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INTRODUCTION AND PHARMACEUTICAL STUDY OF GANDHAKA (SULPHUR)

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ABSTRACT

Gandhaka is commonly known as *Sulphur*. It is described in *Uparasa Varga* in Rasa Shastra of Ayurveda. It is used in many formulations in Ayurveda. It is used in various diseases internally and externally. If Asodhita Gandhaka is taken internally it produces many undesirable effects and disorders in the body, so it should be used carefully after proper *shodhana* according to Ayurvedic text. Pharmaceutical study of various steps of *Shodhana* process of *Gandhaka (Sulphur)* is described here along with its introduction. The pharmaceutical study was done in National Institute of Ayurveda, Jaipur in 2006. AFI was followed for *Shodhana* of *Gandhaka*. *Gandhaka*, after undergoing *shodhana* treatment becomes free from impurities (undesirable substances) and untoward toxic effects and may not cause any undesirable symptoms in the body. Here in this pharmaceutical study of *Gandhaka Shodhana* total loss in weight was observed 18%.

Keywords: *Gandhaka*, *Sulphur, Shodhana, Goghrita ,Godugdha, Nirvapana etc.*

INTRODUCTION

According to the Rasa literature, *Gandhaka* (sulphur) has been included in ***'Upa Rasa'*** group and it is the first drug of this group[1]. In Rasashastra sulphur stands next to mercury in importance[2] it is also considered as an essential agent for the various processes of mercury such as *Murcchana*[3] *Jarana*[4] etc. It is believed to impart many desirable properties to *Parada* and reduce its toxic effects[5] Probably because of this mercury is mostly administered internally in association with sulphur, as mercury containing preparations without sulphur are considered to be more toxic. In addition to its value for making the mercury therapeutically useful, it is also used for the *bandhana* (solidification) of mercury. In addition to its usefulness for mercury it is also described to be used for the '*Marana'* of other metals[6]. Thus, sulphur is considered most valuable element of various purposes in Rasashastra.

Synonyms

Symbol	:	S
Sanskrit	:	*Gauribeeja, Balivasa, Lelitaka, Atigandha, Peeta, Dhatuha, Shulvari, Pamari, Keetaghna* etc[7].
Hindi	:	*Gandhaka*
English Name	:	Sulphur

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Table No. 1: Important Characters of Sulphur[8]

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 (^{0}C)	**119.0**
Boiling Point (^{0}C)	**444.6**	**Heat of atomization (Kcal./mole)**	**56.9**

Occurrence and distribution

According to ancient text *'Shweta Dveepa'* and *'Khseera Sagara'* are its places of origin. Probably these are suggestive of an island of Sicily and Himalaya or Indo-Iranian region respectively[9].

Sulphur is one of the widely occurring elements and constitutes nearly 0.1 percent of the earth's crust. In the Free State, it occurs in the volcanic regions of Sicily, Ice land, Mexico, Louisiana and Texas states of U.S.A. In smaller quantities, it occurs in New Zealand, Russia, Japan and Baluchistan (Pakistan). However, it occurs more abundantly in the combined state as -

Sulphide ores

E.g. Galena (PbS), Chalcopyrite ($CuFeS_2$), Cinnabar (HgS) Zinc blend (ZnS), Iron pyrite (FeS_2),

As Sulphates

Gypsum ($CaSO_4$, $2H_2O$), Celestite ($SrSO_4$), Heavy spar ($BaSO_4$)

As Hydrogen Sulphide

In spring water, coal gas, sewage gas, etc. sulphur forms an essential constituent of many natural products of plant and animal origin, e.g. garlic, mustard, egg, hair, protein etc [10].

Physical Properties of Sulphur

Sulphur is a yellow solid with no taste and odour. It is freely soluble in carbon disulphide but insoluble in water and sparingly soluble in alcohol and ether. Its vapours are poisonous for bacteria and fungi but not for animals or human beings[11]. Sulphur is soluble in *Til Taila* (Oil of Sesamum indicum) in the Ratio of 1: 16, when heating it at low temperature[12].

Varieties of Sulphur

According to various texts following four varieties of sulphur are mentioned as below-

Table No. 2: Showing the Varieties of *Gandhaka* according to various texts

S.No.	Name of the variety	R.R.S.	R.P.S.	Y.R.
1.	*Rakta (Shukachanchunibha, Shukatunda)* like parrot's beak	+	+	+
2.	*Pita (Amlasara, Shuka Picchhanibha)* like parrot's wing	+	+	+
3.	*Shukla* (White)	+	+	+
4.	***Krishna* (Black)**	+	+	+

Table No.3: Table showing the Properties of these varieties of Sulphur is described as follows[13]

S.No.	Colour	Quality	Use
1.	White *(Shweta)*	Inferior	**marana of metals**
2.	Yellow *(Shuka picchha) (Am-*	Medium	**Rasa therapy**

	lasara Gandhaka)		
3.	*Rakta (Shuka Chanchu)*	Superior	***Lohavada***
4.	***Krishna* (Black)**	***Durlabha* (Rare)**	***Dehavada***

Effect of *Ashodhita Gandhaka*

If *Asodhita Gandhaka* is taken internally it produces many undesirable effects and disorders in the body, viz.

Disarrangement of Pitta - Rakta equilibrium in body

- ★ Pyrexia
- ★ Giddiness
- ★ Mental disorders
- ★ Dermal disorders
- ★ Loss of strength, vitality and appetite[14]
- ▪ Hence, In Ayurveda it is advised that *Gandhaka* should always be subjected to *shodhana* process before prescribing for therapeutic purposes.

***Shodhana* Method**

There are several methods for the *shodhana* of *Gandhaka* but the commonest method consists of its melting in an iron spoon smeared with ghee by heating and filtering it through the cloth in the cow's milk repeatedly for 3 or 7 times. Then wash it with hot water and dry[15].

