



Macroscopic Evaluation of the Identity of Guggulu, Its Adulterants and Market Samples

Das Hemanta¹, Roshni Pradhan² and Ruprekha Dutta³

¹Professor & HOD, Department of Dravyaguna, Govt. Ayurvedic College, Guwahati, Assam, India

²Plant Collector, Department of Dravyaguna, Govt. Ayurvedic College, Guwahati, Assam, India

³Assistant Professor, Department of Dravyaguna, Govt. Ayurvedic College, Guwahati, Assam, India

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ABSTRACT

One of the important aspects of Ayurvedic Medicine is the quality raw material for preparation; otherwise one cannot expect the desired effect of the treatment. In many important Ayurvedic medicines, the Guggulu is the main ingredient of various formulations. Guggulu is the oleo-gum resin obtained from the guggulu plant (*Commiphora wightii*). In India, the plant is seen in some part of the country, especially in Rajasthan and Gujarat. Now, Guggulu is a high valued medicinal plant and the demand for Guggulu is increasing day by day. Due to over exploitation and unsustainable harvesting, the plant is listed as a critically endangered species. As a result, unscrupulous, deliberate adulteration is a widespread practice for high commercial benefit. Such unscrupulous activity badly affects the property of Ayurvedic Medicine which contains Guggulu as ingredient and poses significant health risk. An effort has been made to evaluate the identity of the origin sample of Guggulu and its adulterant/ substitute macroscopically collected from their original source and sample collected from different market. This study will be helpful for identification of Guggulu organoleptically to some extent.

Keywords: Guggulu; Ayurvedic Medicine; Adulteration; Macroscopic Study; Balsamic; Mucilaginous; Glossy; Rhytodoma

INTRODUCTION

It is an unorganized crude drug, oleo gum-resin, exuded from bark of the plant Guggulu which is one of the most famous herbs in Ayurvedic system of medicine with a wide therapeutic range.

According to Sanskrit definition, the word “Guggulu” means one that protects against diseases^[1, 2, 3]. This word stands for herb as well as for all the preparation that contain it as chief ingredient. The drug occurs in vermicular or stalactic pieces of pale yellow or brown coloured mass; makes a milky emulsion in hot water and readily burns; when fresh viscid and golden coloured; tastes bitter and astringent. The gum oleo resin is located in gum oleo-resin ducts in the parenchymatous bark as slightly yellowish milky juice [4]. [1] [2]

Importance of the Guggulu has been found since Vedic period. In Atharvaveda, this herb is mentioned to be used as fragrant for the purpose of Pati-vedan (used in rituals to

help a woman for finding a suitable and desirable husband) [5]. Also, it is mentioned to be used as Yakshmanashan (to cure tuberculosis) [6] and as Kriminashak (antimicrobial) [7].

In Charak Samhita, Guggulu is mentioned for the treatment of udar rog [8] and vatvyadhi [9].

In Susruta Samhita, Guggulu is mentioned in the treatment of Soth [10].

Vagbhat recommended Guggulu for the treatment of Sthaulya along with other drugs [11]. The best choice of drug in medo-rog and vatic disorder is Guggulu as mentioned in Astanga Hridaya [12]. It is also indicated in Urustambha [13].

In Gad-nigrah, Guggulu is mentioned for the treatment of bran, nadibran, bhagandar etc.

Bhavamisra mentioned five types of Guggulu viz. Mahisakha, Mahanila, Padma, Kumud and Hiranaksha.

Among these varieties, Mahisakha and Mahanila are used for elephants; Kumud and Padma are used for horses and Hiranaksha is used for human beings. If Hiranya variety is not available, the Mahisakha variety may be used for treatment of human. Guggulu is considered as new and old one as mentioned by Bhavamisra . The new Guggulu is vrishya and old is atilekhan. C. Dwarakanathji defines the “purana Guggulu” as 5 years old.

All the Samhita, Sangraha and Nighantus described Guggulu with its various uses.

