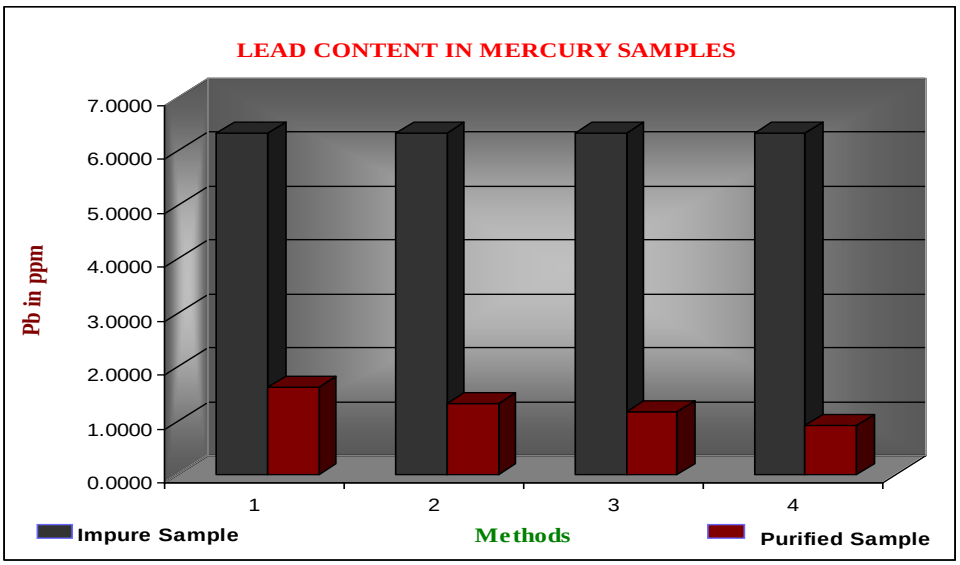

Diagram-2: The bar-diagram showing tin content in Mercury samples

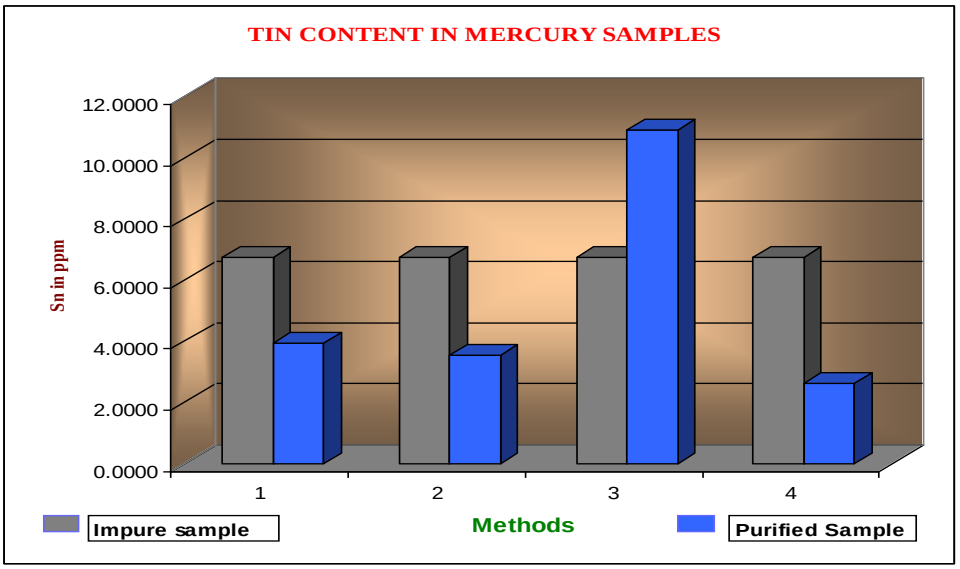

Diagram-3: The histogram showing analysis of time consumption

