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A critical review on different methods of *Shodhana* of *Gandhaka* w.s.r. to its Chemical Characteristics

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ABSTRACT

Introduction: *Gandhaka* has always been an interesting non- metal to be studied by *Ayurvedic* scholars. Its ability to exist in different forms and exhibiting different characteristics intrigued our ancestors. Hence *Gandhaka* is given importance second to *Parada*. **Materials & Methods:** *Gandhaka Shodhana* can be carried out in different ways, of which 4 unique methods are compiled and analysed in detail. The methods incorporated *Dalana, Swedana, Patana* and *Puta* method. **Discussion:** Sulphur exists in different allotropes. Each allotrope exhibits different chemical properties which are utilized by our *Acharyas* in intelligent ways. **Conclusion:** *Gandhaka* even fascinates the present-day scientists and is being studied in detail. If properly studied by Ayurvedic scholars, it can be valuable addition to the field of *Rasachikitsa.*

Key words: *Gandhaka, Shodhana, Allotropes, Sulphur*

INTRODUCTION

Ayurveda has been an ancient medical science of India which encompasses different entities of Human body and environment. *Rasashastra* is a branch of Ayurveda, which embraces most of the natural metals and minerals available on Earth. *Gandhaka* is the most abundantly available drug which has plethora of therapeutic purposes. Hence the utmost importance should be given for its purification process. *Nirukti* of *Gandhaka* is *Tivra Gandhatvam Iti Gandakah* i.e., The substance which possesses strong smell is called *Gandhaka.* According to *Rasa* literature, *Gandhaka* stands next to *Parada* in importance. It is also considered as an essential agent for the various processes of *Parada* such as *Murchhana, Jarana* etc. It is believed to impart many desirable properties to *Parada* and reduces its toxic effects. Sulphur is a yellow crystalline solid, monovalent metal which is odourless, tasteless and appears in different allotropic modifications - Rhombic, Monoclinic, Polymeric**.** The rhombic structure is the most commonly found sulphur form**.**

Occurrence: Sulphur occurs naturally near volcanoes. Native sulphur occurs naturally as massive deposits in Texas and Louisiana in the USA. Other leading producers of sulphur are Canada, Japan, Poland and Soviet Union. Sulphur can be found in the air in many different forms. It can cause irritation to the eyes. The various experimental studies have revealed that the damaging effects of sulphur inhalation are the brain damage through malfunctioning of the hypothalamus, damage to the nervous system, serious vascular damage in brain, heart, and kidneys.

Different ores of *Gandhaka*

Sulphide Forms:

Copper Pyrite - Cu_2S Fe_2S_3

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Iron Pyrite - Fe_2S_3

Galena - PbS

Realgar - AS_2S_2

Cinnabar - HgS

Gpysum - $CaSO_4\,2H_2O$

Gandhaka Bheda (Type)

According to *Rasaratna-Samuccaya* there are three types of *Gandhaka*

1. *Sukhachanchu-Nibha* (Red in colour) and is said to be best in medicinal properties.
2. *Peetha-Varṇa* (Yellow in colour) and is said to be better in properties.
3. *Sweta-Varṇa* (White in colour) and is said to be inferior.

Important characters of Sulphur

Atomic Number	16	Atomic Weight	32.064
Density in Solid State(gm/cc)	2.07	Atomic Radius(h)	1.02
Atomic radius (h) of divalent ion	1.84	Atomic Volume (cc)	15.5
Ionization energy (Kcal/mole)	239.1	Oxidation states	-2, +2, +4, +6
Electro-negativity	2.5	Melting point (°C)	119.0
Boiling Point (°C)	444.6	Heat of atomization (Kcal./mole)	56.9

Gandhaka Shodana

1st Method (*Rasa Ratna Samucchaya*)[1]

Melt *Gandhaka* along with the little quantity of *Go Ghrita* (cow's ghee)

↓

This liquefied *Gandhaka*(sulphur) is then poured into vessel, through a cloth, which was tied over the mouth of the vessel

↓

Then taken it out, and wash with clean water

↓

By this process, the stony substances remain in the cloth and *Gandhaka* become purified.

