

# Studies on identification of Garudapacha - An unfamiliar raw material used in Ayurveda formulations

## Research Article

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### Abstract

**Introduction:** The raw drugs of mineral and metallic origin are exclusively classified into different groups. There are around 70 minerals and metals described in *Rasashastra*. There is a rare mineral called *Garudapacha* used in Kerala state of India, the details of which are scarce or rather not available. It is called as *veluthagarudapacha*, *Palgarudapacha* in Malayalam language and *palgarudakallu*, *palgaruda* and *garudakallu* in Tamil. A brief account of *shodhana* and *marana* is also mentioned for this mineral drug. The *bhasma* of *Garudapacha* is indicated in the conditions like *asthisrava* (leucorrhoea), *netraroga* (Eye disorders), *asthishosha* (osteoporosis) and *mutrakrichra* (dysuria). **Materials and methods:** An attempt was made in this work to collect the samples of *Garudapacha* from different districts of Kerala. Collected sample was examined through selected physical properties of minerals. The sample was also analysed using Scanning Electron Microscopy with Energy Dispersive Spectroscopy (SEM EDS). **Results:** Two samples of *Garudapacha* could be collected one each from Palakkad and Thiruvananthapuram districts of Kerala state. On examination the sample was massive, compact, brittle, translucent to opaque, white stone, with white streak, Pearly to dull luster, flat to conchoidal fracture, 2.5 to 3.5 Hardness and 2.9 to 3 specific gravity. SEM EDS analysis showed presence of magnesium, carbon, calcium and silica. **Discussion and conclusion:** From the physical appearance and other mineralogical features the collected sample was identified as Magnesite a carbonate of magnesium with a chemical composition of  $MgCO_3$ . It was further affirmed while the sample was subjected to instrumental analysis. There was presence of magnesium, carbon and silica among which 28.74% magnesium and 6.89 % was carbon.

**Keywords:** *Garudapacha*, Magnesite, *Marmani gulika*, Minerals, SEM-EDS.

### Introduction

In *Ayurveda*, three types of raw materials that are used in prevention and cure of diseases namely, *jangama* (animal origin) *sthavara* (plant origin) and *oudbidha* (mineral origin). (1)

It is said that, there is not a single substance on this earth which does not have a potential to be used as a drug, provided it is used judiciously by the physician. (2)

However converting these raw drugs into suitable formulation requires skill which is dealt in detail in a specialized branch of *Ayurveda* called *Rasashastra* and *Bhaishajya Kalpana* (*Ayurveda* Pharmaceuticals). The sub branch of this, which exclusively uses mineral raw drugs (*Oudbidha*) is termed as *Rasashastra* (Indian alchemy). The formulations containing metals and minerals can be used for treating diseases as well as promoting health. *Rasashastra* gives a detailed account

of purification, incineration, therapeutic application, dosage and antidotes of different mineral and metals. There are number of metals and minerals that are known to the scholars of *rasashastra* and are included under various groups namely *Rasa*, *Maharasa*, *Uparasa*, *Sadharana Rasa*, *Ratna*, *Uparatna*, *Dhatuvarga*, *Sudhavarga*, *Vishavarga* and *Sikatavarga*. (3-5)

During literature search of *marmani gulika* references of a rare mineral called *Garudapacha* was found which is termed as a white coloured mineral similar to chalk. (6) Many scholars of *Rasashastra* were unaware of this raw material. Extended searches showed that there are a few formulations which contain this mineral ingredient (Table 1).

The above references were from *Ayurveda* books of Malayalam and Tamil books of *Siddha* system of medicine. (11-12) So, it can be assumed that, it is used in southern part of India specially in the states of Kerala and Tamilnadu.

It is called as *veluthagarudapacha*, *Palgarudapacha* in Malayalam language and *palgarudakallu*, *palgaruda*, *Garudakallu* in Tamil. Further, it is to be noted that brief account of *shodhana* (purification process) and *marana* (process of incineration) is also mentioned for this mineral drug. (13-14) The *bhasma* of *Garudapacha* is indicated in

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**Table 1: Formulations of *Garudapacha***

