



Journal Homepage: - www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI: 10.21474/IJAR01/11381

DOI URL: <http://dx.doi.org/10.21474/IJAR01/11381>



RESEARCH ARTICLE

GANDHAK (SULPHUR) A CONCEPTUAL STUDY

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Manuscript Info

Manuscript History

Received: 20 May 2020

Final Accepted: 24 June 2020

Published: July 2020

Key words:-

Ayurveda, Gandhak, Sulphur

Abstract

Gandhak is chemically Sulphur and the second most important element in Rasa Shastra than Parada. It is characterized by the strong smell and gets this name. Gandhak has been included in Uparasa and said that it has ability of bhasmikaran for all Loha.^{R1} The best acceptable types of Gandhak is greenish-yellow or also called Amalasar Gandhak. Purified Sulphur has fungicidal and anti-parasitic effect and mainly used in various skin disease like dermatitis, psoriasis, eczema and more. It is also used in arthritis and chronic cough. Gandhak has merit to enhances the qualities of Parada and the combination like Kajjali, Hingula, Rasa-Sindoor, Makardhwaj etc. are most potent Rasa preparations.

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Introduction:-

Gandhak is second most important mineral of Rasa-Shastra. It is enumerated in Uparasa, and having characteristic smell¹. Keetnashan, Kushthari, Putigandh, Keetaghna etc. are the synonyms of the Gandhak given on its therapeutic effects. It has many therapeutic uses like Krimidoshar, Jantughna, Aamdoshhar, Kusthar and also having Rasayan properties². It is found as native or compound forms like as galena (PbS), realgar (As₂S₂), cinnabar (HgS), calcium sulphate etc. It is a pale yellow, brittle, crystalline solid, insoluble in water but soluble in carbon-disulphide, benzene and turpentine³. It is essential for human body and a minor constituent of fats, fluids and skeleton. It has been used for the manufacture of sulphur dioxide, sulphuric acid, carbon-disulphide, matches gun powder, fireworks, bleaching agents etc. In medicinal use it cures various diseases ex skin diseases. It has been frequently used in almost all mercurial preparations. After appropriate Sodhana, it has many benefits as important agent for various procedures of Parada- Murcchana, Jarana and others⁴.

Origin of Gandhak:

In Samudra manthan the menstruate of Goddess Parvati came out then its strong smell hypnotized all demons, so named as Gandhaka⁵. In other opinion, during Samudra manthana, on every pulling by Vasuki-naga exhaled poisonous and inflammable air, which caused the melting of demon King Bali's fat. The fat was having peculiar smell, called as Gandhaka and also called Bali Vasa⁶.

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Etymology & names:

The substance that possesses strong and irritant smell, called Gandhaka⁷. Due to its characteristic pungent odour, known as Gandhaka⁸.

Vernacular name:

Sanskrit Name : Gandhakam

Hindi Name : Gandhaka

English Name : Sulphur

Table 1:- Various synonyms and its meaning⁸⁻¹⁰

Synonyms	Meaning
Gandhaka/ Gandhi/ Gandhik	Due to its strong & peculiar odour/ having odiferous, smelling
Gandhpashana	Sulphur ore (Stone-rock)
Rasgandhaka	Listed in Uprasa
Sugandhika	Sweet smelling & fragrance
Putigandha/ Atigandha	It has a strong smell/ excessive strong odour.
Gandhamadana	Intoxicate with fragrance
Pamari/ Kushthari	Treat skin disease-Pama/ treat Kushtha-roga.
Keetnashan	Having insecticidal properties
Bali/ Daityendra	Origin from Bali, king of demons.
Navneet	Yellow colour like fresh butter
Sharbhumija	Found in small pond.
Shulvari / Shulvaripu	Degenerate copper.
Kruragandha	Smell formidably.
Shukapuchcha	Colour like the feather of the tail of a parrot.
Gauripushpa	Originate from Rajah of Parvati,

Review of Literature:-

In Vedic texts, no references regarding Gandhaka are available.

Classical texts:

Brihatrayi have used Gandhaka both internally and externally in skin disorders.

