

Comparative Quality Assessment of Genuine and Market Samples of Guggulu (*Commiphora wightii*) Oleo-Gum-Resin

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Abstract: Guggulu, the oleo-gum-resin of *Commiphora wightii* (Arn.) family -Burseraceae, is an important Ayurvedic drug used in medoroga, sandhivata, and vrana. Because the source plant is scarce and demand is high, marketed Guggulu is prone to adulteration with other gums and resins and to poor quality from improper collection, processing, and storage, which can affect the efficacy of the drug and its formulations. The present study aimed to assess and compare the quality of genuine and market samples of Guggulu on the basis of organoleptic, physicochemical, and phytochemical parameters. A taxonomically authenticated genuine sample (Sample A) and four market samples from Mumbai (Sample B), Delhi (Sample C), Bangalore (Sample D), and Kolkata (Sample E) were evaluated. Organoleptic characters (color, odour, taste, texture, and appearance) were recorded as a quick indicator of authenticity. Physicochemical parameters, including loss on drying, total ash, acid-insoluble ash, water-soluble ash, and alcohol- and water-soluble extractive values, were determined as per Ayurvedic Pharmacopoeia of India methods to indicate moisture, inorganic impurities, and extractable active matter. Preliminary phytochemical screening was carried out to detect alkaloids, flavonoids, tannins, phenolics, steroids, terpenoids, saponins, glycosides, and carbohydrates. Sample A showed Organoleptic characteristic with physicochemical values within pharmacopoeial whereas market samples differed in organoleptic characters and showed higher or lower values, with the greatest variation in physicochemical evaluation. Phytochemical screening confirmed steroids, terpenoids, flavonoids, etc. in Sample A, while some market samples showed absent or weak reactions for these constituents. Together, these parameters provide a simple, reliable, and low-cost means of judging Guggulu quality, and the differences observed between the genuine and market samples indicate adulteration or substandard quality in some marketed material, supporting routine standardization before use in formulations.

Keywords: Guggulu, *Commiphora wightii*, organoleptic evaluation, physicochemical analysis, phytochemical screening, quality assessment

1. Introduction

Guggulu, the oleo-gum-resin of *Commiphora wightii* (Arn.) Bhandari (Burseraceae), is one of the most important drugs of Ayurveda. Described in the classical texts, it is regarded as *tikta* and *katu* in taste with *ushna virya*, and is attributed with *lekhana*, *medohara*, *vatahara*, and *vranaropana* actions^[1]. It is prescribed in *medoroga*, *sandhivata*, *amavata*, *vrana*, and *prameha*, and forms the base of many classical formulations such as Yogaraja Guggulu and Kaishora Guggulu. Modern studies support these uses^[1]. The resin contains terpenoids, steroids, lignans, and flavonoids, with Guggulsterone E and Z as the main bioactive markers, and Guggulu extracts have shown hypolipidaemic, anti-inflammatory, antiarthritic, antioxidant, anti-obesity, and wound healing activities in experimental studies^[2]. Rising demand from the Ayurvedic and herbal industries has placed heavy pressure on natural populations of *C. wightii*, which is now a threatened species because of excessive tapping and poor regeneration^{[3][7]}. As supply falls short, the market is prone to adulteration with other gum-resins, sand, plant debris, and exhausted or poorly stored material, which can reduce the safety and efficacy of formulations^[4]. Quality assessment of the raw drug is therefore essential. Organoleptic evaluation offers rapid identification, physicochemical parameters such as ash and extractive values indicate purity, moisture, and extractable matter, and preliminary phytochemical screening reveals the classes of

constituents present, as described in the Ayurvedic Pharmacopoeia of India and quality standard of Indian medicinal plants guidelines. Comparative data on Guggulu from different Indian markets are limited. This study therefore evaluated the organoleptic, physicochemical, and phytochemical characteristics of a genuine sample and four market samples from Mumbai, Delhi, Bangalore, and Kolkata.