Effect of *Shodhana*

Gandhaka, after undergoing shodhana treatment becomes free from impurities (undesirable substances) and untoward toxic effects and may not cause any undesirable symptoms in the body.

Qualities of *Prashasta Gandhaka*

According to texts, *Gandhaka* should be clean, lustrous and smooth, look like fresh butter *(Navaneeta)*. Its colour and tinge should be similar to that of turmeric *(Rajani Samaprabha)* i.e. greenish yellow. Out of different varieties of sulphur only *Amlasara gandhaka* meets with these requirements and should be preferred for use in rasa preparations[16].

Pharmacological and Therapeutic Properties

Rasa	:	*Katu, Tikta*
Guna	:	*Snigdha, Sara*
Virya	:	*Ushna*[17]
Vipaka	:	*Katu. Madhura*
Karma	*i.*	***Doshika -*** *Kapha Vatahara* and *Pittajanana*
	ii.	**Systemic-** *Dipana, Pachana, Amajirna Prashamana, Sara, Vishaghna, Balya, Yogavahi.*
	iii.	**Therapeutic-** *Kandu, Kushtha, Visarpa, Dadru, Krimi, Kasa, Shvasa etc.*
	iv.	**Pharmacological**[18] - may be used for disinfectant, destroying bacteria fungi and insects.
Dose	:	125 mg to 1 gm. (of purified sulphur)
Anupana/Sahpana	:	*Ghee* and Sugar, Cow's milk
Important formulations:		*Kajjali, Rasa-Sindura, Rasa-Parpati, Gandhaka Rasayanas, Gandhaka Tail* etc.

Shodhana of Gandhaka*[19] *(General purification of Sulphur)

Apparatus : Heater, Iron pans *(Kadhai),* Spoon, Cloth, Vessels etc.

Ingredients and their proportion

1. *Ashuddha Gandhaka* (Impure Sulphur)- 100 gm

2.	*Goghrita* (Cow's Ghee)	-	25 gm each time (total 75 gm)
3.	*Godugdha* (Cow's milk)	-	400 ml, each time (total 1200 ml.)
			Q.S. for sub emersion

Procedure

- ★ Hot milk was poured in a vessel and a *Ghee* smeared cloth was tied covering its mouth.
- ★ Now, Sulphur was powdered.
- ★ An Iron pan *(Kadhai)* was kept on slow heat and *Ghrita* was put into it. When the *Ghrita* became hot, sulphur powder was put into it.
- ★ On melting, sulphur was immediately poured into the milk through the cloth. Sulphur was thus filtered. It had collected at the bottom of the vessel containing milk.
- ★ After the completion of the process, sulphur was washed with hot water.
- ★ This process was repeated for 3 times, changing cow's milk and *Ghee* every time.
- ★ The sulphur was washed with hot water, then dried well and powdered.

Observations

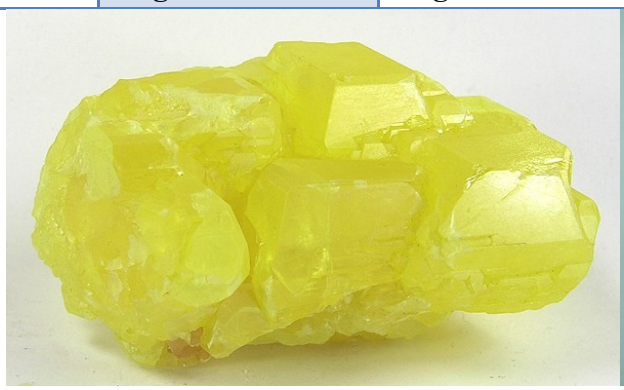
The purified sulphur was of shining yellow colour with a greenish tinge. It was found divided in granules. By general purification the impurities of sulphur were eliminated in following three ways –

- The fat soluble impurities were dissolved in *Ghrita* and removed with it.
- The water and milk soluble impurities were removed with milk.
- The foreign particles (Sand, Stone etc.) mixed with sulphur and insoluble in *Ghrita* were held up on the cloth during filtering.

Results (Quantitative Measures)

Table No. 4: Showing results of *Gandhaka Shodhana*

S.No.	Weight of Impure Sulphur	Weight of Purified Sulphur	Weight of loss during the process	% weight loss
1.	100 gm	92 gm	8 gm	**8%**
2.	92 gm	86 gm	6 gm	**6.52%**
3.	**86 gm**	**82 gm**	**4 gm**	**4.65%**



BEFORE SHODHAN
***Ashudha Gandhaka* (Impure Sulphur)**

AFTER SHODHAN
***Shodhit Gandhaka* (Purified Sulphur)**

Thus it is obvious by the above table that after repeating *shodhana* process for three times, the weight of Sulphur was 82 gm and total loss during the process was 18 gm. (18%).

Precautions

- For melting Sulphur was kept on low heat to avoid it from catching fire.

- The melted Sulphur was filtered immediately to avoid it from sticking to the pan and the cloth.
- The unmelted part of Sulphur was again melted and filtered to avoid the loss.
- The amount of *Ghrita* required is approximately ¼th part of Sulphur.
- Before storage, purified Sulphur was washed well with warm water to remove the remnants of *Ghrita* and milk which in due course may foul smell due to putrefaction.

Here, yield of purified sulphur was less obtained because of small quantity of this batch. We can recover the losses of sulphur by repeating this procedure in large quantity of batch.

CONCLUSION:

Gandhaka, after undergoing *shodhana* treatment becomes free from impurities (undesirable substances) and untoward toxic effects. Here in this *Gandhaka Shodhana* practical total 18 % loss in weight was observed. AFI was followed for *Shodhana of Gandhaka*.

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