Guggulsterone, one of the constituents, of Guggulu is reported as a lipid and cholesterol lowering agent.

It is the high valued medicinal plant and the demand of Guggulu is increasing day by day in Indian crude drug market, however the production of guggulu in India is extremely low. As per estimation the annual demand of Guggulu is nearly 1000 tonnes and nearly 500–1000 tonnes of guggulu is imported from Pakistan annually. The plant guggulu (*Commiphora wightii*) has already been enlisted as endangered species by World Conservation Union (IUCN). Now, unscrupulous, deliberate adulteration is widespread practice in the crude drug market for high commercial benefit.

STUDY MATERIAL

Literary materials of the Guggulu and the adulterants/substitutes have been collected and studied it thoroughly from different ancient as well as modern books. The genuine sample of Guggulu has been collected from original source. The adulterant/substitute of Guggulu as mentioned in the different classics has been identified and collected after proper identification and also samples of crude drug (Guggulu) were collected from different market. All the collected samples were studied macroscopically to evaluate the characteristics of Guggulu as mentioned in the Ayurvedic text and also tried to evaluate the characteristics of adulterant/substitute to compare with the original sample of Guggulu.

The general method for examination of unorganized drug includes the examination of certain features like:

1. Form

Lumps, tears, tears embedded in a matrix, liquid etc.

2. Size

The approximate average size should be determined.

3. Colour

This should be determined in the bulk and also of thin pieces viewed by transmitted light.

4. Specific Gravity

In liquid drugs determine whether this is greater or less

than one.

5. Packing

Where pieces of skin, leaves, etc. are present these should be recorded as an additional aid to identification.

6. Surface

Waxy, dusty etc.

7. Fracture

Brittle, granular etc.

8. Fractured surface

Porous, smooth etc. The colour should be recorded where it differs from that of the external surface.

9. Odour- record it.

10. Taste- record it.

11. Solubility

The degree of solubility of the drug in a variety of solvents should be determined and recorded, e.g. in water, alcohol, ether, light petroleum, etc.

12. Peculiarities

Any peculiarities should be recorded when they constitute additional aids to identification.

Synonym of Guggulu and their meanings are mentioned as follows [14, 15, 16, 17, 19]:

Guggulu: Safe guard from diseases or remove a number of ailments.

Kumbho lukhalakam: Exudes a gum resin coming out from cavities.

Koushik: It is produced in the ridges or cuts on the stem.

Devadhup : Used as an incense in God's worship.

Palankash : It reduces the unwanted muscles or fatty tissue due to its lekhana property.

Pur: It is the best medicine for management of many diseases

Mahishaksha: Reddish black in colour like the eye of buffalo.

Kalaniryash: The resin is reddish black.

Durga: The plant is growing in acrid zone.

Marudesya: Growing in acrid zone.

Rakshoha: The fumigation of the resin acts as an antiseptic and give a protection.

Ulukhal: Exudes a gum resin which come out from cavities.

Kananiryash: The resin become in the form of particle.

The vernacular names of Guggulu are [18]:

Sanskrit : Pura, Mahisiksa, Kausika, Palankasa

Assamese : Guggul

Bengali : Guggula

English : Gum-gugul, Indian Bdellium

Gujrati : Gugal, Guggal, Gugar

Hindi : Guggul

Kannada : Kanthagana, Guggala, Mahishaksha guggulu, Guggulugida, Guggulu Guggal

Kashmiri : Guggul Dhoop, Kanth Gan

Malayalam : Gulgulu, Guggulu Marathi : Guggul, Mahishaksh

Oriya : Guggulu

Punjabi : Guggal

Tamil : Mahisaksi Guggalu

Telugu : Makishakshi guggulu, Guggipannu

Urdu : Muqil (Shihappu)

Properties [1, 14, 15, 16, 17, 19]:

Table 1. Properties of Guggulu as described in various Nighantus'