Sl	Name of the formulation	Dose	Indication
1	<i>Marmani gulika</i> (6)	External application	<i>Marmabhighata</i> (injury to marma)
2	<i>Tarunabhaskara gutika</i> (7)	125 mg	All types of poisoning
4	<i>Gorochanadi matrai</i> (8)	125 mg	All types of jwara (fever)
5	<i>Cheenapavu Ghritam</i> (9)	Not specified	<i>Visha</i> (poison), <i>Unmada</i> (psychosis), <i>Apasmara</i> (epilepsy)
6	<i>Kantashuddhi Gulika</i> (10)	Not specified	<i>Kasa</i> (cough), <i>Swasa</i> (asthma), <i>Kaphavikara</i> (disorders relating to <i>kapha</i> ), <i>Vayukshobha</i> (disorder of <i>vata</i> ), <i>Jwara</i> (fever)
7	<i>Akkiradi churnam</i> (10)	15 gms	<i>Garbhashula</i> (pain in uterus) and infertility
8	<i>Povamkurnniladi Avanakkenna</i> (10)	Not specified	<i>Swasa</i> (asthma), <i>jwara</i> (fever), Rickets, Dysuria

conditions like *asthisrava* (leucorrhoea), *netraroga* (Eye disorders), *asthishosha* (osteoporosis) and *mutrakrichra* (dysuria). (14)

In view of these observations a study was undertaken to collect the samples of *Garudapacha* and establish its identity.

## Materials and Methods

In this work, an attempt has been made to collect the samples of *Garudapacha* and establishing its identity based on physical and chemical properties minerals as well as instrumental analysis.

It is done in following sequence:

- Collection of sample of *Garudapacha*
- Establishing the identity of collected sample of *Garudapacha*
- Observations and results

### Collection of sample of *Garudapacha*

Based on the observations that the references of this mineral are confined to Malayalam books of Ayurveda, attempt was made to collect the sample of *Garudapacha* from raw drug vendors of Kerala. Drug vendors of Kannur, Ernakulam, Palakkad, Trissur, Wayanad, Kasaragod, Kozhikode, Pattanamtitta, Kollam and Thiruvananthapuram were contacted for the samples of *Garudapacha*. Among 14 different vendors contacted from above places, only two samples of *Garudapacha* could be collected one each from Palakkad and Thiruvananthapuram. The collected samples were white coloured chalk like stones.

### Establishing the identity of collected sample of *Garudapacha*

*Garudapacha* is a not familiar mineral to the experts of *Rasashastra*. In view of the same it was envisaged to study the mineralogical properties of *Garudapacha*. So the collected sample was subjected to identification tests based on Physical characteristics as well as instrumental analysis.

### Identification of sample of *Garudapacha* based on mineralogical Characters

An attempt of identifying the collected samples of *Garudapacha* based on physical properties of minerals was carried out at Dept of Geology, Govindram Seksaria Science College, Tilakwadi, Belgaum, Karnataka. As the physical appearance of both the samples was similar, only one sample was used for the study.

### Methodology

Following parameters were studied using a few of the methods explained under study of physical characters of minerals. The methods and tools used are:

#### Form

The mineral sample was examined in natural day light. Individual crystals are too small to be seen with the naked eye. The development of an individual crystal or an aggregate of crystals to produce a particular external shape is described as its habit. There may be aggregates of the crystals of which individuals can be seen with the naked eye. The mineral sample was also examined by vigorously shaking it in hand to understand the compactness of crystal aggregates. (15)

#### Colour

The mineral sample was examined in natural day light for colour and the same was noted.

#### Streak

Tool required: Streak plate

The sample of *Garudapacha* was taken on a streak plate. It was rubbed across the white surface of the streak plate. The colour of the powder left on the streak plate was noted. (15)

#### Lustre

The mineral sample was examined in natural day light. The light reflected on the faces of crystals, cleavage planes or fresh fracture of a mineral was observed carefully. Based on the reflected light, the type of lustre was decided. (16)

#### Transparency (Diaphaneity)

The sample was taken in hand and observed against source of light. The degree of transparency was recorded accordingly. (17)

#### Cleavage

Tool required: Small hammer

The mineral was taken and hit with a hammer gently to break it. Observed for the way in which it

breaks and broken surface of the mineral mass. The procedure was repeated thrice. Also an attempt was made to observe the cracks which may indicate the cleavage direction. (18)