↓

The poisonous substance in the *Gandhaka* float on milk mixed with *Ghee*, and the sulphur remains inside the milk in solid form.

2nd Method (*Rasa Tarangini*)[2]

The four *Pala* (200gms) of *Ashuddhitha Gandhaka* is triturated in a clean *Khalva Yantra*

↓

The fine powder of the same is taken in a *Damaru Yantra* and subjected for 4 *Prahara*(12 hours) of *Madhyamaagni(*moderate heat).

↓

When cool on its own the *Yantra* is carefully unsealed and the sulphur adhered at the base of the upper pot in droplet format is neatly collected.

↓

This bright yellow purified sulphur is considered as *Shodhita Gandhaka*

1. The sulphur in this method rises up in vapour form and adheres at the base of upper pot so; there is no chance for any physical impurities to prevail in it.
2. The purified sulphur here, remains free from *Snigdhamsa* or fragrance of milk, ghee, oil

3rd Method (*Rasa-Jala-Nidhi)*[3]

Gandhaka should be melted and poured to a piece of cloth into the *Bhringaraja Swarasa*

↓

It is then to be powdered and boiled with the *Bhringaraja Swarasa*

↓

Then again *Gandhaka* should be melted and poured into the *Bhringaraja Swarasa*

↓

Gandhaka thus purified and used for all the purposes

4th Method (*Ayurveda Prakasha*)[4]

Gandhaka is taken in a clean *Khalvayantra* and pounded

↓

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Milk is taken in a mud pot and sealed with *Khora* cloth upon which sulphur is placed

↓

This whole apparatus is placed in a pit of *Laghu Puta* and covered with iron *Kadai*

↓

Over this *Kadai*, 12 *Vanopalas* are placed and ignited, left until complete burning and complete cooling. Later the *Gandhaka* obtained in the milk is washed with hot water, dried and the whole process is repeated for 3 times.

Discussion

- Sulphur has many allotropes among which rhombic and monoclinic are commonly occurring and stable forms
- Rhombic sulphur is arrangement of Sulphur atoms in rhomboid crystal shape which is stable and requires more energy to break the forces between the molecules and to create new molecules[6]
- Monoclinic sulphur on the other hand is a linear arrangement of Sulphur molecules which requires less energy to break bonds[6]
- Sulphur has a unique characteristic of varied melting points between 115°C to 120°C
- This varied melting points are an opportunity to create various allotropes according to our need
- Rhombic Sulphur is more stable and commonly occurring in the nature and is obtained by heating Sulphur to 120°C and then rapidly cooling below 96°C[5]
- This can be achieved by incorporating 4th method where there will be rapid cooling and major proportion of Sulphur will be rhombic form
- Rhombic Sulphur will be very useful if it is used in the preparation of *Kajjali/Kharaliya Rasayana* or if it is administered directly to a patient along with an *Anupana*
- Since Rhombic Sulphur is stable, it does not react with acids and other organic compounds in a human body.
- Monoclinic Sulphur is obtained by heating slowly to 115°C and cooling down slowly to 96°C.[5]
- The method of *Dalana* is structured exactly in the same way to obtain monoclinic sulphur where fats help in gradual heating of Sulphur and is poured into pre-heated Milk which cools only till 100°C
- Monoclinic Sulphur is especially useful in *Marana* procedure where Sulphur is expected to reduce or calcinate metals/minerals and form newer compounds at a rapid rate
- This allotrope of Sulphur is particularly useful even for preparation of *Kupipakwa* and *Pottali Rasyanas* as it is evident in XRD findings of some *Kupipakwa* preparations.

Conclusion

Gandhaka being most abundantly available might have provoked our ancestors to study in detail and to make it feasible for therapeutics. This leads to multi-innovational methods of *Shodhana* in different classics. After thorough scrutiny of all the *Rasagranthas*, one can find at least 20 different methods of *Shodhana*. Although a theoretical interpretation of chemical significance of all these procedures can be made, it must be proven practically. Advanced technology and methods of chemical evaluation must be explored or invented in order to deepen our understanding of *Gandhaka.*

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