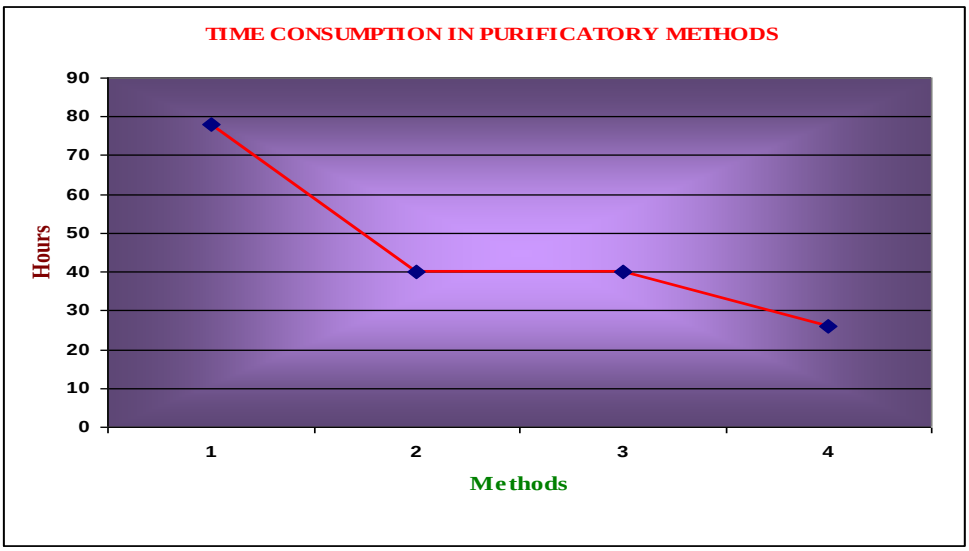

Diagram-4: The histogram showing analysis of expenditure

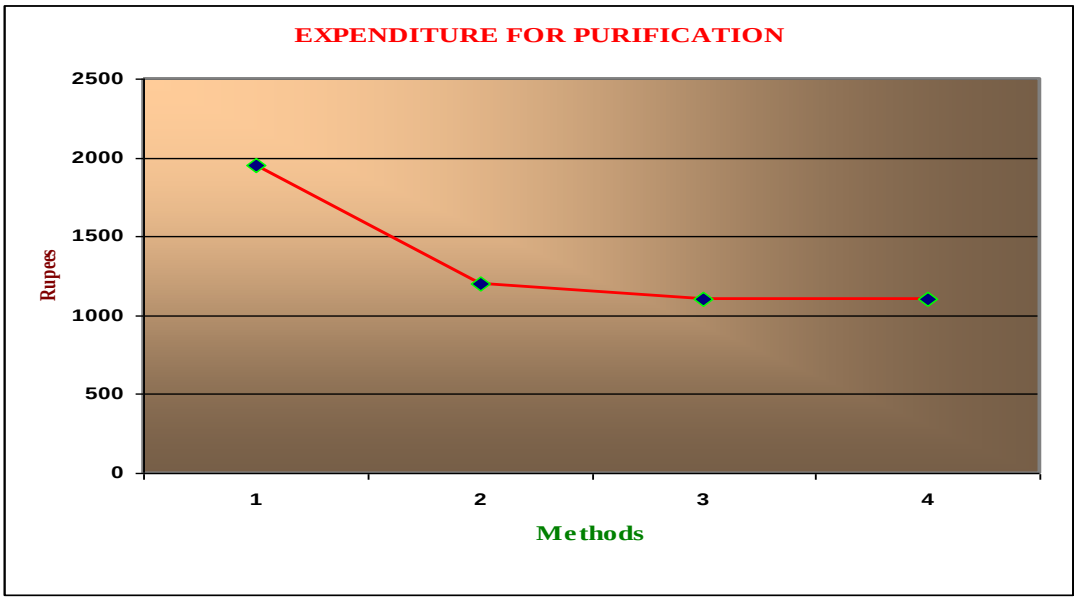

Diagram-5: The pie-diagram showing yield analysis of Mercury