### Hardness

Tool required: Moh's Scale of Hardness, Hand lens

The sample of *Garudapacha* was held in hand and a smooth surface was selected. This smooth surface firmly scratched with sharp edge of a reference mineral, specified in Moh's Scale of Hardness. First scratching was started with talc which has known hardness of 1. Observed if, talc can scratch the sample of *Garudapacha*. If not, reference mineral with hardness 2 was used to scratch the surface of *Garudapacha* and observed for scratch. The scratch was observed under a hand lens to ensure that it is a scratch and not the powder from the reference mineral. If it is a scratch, rubbing would not make it disappear, whereas if only a streak, it can be rubbed off. The procedure of scratching process with reference minerals was continued in increasing order of hardness, one by one, to determine nearer to correct hardness of the sample. (19)

Obviously, if the sample can be scratched by a particular reference mineral (say-A) of known hardness then it is understood that the sample under examination has a hardness lower than reference mineral-A.

### Fracture

Tool required: Small hammer

The mineral was taken and hit with a hammer gently to break it. Observed the broken surface (other than the cleavage plane/direction) and to decide the type of fracture. (18)

### Tenacity

Tool required: Small hammer

The mineral was taken and hit with a hammer gently. Repeated the process several times till the substance breaks into pieces. If it does not break, then the change in the shape of the sample was observed. Also an attempt was made to bend it and crush it. Observations were recorded accordingly. (17)

### Specific gravity

Tool required: walkers steelyard balance

A steelyard balance is a straight beam balance with arms of unequal length. It incorporates a counterweight, which slides along the longer arm to counterbalance the load and indicate its weight. The steelyard comprises a balance beam which is suspended from a Lever/pivot or fulcrum which is very close to one end of the beam. The two parts of the beam which flank the pivot are the arms. The arm from which the object to be weighed (the load) is hung is short and is located close to the pivot point. The other arm is longer, is graduated and incorporates a counterweight which can be moved along the arm until the two arms are balanced about the pivot, at which time the weight of the load is indicated by the position of the counterweight. (20)

The mineral specimen of *Garudapacha* was suspended by a thin nylon thread from the longer arm. It is moved along the graduated arm so as to bring the end of the arm opposite the fixed index mark and the position of the specimen on the arm is noted (a). Now the specimen is submerged under water. This is done by placing a beaker filled with water below the specimen. This will disturb the balance. The specimen is then moved away from the fulcrum until the beam again comes opposite the index mark (b).

The specific gravity (SG) of the mineral is calculated using following formula:  $SG = b/b-a$

### Instrumental Analysis sample of Garudapacha

Collected sample were analysed using Scanning Electron Microscopy with Energy Dispersive Spectroscopy (SEM Edas) at Vijnana bhavana, Manasagangotri, Mysore. For this purpose SEM of Zeiss company model number EVO LS 15 made in Germany was used.

### Method

Principle: EDS is based on the emission of a specimen characteristic X-rays. A beam of high energy charged particles (electrons or protons) are focused into the investigated sample. An electron from a higher binding energy electron level falls into the core hole and an X-ray with the energy of the difference of the electron level binding energies is emitted. EDX analysis gives a spectrum that displays the peaks correlated to the elemental composition of the investigated sample. In addition, the elemental mapping of a sample can be created with this characterisation method.

The EDS detector system performs a simultaneous display of all mid-energy (1-20 keV) X-rays collected during any individual analysis period and the energy of the X-rays is reproduced as a spectrum, which is a histogram plot of number of counts against X-ray energy. The spectrum contains both semi-qualitative and semi-quantitative information. The position of a peak in the spectrum, its energy, identifies the element; the area under the peak is proportional to the number of atoms of the element in the irradiated area. X-rays are also produced when the electron beam is slowed by the electrostatic fields of the atomic nuclei of elements present in the specimen. These X-rays form a continuous radiation that appears below the peaks in that spectrum. Qualitative analysis, *i.e.*, identification of elements in the spectrum, is usually achieved using manufacturer's software. (21)

### Sample Preparation and Mounting

Collected sample of *Garudapacha* was sliced into thin piece with help of sharp diamond edged knife. It was dried well using a critical point drier. Then the slice of the sample was mounted on the stub and coated with conductive material. Then it was placed inside the machine and spectrum was recorded in the software using a computer.

## Observations and results

During mineralogical studies for establishing of Identity of *Garudapacha*, following features are noted.