Properties	Priyanighantu	Dhanwantari Nighantu	Bhavaprakash Nighantu	R a j Nighantu	S o d h a l a Nighantu	Kaiyadeva Nighantu
Guna		Picchila	Visada Ruksha Atilaghu		Laghu Ruksha Tikshna Sara Sukshma	Visada Sigdha Sugandha
Rasa	Tikta-Katu	Katu Tikta Kashaya	Tikta Kashaya Katu	Katu Tikta	Katu Tikta	Tikta Katu Kashaya Madhura
Vipaka			Katu		Katu	Katu
Virya	Ushna		Ushna	Ushna	Ushna	Ushna
Dosakarma	K.V. Samak		Pittajanak		Tridosahara	

Systematic position of the drug [20]

Commiphora wightii (Arn.) Bhandari

Synonyms: *Balasamodendron mukul* Hook. Exstocks

Commiphora mukul Hook. Exstocks.

Kingdom : Plantae

Phylum: Tracheophyta

Class: Magnoliopsida

Order: Sapindales

Family: Bursereaceae

Genus: Commiphora

Species': *C. wightii*

Botanical Description of the Plant

Commiphora wightii is a woody shrub or a small tree which grows to the height of 2-3 metres, much branched with characteristics silvery and paper like bark peelings. Branches are knotty and crooked, divaricate, usually ending in a sharp spine.

Leaves: the leaves are rhomboid-ovate, 1-3 foliate, serrate,

toothed in the upper part, smooth and shining, the lateral leaflets when present less than half the size of the terminal ones.

Flowers: Flowers in the fascicles of 2-3; pedicels very short. Calyx campanulate, glandular, hairy; lobes are 4-5 in number, triangular, as long as the tube. Petals are brownish red, broadly linear, nearly thrice the length of calyx, reflexed at the apex. Stamens are 8-10 in number, alternatively long and short, half the length of the petals. Disk, 8-10 lobed, the alternate sinuses deeper and in these are inserted the shorter stamens. Ovary oblong-ovoid, attenuated into the style.

Fruits: The fruits are small, red in colour when ripe, ovoid, drupes.

Gum Resin: Pale yellow to brown aromatic gum resin obtained from the bark of the plant. Agglomerated tears of resin are somewhat transparent, with waxy surface and brittle in nature. Gum-resin is thick, scented, burnt on fire, liquefies in sun heat. When dissolved in water, it turns milky white [21, 22, 23].

Distribution of the Plant

The Guggulu plant may be found from Northern Africa to Central Asia, but is most common in Northern India. It prefers arid and semi-arid climates and is tolerant of poor soil.

It is mostly found in rocky tract of Rajputana, Khandesh, Berar, Mysore, Sind and Baluchistan.

Substitute/ Adulterants of Guggulu

According to the Database on Medicinal Plants Used in Ayurveda by CCRAS, the oleo-gum resin obtained from *Boswellia serrata* roxb. (Salai Guggulu) is the major adulterant. It is the common adulterant in Indian market and *Hymenodictyon excelsum* (Roxb) Wall, is also Indian adulterant.

Myrrh or herbal myrrh of commerce which is derived from *Commiphora myrrh* (Ness) Engl. imported from Africa and constituting the drug bol or hirabol, is the common adulterant of Guggulu.

Gum resin is often mixture or adulterated with resin yielding plants i.e. *Albizia lebeck*, *Butea monosperma*, *Moringa olifera*, *Acacia nilotica*, *Acacia catechu*, *Pinus roxburghii*.

There are two species of *Commiphora* i.e. *Commiphora roxburghii* (Arn) Engl. and *Commiphora opobalsamum* (Linn) Engl. which also yield 700 gm. to 1 kg. of gum Guggulu collected in cold season.