Chikitsa Grantha:

Chakrapani has first formulated Rasa Parpati (Parada with Gandhka) for Grahani Chikitsa¹¹. Yogratnakar described Gandhaka Rasayana in Rasayanadhikar, used for various skin disorders and immune boosting¹².

Rasa Granth:

Almost all texts of Rasashastra have described the Gandhaka in their texts.

Nighantu:

All texts of Nighantu after 13th century have described Gandhaka.

Types of Gandhaka:**Table 2:-** Types of Gandhak in various texts¹³⁻¹⁵

Texts	Rakta (Red)	Pita (Yellow)	Shweta (White)	Krishna (Black)
Rasatarangini		+		
Rasamritam		+		
Rasapaddhati		+	+	
Rasachintamani		+	+	
Rasaratna Samucchya	+ (Shukatunda) (best quality)	+ (Shukpichchha) (medium quality)	+ (Khatikakar) (inferior)	+ (Durlabha) (rarest)
Rasarnava,	+	+	+	
Rasendrapurana,	+	+	+	

Br.Rasarajasundar	+	+	+	
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Structural types of Gandhaka:

Amalasar Gandhaka: amorphous, sublimated sulphur- only for internal use.

Pinda Gandhaka: crystalline sulphur-only for external use.

Only the Pita variety is available and considered as best for the Rasayana. It is of two types-

Amalasar Gandhaka:

Rasaratna Samuchchaya named it Shukapichchha. It appears greenish yellow like fresh Amla (*Emblica officinalis*) colour. Rasatarangini mentioned it yellow like Haridra (*Curcuma longa*) colour and butter like soft. It is used in Rasayana and internally.

Pinda Gandhaka:

Rasatarangini mentioned it similar as Amalasar but have many impurities. It is a precipitated form of sulphur and used only for external application in skin diseases¹⁶.

Acceptable qualities:

In Rasatarangini, it should have Nirmal (clean without physical impurities), Rajanisamaprabho (yellow colour as Haridra), Deeptimamscha (lustrous) and Navneetkomalah (soft like butter). Only Amalasar Gandhaka have these properties, so used for many preparations¹⁶.

In Ayurved Prakash, it should have Shukapichchha-samachhaya (greenish yellow colour like tail of parrot), appearance- Navneetsamprabhah (fresh butter), Masrinah (smooth), Kathinah (firm) and Snigdha (greasy in touch)¹⁷.

Impurities and its effects:

Generally two types of impurities present- viz. Silachurna (silica) and Visha (arsenic) Impure Gandhaka produce many disorders such as Jwara, Bhrama, Twak-vikar, Rakta-vikar, vitiate Roop, Virya, Bala and Sukra¹⁸. RRS mentioned, pure Gandhaka can take without any precautions otherwise impure Gandhaka has harmful effect like Halahala-visha¹⁹. It also causes respiratory, neurological and behavioral disorders.

Purification:

Shodhana process removes the physical as well as chemical impurities.

Table 3:- Some most important methods of purification²⁰⁻²²

S N	Methods of purification
1	Swedana with milk for 1/2 hr then melted in Ghrit and filtered with a cloth.
2	Melted in Mustard/Til/Kausumbh oil, poured in milk and allowed to cool, then wash with hot water and dried well.
3	Melted in Ghrit and poured in milk and allow to cool then wash with hot water. Repeat this for three times.
4	Melted and poured in to Bhringraaja Swarasa. Repeat for seven times.
5	In Swedani yantra, Gandhaka purified in first time.
6	Urdhawapatana of Gandhaka makes it best and pure.
7	Heated with limewater, then after cooling, Lavanadravaka is added drop by drop then whole Gandhaka precipitate in the bottom.
8	Gandhaka and ¼ Tankana, pasted with Bijpurak swarasa and bhawana with Erand oil, then dried in excessive sun light.



Fig 1:- Different procedures of purification.