### Results of Mineralogical studies

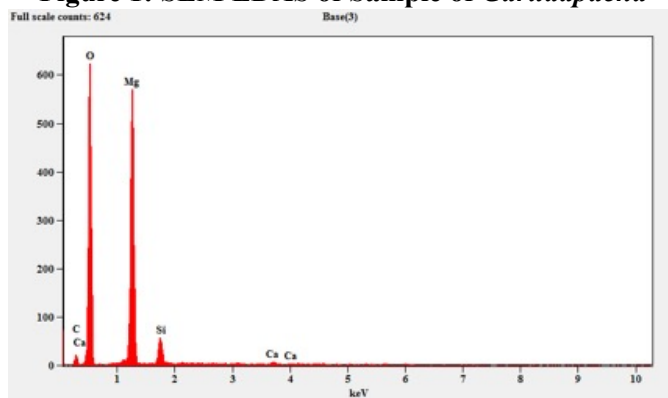
**Table 2: Showing the identification features of *Garudapacha***

SI No	Name of the test	Results
1	Form	Massive, Compact
2	Colour	White, grayish white, chalk like
3	Streak	White
4	Lustre	Pearly, dull or earthy
5	Diaphaneity	Translucent-Opaque
6	Hardness	3.5-4.5
7	Fracture	Flat or conchoidal
8	Tenacity	Brittle
9	Specific gravity	2.9-3

Based on above observations, it is identified as **magnesite** a carbonate of magnesium with a chemical composition of  $MgCO_3$ .

### Results of SEM Edax

**Figure 1: SEM EDAS of Sample of *Garudapacha***



**Table 3: Showing the element composition of *Garudapacha***

Element Line	Weight %	Weight % Error	Atom %
C K	6.89	± 1.06	10.12
O K	60.40	± 0.83	66.61
Mg K	28.74	± 0.43	20.87
Si K	3.47	± 0.27	2.18
Si L	---	---	---
Ca K	0.50	± 0.13	0.22
Ca L	---	---	---
<b>Total</b>	<b>100.00</b>		<b>100.00</b>

## Discussion

*Garudapacha* is not a well known raw drug for *Ayurveda* fraternity. The knowledge about this drug is confined to Malayalam books of *Ayurveda*. There are two distinct identities for this raw drug. A few translations term this raw drug as a herbal drug known by the name *Sellaginella rupestris*.(23-23) In Ayurvedic Formulary of India (AFI) however, this is mentioned as

a white coloured mineral looking like chalk. So this work was carried out with exclusive search of mineral drug called as *Garudapacha*. Attempts of collecting the mineral specimen of *Garudapacha* could result in two samples of white coloured stones.

*Rasashastra* deals with a number of minerals categorized under *Maharasa*, *Uparasa*, etc. These are identified on the basis of *grahya lakshana* mentioned in the books of *Rasashastra*.(24) Most of the *grahya lakshana* are mentioned based on the organoleptic characters of the raw drug or physical appearance. For example *pruthudalam* (with layers) is the feature mentioned for *Abhraka* (mica) which indicates the separation of leaflets of mica (25). *Ishtika churna sankasaha* (brick red in colour) is the feature mentioned for *kampilaka* (*Mallotus philippensis* Muell. Arg) which, suggests the natural colour of the raw drug (26). These *grahya lakshana* (characteristic features) are relatable to the physical or chemical characteristics of the minerals. As *Garudapacha* is not mentioned in front line books of *Ayurveda*, the identification features of this drug are not described. So an attempt was made in this work to establish the physical properties of the collected samples of *Garudapacha*.

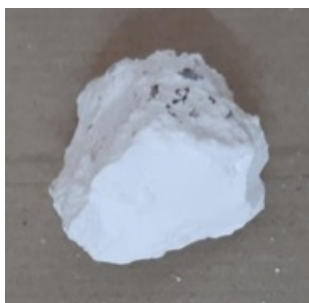
It is observed that the colour collected samples was white/ grayish white/ chalk like and streak was white. This feature was satisfying the description of the sample as given in AFI. The stony appearance was evident with massive and compact form as well as opaque nature. The hardness of 3.5 to 4.5 suggests that the drug is not much harder and can easily be powdered by crushing in stone mortar. The brittleness of the material also will positively influence the powdering of the drug. The substances with hardness of more than 5.5 get powdered with difficulty and considered as relatively harder minerals. Most of the carbonates, sulphates and sulfides are considered as softer as they have hardness less than 5.5. Silicates will be considered as harder. Flat or conchoidal fracture of the specimen indicates that the mineral is brittle without a proper breaking plane. Specific gravity of a mineral is density of the sample in relation to equal amount of water. Specific gravity of 2.9 to 3 indicates that it is almost three times denser than water.