Collection of the Samples for study

The genuine Guggulu was collected from the stem of the plant *Commiphora wightii* at Mangliawas farm 27 km.

away from Ajmer towards south under Regional Research institute (Ayurveda), Jaipur of CCRAS is working on the cultivation programme. In Mangliawas farm the plantation is spreading over the entire foot hills and on scattered hillocks of the field.

For collection of Guggulu gum, the best tapping period has been recognized from the middle of December to the end of the February. The plant of 7 years of age group are suitable for tapping the gum resin. The contractors use a solution prepared in sulphuric acid for complete extraction of gum resin. The use of Sulphuric acid resulted in the destruction of the old plant stock throughout the forest area. Incisions of 0.8–1½ cm deep are made on the main trunk and thick branches after dipping the knife in the solution of the angle 60°. The yellow fragrant liquid starts coming out just after incision for hours depending upon the plant. The liquid solidifies in due course of time and the same is collected after a day or two.

The gum resin of *Boswellia serrata* was collected from a hilly place, nearby Ramgarh, Jaipur, Rajasthan. The plant *Boswellia serrata* is naturally available there. The incision was made on the trunk of the plant and after two weeks it was collected in the month of July 2009.

The gum of *Butea monosperma* had also been collected from Rajasthan. This plant mostly available in Rajasthan. The incision was made on trunk and after 2 days red colour resin was collected from the incised area of the trunk. *Butea monosperma* consist of dried gum exuding from natural cracks or artificial incision in the stem bark of the plant.

The gum of *Acacia nilotica* was collected from the Rajasthan. The gum is obtained by making incision into the bark. The babul is ready for collection of gum with age and gum exuding naturally from the bark or accelerated by artificial scars. Collection takes place at intervals during the dry season from November to May and two main harvests are taken in December and April, in the major gum producing areas of the northern hemisphere. In general, higher the average temperature, greater is the production of gum. However, the natural yield of gum from each tree rarely exceeds 10-100 gm per harvest. Hence, for commercial production of the gum, stripping of 2 ft by 2 in section of the bark from the tree trunk is carried. In 4-8 weeks the dried gum harvested in this way can amount to ~200g per tree. High rainfall during the growing season and the higher temperature during dry season give the higher gum yield.

The gum of *Moringa olifera* was collected from a matured plant in the campus of Govt. Ayurvedic College, Guwahati, Assam. The gum was automatically exuded and deposited on the trunk during the month of August 2009. So, it was

collected without any incision or any effort.

It is reported in different books that *Commiphora roxburghii* yields 700 gm. to 1.0 kg. gum Guggulu and the plant is abundantly available in Assam. However, practically at present, the plant *Commiphora roxburghii* is not abundantly available in Assam.

The other gum resin which is substituted/adulterated for Guggulu, could not be collected due to non-availability of abundant sources and timing. For this I took help of museum of NIA, Jaipur, Govt. Ayurvedic College, Guwahati and markets and the literary material has been collected from different books.

RESULT AND DISCUSSION

Organoleptic study

1. Guggulu:

The gum collected from the plant *Commiphora wightii* is in vermicular or stalactitic pieces, pale yellow, brown or dull green in colour with a bitter aromatic taste and balsamic odour, make emulsion in hot water and readily burn,

When fresh : viscid and golden coloured

Odour : aromatic

Taste : bitter and astringent.

As per the API, the microscopic standard of the Guggulu should be-

Foreign matter : Not more than 4%

Total ash : Not more than 5%

Acid soluble ash : Not more than 1%

Alcohol soluble extractive : Not more than 27%

Water soluble extractive : Not more than 53%

Volatile oil : Not more than 1%

2. Gum collected from *Boswellia serrata*:

The gum collected from the plant *Boswellia serrata* is stalactitic, transparent, tears forming agglomerates of various shape and sizes, brownish-yellow, upto 5 cm. long, 2 cm. thick, fragrant, fracture brittle, fracture surface waxy and translucent; burns readily and emanates an agreeable characteristic, balsamic resinous odour; taste aromatic and agreeable.