Rasapanchaka (Pharmacological properties)²³⁻²⁷

1. Rasa – Madhura, Katu, Tikta.
2. Guna – Sara, Snigdha, Laghu.
3. Virya – Ushna
4. Vipaka – Katu / Madhura
5. Dosh Karma – Vata Shamaka, kapha Shamaka, Pitta vardhaka.
6. Systemic Karma– Deepan, Pachana, Vishaghna, Pleeaghna, Drishti Karaka, Amadoshanashaka, Vrishya, Balya, Rasayana, Yogvahi, Shoshan, Krimighna.
7. Therapeutic uses– Kushtha, Kandu, Visarpa, Dadru, Krimi, Jwara, Kasa, Shwasa, Kshaya, Amajeerna, Garvisha-har.

Dose:

Purified Gandhaka-125 mg to 1 gram.

Anupana/Sahapana:

Dugdha, Ghrita, Madhu, Bhringaraja Swarasa, Dhatri Swarasa, Vasa Swarasa, Triphala Kwath etc.

Pathya:

Jangala Mansa, Goat's flesh.

Apathya:

Kshara, Shaka, Amla, vinegar, Lavana, pulses, Taila, Excessive riding, Kanji, Kakarashtaka dravya, Stri-sevan, Vidahi and Ushna virya dravya²⁸.

Modern Discription:²⁹

Symbol	S	Atomic Number	16
Atomic Weight	32.064	Density in Solid state (gm/cc)	2.07
Atomization Heat(K.Cal/Mole)	56.9	Ionization Energy(K. Cal/Mole)	239.1
Oxidation of States	2,+2,+4,+1	Electron Negativity	2.5
Melting Point (⁰ C)	115.21	Boiling Point (⁰ C)	444.6

Availability of sulphur:

Sulphur is one of the widely occurring elements and nearly 0.1% and 5th most common element of the earthy crust. Elemental sulphur can be found near hot springs and volcanic regions of the world. Sicily was the major source and currently mined in Indonesia, Chile, Japan and gulf of Mexico. Fossils based sulphur are obtained from U.S., Russia, Turkmenistan, Ukraine and Poland³⁰. In India sulphur is obtained from Mayurbhanj (Bihar), Malaghatia (Orissa), Sinhbhum (Jharkhand), Laki, Ghirjari bunder (Bombay), Gullbarga, Mudamar (Hyderabad), Balistan, Rupasar, Pugavalley (Kashmir), Arcot, Volunderpet, Podiawalian (Madras), Godawari, Travankar, Mangamalai, Kohat, Shirani Dorunda (North-west) and some part of Punjab, Dehradun, Jonsar Babar, Kumayun Ramganga (UK) and Gargia river, Nandaprayag, Mansiyari Mulladasoli, Mullanagpur (U.P.)³¹.

Minerals and ores:

Gandhaka is found in nature in native as well as in compound forms. Common compound forms are sulphide and sulphate.

Sulphide ores:

Iron Pyrites (FeS_2), Copper Pyrites ($\text{Cu}_2\text{SFe}_2\text{S}_3$), Galena (PbS), Zinc blend (ZnS), Arseno Pyrites, Pyrrhotite, Orpiment (As_2S_3), Realgar (As_2S_2), Cinnabar (HgS), Marcasite, Stibnite (SbS), Argutite.

Sulphate ores:

Gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$), Barite (BaSO_4), Alunite ($\text{KAl}_3(\text{SO}_4)_2(\text{OH})_6$), Salestone- (SrSO_4), Kiesrite ($\text{MgSO}_4 \cdot \text{H}_2\text{O}$), Ferrous Sulphate ($\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$), Copper Sulphate ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$), Globar's Salt ($\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$)

Types of sulphur:

Sulphur is found in 3 forms:

Crystalline sulphur: It is further divided in 2 Sub types :

1. Octahedral, Rhombic or a-Sulphur
2. Prismatic, Monoclinic or b-Sulphur

Amorphous sulphur: It is further divided in 3 Sub types :

1. Plastic or g-Sulphur
2. White amorphous Sulphur
3. Yellow amorphous Sulphur

Colloidal or d-sulphur

Chemical properties:

1. For the manufacture of sulphur-di-oxide, sulphuric acid, carbon-di-sulphide, matches gun powder, fireworks etc.
2. For the manufacture of bi-sulphites of calcium and magnesium, this required for bleaching agents²⁹.