Based on these observations, the collected sample of *Garudapacha* was identified as **Magnesite** a carbonate of magnesium with a chemical composition of  $MgCO_3$ . It was further affirmed while the sample was subjected to instrumental analysis. There was presence of magnesium, carbon and silica among which 28.74 (weight %) magnesium and 6.89 (weight %) was carbon. Magnesite typically has an opaque cast and its colour range from white to black with different shades of yellow, blue, red, or orange. The material features a unique hexagonal crystal structure. It typically has an earthy or chalky texture and is enormous, coarse to finely granular, compact, lamellar, or roughly fibrous. Magnesite has an X-ray density of  $3.0095 \text{ g/cm}^3$  and the hardness of magnesite on Moh's scale is between 3 to 4.5. Magnesite has a specific gravity ranging from 2.98 to 3.44 considerably lower than other hydrates and basic carbonates (27)

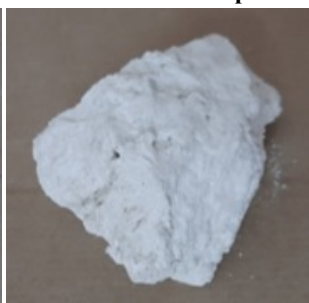
## Conclusion

*Garudapacha* is not a well known raw drug of *Ayurveda*. The knowledge of this mineral is confined to Malayalam books of *Ayurveda*. Attempts of collecting *Garudapacha* could result in two samples one each from Thiruvananthapuram and Palakkad districts of Kerala. On examination the sample was massive, compact, brittle, Translucent to opaque, white stone, with white streak, Pearly to dull luster, flat to conchoidal fracture, 2.5 to 3.5 Hardness and 2.9 to 3 specific gravity. During mineralogical studies, it is identified as Magnesite a carbonate of magnesium with a chemical composition of  $MgCO_3$ . Instrumental analysis showed presence of Magnesium, Calcium and silica among which 89.14 (weight %) was oxide of magnesium.

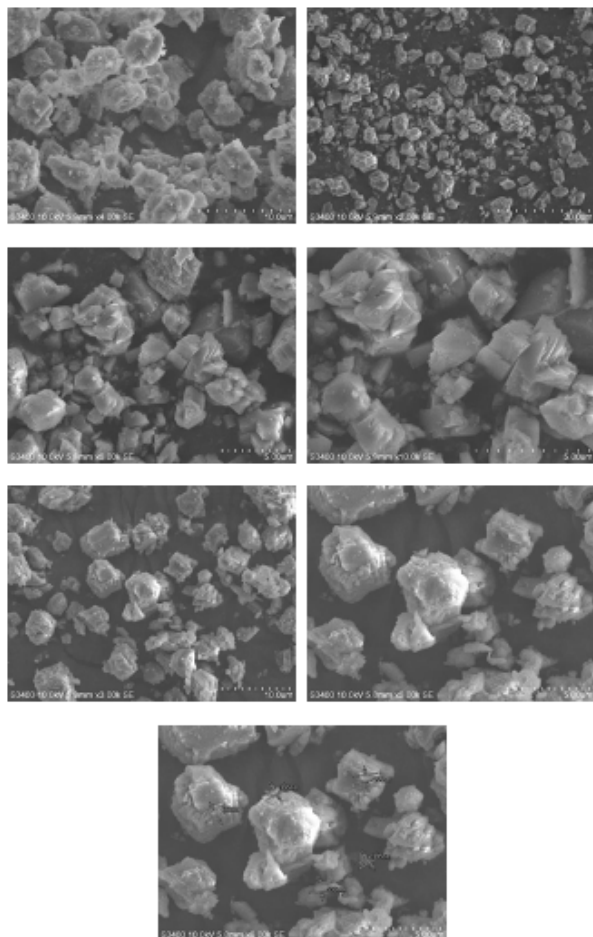
**Plate 1: Sample collected from Palakkad**



**Plate 2: Sample collected from Thiruvananthapuram**



**Plate 3: Results of Scanning Electron microscope**



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