Identification : Trituration with water forms an emulsion; when immersed in Alcohol (90%) a tear of kunduru is not altered much in form but becomes almost opaque and white; when a drop of concentrated H₂SO₄ is added on a freshly fractured surface, it becomes cherry red which, when washed with water changes to a white emulsion then turn to a buff colour.

3. Myrrh:

The gum resin collected from *Commiphora myrrh* is reddish brown. It is also known as myrrh. The high quality myrrh can be identified through the darkness and clarity of the resin. However, the best method of judging resin's quality is by feeling the stickiness of freshly broken fragment directly to determine the fragrant oil content of the myrrh resin. The scent of raw myrrh resin and its essential oil is sharp, pleasant, some what bitter and can be roughly described as being "stereotypically resinous". When burned it produces a smoke that is heavy, bitter and somewhat phenolic in scent, which may be tinged with a slight vanillic sweetness. Unlike most other resin, myrrh expands and 'blossoms' when burned instead of melting or liquefying.

4. Gum collected from *Albizia lebeck*:

Albizia gum exude quite freely on the stem and branches. The gum is formed as round elongated tears of variable size. The gum of *A. lebeck* is exudated freely and dries in stalactiform masses. The exudate is usually red to brown. The gum varies in colour from light yellow to deep brown. It is sometime, perfectly soluble, as reported 5 gm. in 100 ml. water. No complete structure of *Albizia lebeck* has thus been proposed. A partial structure was proposed to consist of main chain $\beta(1-3)$ D-galacton unit with some $\beta(1-6)$ linked D-galactose unit.

5. Gum collected from *Butea monosperma*:

It occurs in pieces flattish, perfectly transparent, smooth and shining, ruby red to dark brown; buff coloured pieces of bark attached; no peculiar odour, taste- astringent.

6. Gum collected from *Moringa oleifera*:

The stem of the tree exudes a gum which is initially white in colour but changes to reddish brown or brownish blackish on exposure. It is sparingly soluble in water but swell in contact with water giving a highly viscous solution. It is a polyuronide consisting of arabinose, galactose and glucuronic acid in the proportion of 10:7:2 mole; rhamnose is present in traces 6.

7. Gum collected from *Acacia nilotica*:

Acacia occurs in the form of tears which may be round or irregular in shape having glossy surface and break with difficulty indicating conchoidal in fracture. Some cracks may be observed on the surface of the tears and these are formed during the process of drying. The colour varies from pale yellow to light brown. Taste- mucilaginous, no characteristics odour. It is water soluble.

8. Catechu (Black):

The heart wood extract of *Acacia catechu* is dark brown to black coloured irregular masses, lumps or cubes depending upon the mode of solidifying the extract. It has glossy or

porous surface with very brittle fracture breaking into powdery mass. Taste is bitter in beginning but turns astringent afterwards. It has no characteristic odour.

9. Gum collected from *Pinus roxburghii*:

It is collected by tapping the wood. It is blackish brown in colour, semi solid, mostly associated with debris from needle wood chips and bark of the source plant. Odour- terebinthene, taste- pungent.

Table 2: Distinguishing macroscopic features of Guggulu and its adulterants

[1] [2]	1. Guggulu (Fresh)	2. Guggulu (old)	3. Gum collected from <i>Boswellia serrata</i>	4. Myrrh	5. Gum collected from <i>Albizia lebeck</i>
Form:	Vermicular	Different irregular, warty & pieces are made up of granules by adhering. Sizes are in irregular pieces	Stalactitic, tear forming agglomerate of various shape. Size is variable.	Tears in various type. Size 5 cm long 2 cm thick (approx)	Stalactitic form masses, Round elongated tears
Size:	Variable	Irregular pieces			Variable size
Colour:	Golden, yellow, viscid, more or less transmitted light in case of small pieces	Blackish	Brownish yellow, transparent	Reddish brown	Light yellow to dark brown
Packing:	Dry leaves scaly structure & small branches of tree	Dry leaves scaly structure & small branches of tree	No any	No	No
Surface:	Waxy	Rough surface & Hard, waxy fracture	Waxy & Brittle	Waxy surface, brittle fracture	Waxy
Fracture:					
Odour:	Balsamic	No specific odour	Balsamic resinous odour		No specific odour & Mucilaginous taste
Taste:	Bitter	Bitter in taste		Pleasant odour & somewhat bitter taste	
Touch:	Sticky	Not sticky, rough to touch	Smooth	Stickiness of fresh broken fragment	Smooth