Pharmacological properties:**External:**

Pure sulphur when applied topically that converts into sulphide form an or polythionic acid, is a mild irritant, germicidal and comedogenic (anti-acne). Topical application is reportedly toxic to the parasitic arthropod *Sarcoptes scabiei*. It has been suggested that the antibacterial activity may partly result from inactivation of sulfhydryl groups contained in bacterial enzyme systems³². Pentathionic acid as an oxidation product of sulphur is germicidal as bactericidal and fungicidal. It has also bacteriostatic (against gram positive) and keratolytic property. Alone, or in combination with other keratolytic agents (often 2% salicylic acid) widely used in the treatment of cutaneous disorders such as psoriasis, seborrhia, eczema, dermatitis and lupus erthematosus³³.

Internal:

Sulphur is insoluble in the stomach and in the intestine converted in to alkaline sulphide and sulphurated hydrogen, which stimulates the peristalsis. It has mild laxative effect and soothing effect on the blood vessels so, relieves pain by soften the stool in haemorrhoids, fistula-in-ano, and anal prolapsed. It is also used extensively in arthritis and chronic cough.

Toxicity:

Excessive amount of sulphides and hydrogen sulphide may produce symptoms like asphyxia and paralyse the nervous and muscular system. Large doses may have hepatotoxic properties. Rarerly sulphide absorbed from the intestine may produce the enterogenous cyanosis due to the formation of sulphaemoglobin³⁴⁻³⁵.

Excretion:

It is excreted in the stool mostly unchanged, rest in the urine as sulphate. About 10-14% of sulphur is absorbed as sulphide and excreted by the lungs, sweat glands and milk. When excreted through lungs and sweat, it gives offensive smell to the breath and blackens the silver ornaments in touch with skin respectively. The drug is not detectable in skin after 24 hrs. and after 20 hrs 50% eliminated through urine³⁶.

Discussion:-

Rasashastra has two approach one is Lohavedha (conversion of mercury to gold, silver) and second is Dehavedha (internal use of metallic preparations). Gandhak is a most important mineral in Rasashastra, used for the preparation of Kajjali and then to various preparations of Kupipakwa, pottalli, parpati, khalwirasa. For any mercurial preparations it is most demanding mineral. Sulphur may reduce the nephrotoxic and allergic manifestations of mercury. The uses of Gandhaka started from Samhita period and its external or internal uses indicate that the Acharyas were well known about their therapeutic properties. Almost all Rasashastra texts are mentioned the detailed description. Mythological origin can interpreted with the consequences of sedimentation of volcanic exudates. From starting it may changed from black to red, red to yellow then into white. Therapeutically it has been used for Deepan, Pachana, Amanashan, Rasayana and destroy the skin disorders, Krimi roga, Swasa, arthritis and other diseases also. It used as Fungicide and anti-Parasitic. It should be used after shodhan, because raw gandhak contains impurities like shila churna and Malla visha. It is an important agent after the Parad in mercurial preparations. It is essentially used in the Parada Murcchan, Jarana, Badhan and others procedures. It is also essential for the Sattvapatan of various minerals and believed that only Gandhaka is able to form all types of Lauha in to Bhasma.

Conclusion:-

Gandhak has most important role in the preparation of mercurial formulations. It enhances the qualities and reduces the toxicity of Parada. Amlasar Gandhak having yellow colour is the best among four types. Rasa-Sindoor, Makardhwaj are the most popular preparations of Gandhak. Pure sulphur has no effect on skin, but when mixed with greasy substances, that converts into sulphide form, is probably responsible for the therapeutic effects. In intestine, it converted in to alkaline sulphide, which causes laxative action. In excessive amount of sulphide absorbed from the intestine may produce the cyanosis due to the formation of sulphaemoglobin and produce asphyxia, and paralyse the nervous and muscular system. It may be concluded that Gandhak and their preparations are widely prescribed for their therapeutic importance. In Ayurvedic fraternity it is most reputed drug. Authors suggested that there is a need of further studies to know its pharmaco-dynamics and other pharmacological effects and procedures to reduce the toxicities.

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