Solubility:	Water soluble, make emulsion in hot water readily. In cold water also it produces milky emulsion but slowly & when rub the pieces with water become milky. It is sticky, produces thread like structure, adhere with finger.	Water soluble, makes emulsion in hot water-balsamic smell in the steam, some white particle suspended in water. When soaked in cold water some white particle along with milky water dispersed. It is not sticky as like new Guggulu.	Soluble in water, it is mucilaginous in touch & slimy. It is not sticky.	Soluble in hot water and give light yellowish colour mixture. Not sticky	Soluble in water.
Any other character:	Readily burnt.	Readily burn	Readily burn.	Produce smoke & expand, when burn. Not melting or liquidifying	

Table 3. Distinguishing macroscopic features of Guggulu and its adulterants (continued)

[1] [2]	6. Gum collected from <i>Butea monosperma</i>	7. Gum collected from <i>Moringa olifera</i>	8. Gum collected from <i>Acacia nilotica</i>	9. Black catechu	10. Gum collected from <i>Pinus roxburghii</i>
Form:	Pieces, flattish	Lump	Tears which is round and irregular in shape	Irregular masses, lumps or cubes depending upon the solidifying the extract	Compact piece in different shape upto 4cm long 3 cm thick
Size:	Very small, 1-2 mm long	Variable	Tears 5 m to 2 m long	Variable	Like the pieces of alum in different size
Colour:	Ruby red to dark brown, buff coloured pieces of bark attached	Initially white but change to reddish on exposure	Pale yellow to light brown	Dark brown to black	Blackish brown, transparent
Packing:	Thin pieces of bark, rhytiodoma	No any	No any	No any	Wood-chip bark of the source plant
Surface:	Smooth, regular shining & Brittle sharp		Glossy, some cracks is over the surface & Hard, conchoidal fracture	Glossy & Brittle	Smooth & Sharp
Fracture:		Smooth & Sharp			
Odour:	No peculiar odour & Astringent taste	No specific odour & Mucilaginous	No specific odour & Mucilaginous and sticky	No specific & Taste is bitter in beginning but turns astringent afterwards	Terebin-thene & Pungent
Taste:					
Touch:	Very smooth	Not so smooth, little bit rough	Rough	Smooth	Smooth

Solubility:	Not dissolve in water	Sparingly soluble in water but swell in contact with water giving a highly viscous solution.	Make solution in water like sugar.	With water produce a brown colour mixture	Not soluble in water, steam given terebinthene smell
Any other character:	When burn it is swell up like "laja" (popcorn)	Burn with little sound & smoke. No specific odour etc.	Readily burn	Become blackish when burn	Readily burn

Study of market samples

1. The sample collected from the Mumbai market, has found to have the following characters-

- Form : Mass of granules adhere, it is sticky.
- Size : Upto 4 cm. long x 3 cm. breadth x 3 cm. thick to small and very small in different size.
- Colour : Brown to blackish.
- Packing : Plastic thread, scaly appearance.
- Surface : waxy, irregular.
- Fracture : Waxy
- Fracture Surface: Waxy, translucent.
- Odour : Mild Balsamic
- Taste : Bitter
- Solubility : In hot water there is formation of emulsion.

Some viscous white particles were seen in the bottom of the Beaker. The smell of the steam is not pleasant; it is like smell of lime.

- It is readily burn.

2. The sample collected from Kottakal, Kerala Market has been found to have the following characters-

- Form : Mass adhered with granular & it is sticky.
- Size : Upto 2 cm. long x 1.5 cm. breadth x 1 cm. thick to small and very small pieces.
- Colour : Reddish brown to blackish.
- Packing : Branches of the tree, scaly appearance.
- Surface : waxy, irregular.
- Fracture : Waxy
- Fracture Surface: Waxy, translucent.
- Odour : No specific odour.
- Taste : Bitter

(x) Solubility : Formed emulsion in hot water and the smell of

the steam mild balsamic.

- It is burn readily.

3. The sample collected from Amritsar market has found to have the following characters-

- (i) Form : Mass adhered with granules & it is dry.
- (ii) Size : Upto 5 cm. long x 4 cm. breadth x 4 cm. thick to small and very small pieces.
- (iii) Colour : Brown to blackish.
- (iv) Packing : Scaly appearance.
- (v) Surface : waxy.
- (vi) Fracture : Waxy
- (vii) Odour : Balsamic.
- (viii) Taste : Bitter.
- (ix) Solubility : Formed emulsion in hot water only some scaly material found as sediment. Smell of the steam is balsamic.
- (x) It is burn readily.

4. The sample collected from Jaipur market is having the following features-

- (i) Form : Mass adhered with granules & it is dry.
- (ii) Size : Upto 5 cm. long x 4 cm. breadth x 4 cm. thick to small and very small pieces.
- (iii) Colour : Brown to blackish.
- (iv) Packing : Scaly appearance.
- (v) Surface : waxy.
- (vi) Fracture : Waxy
- (vii) Odour : Balsamic.
- (viii) Taste : Bitter.
- (ix) Solubility : Formed emulsion in hot water only some scaly material found as sediment. Smell of the steam is balsamic.
- (x) It is burn readily.

5. The sample collected from Guwahati market has found to have the following characters-

- (i) Form : Different form in different masses, dry in nature.
- (ii) Size : Upto 4 cm. long x 3 cm. breadth x 3 cm. thick to small and very small pieces.
- (iii) Colour : Brownish to blackish.
- (iv) Packing : Scaly appearance, branches of tree & bark.
- (v) Surface : dry, irregular, rough.
- (vi) Fracture : Waxy.
- (vii) Odour : No balsamic but it is fragrant.
- (viii) Taste : Not bitter or no any specific taste.
- (ix) Solubility : Partially it is formed white mixture in hot water and some pieces of the material remain as it is and pieces

becomes slimy and blackish in colour. The steam is not balsamic but it is fragrant.

- (x) It is burn readily.

CONCLUSION

The Guggulu and its adulterants as mentioned in different classics has been identified and the relevant parts were collected from their original source. All the macroscopic characters of the different market samples were thoroughly studied along with Guggulu and its adulterants and the following inferences were made out:

1. The sample of Mumbai market mixed with plastic thread which is unwanted. The odour found in the steam when soaked in the hot water is like that of odour of lime which is not pleasant and there was found sediment of some white material.
2. The sample of Kottakal market was lightly reddish colouration, the odour of the sample was not Balsamic but when it was soaked in hot water there was found mild balsamic odour of the steam.
3. The sample of Amritsar was having almost all the characteristics of Guggulu which is coincided with original sample.
4. The sample of Jaipur market is also found same characteristics with Amritsar market.
5. The sample collected from the Guwahati market is found different character other than the character of Guggulu. Taste was not bitter and not formed any emulsion in hot water also.

When Guggulu, its adulterants and market samples were comparatively studied through macroscopic examinations as mentioned in Table 2 & Table 3 along with taking references from various literatures and texts, it was found that the characteristics of the market samples of Amritsar and Jaipur coincided with the original Guggulu sample. But the market samples collected from Mumbai, Kottakal and Guwahati were found to be completely different from Guggulu and any of the mentioned adulterants.

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