2. Materials

The genuine sample of Guggulu (Sample A) was collected from an authentic source at Vandhay village, Tal. Bhuj, Gujarat, and authenticated by [name, designation, institution]. Market samples were purchased from major raw drug markets representing four zones of India: West zone, Mumbai (Sample B); North zone, Delhi (Sample C); South zone, Karnataka (Sample D); and East zone, Kolkata (Sample E). All samples were stored in clean, airtight, labelled containers until analysis.

3. Methodology

Organoleptic evaluation^[5]:

Organoleptic evaluation was carried out as per the Ayurvedic Pharmacopoeia of India (API) using the *Panchabhautika Pariksha* (sensory examination). A

proforma was prepared for recording the observations, which included the following:

- **Shabda Pariksha:** Brittleness and breaking pattern were assessed by bending and rupturing the crude drug.
- **Sparsha Pariksha:** Texture was assessed by rubbing a small amount of the drug between the thumb and fingers.
- **Rupa Pariksha:** Color and morphology of the drug were observed.
- **Rasa Pariksha:** Taste was assessed by the volunteers themselves.
- **Gandha Pariksha:** Odour (*sugandha* or *durgandha*) was assessed by smelling the resin. The resin was then burnt over a flame, the smoke was inhaled, and the odour was noted.

Ten volunteers were selected at random. Each volunteer performed the *Panchabhautika Pariksha* on the genuine and all market samples, and the final observations were drawn from their combined responses.

Physicochemical analysis^[5]

Physicochemical parameters of all samples (A to E), namely foreign matter, total ash, acid-insoluble ash, alcohol-soluble extractive value, and water-soluble extractive value and Ph were determined as per the standard methods given in the Ayurvedic Pharmacopoeia of India (API)

Preliminary phytochemical screening^[5]

Extracts of all samples (A to E) were prepared in Methanol and subjected to preliminary phytochemical screening for

alkaloids, flavonoids, tannins and phenolic compounds, steroids, triterpenoids, saponins, glycosides, and carbohydrates, as per the standard procedures given in the Ayurvedic Pharmacopoeia of India (API). The presence or absence of each phytoconstituents was recorded as (+) or (-) based on the characteristic color change or precipitate formation.

4. Results

A. Organoleptic Evaluation

Organoleptic evaluation done by *Panchabhautik parikshan* Parameter used for this *parikashan* are,

1) *Shabda parikshan*/fracture characteristic:

The sound is not very loud, as *Guggulu* possesses a certain degree of plasticity and softness.

Table 1: *Shabda parikshan* of genuine and market samples of *Guggulu*

Parameter	Sample A	Sample B	Sample C	Sample D	Sample E
Shabda (fracture)	Brittle	Brittle	Very hard	Brittle	Crumbled/Granular

2) *Sparsha parikshan*/texture:

The texture was examined by holding the resin between thumb and index finger. Gently press, roll, and stretch the resin.

Table 2: *Sparsha parikshan* of genuine and market samples of *Guggulu*

Parameter	Sample A	Sample B	Sample C	Sample D	Sample E
Sparsha (Touch)	Sticky, Resinous	Sticky, Resinous	Sticky, Hard, Resinous	Sticky, Resinous	Slightly Sticky, Resinous

3) *Rupa parikshan*

Refers to the assessment of the appearance of *Guggulu* resin by naked eye.

Table 3: *Rupa parikshan* of genuine and market samples of *Guggulu*

Parameter	Sample A	Sample B	Sample C	Sample D	Sample E
Rupa (Color)	Yellowish –brown to dark brown	Brown to dark brown	Brown to dark brown	Yellowish –brown to dark brown	Orange-yellowish brown

4) *Ras parikshan*/taste

Ras parikshan done by individually by volunteers.

Table 4: *Ras parikshan* of genuine and market samples of *Guggulu*

Parameter	Sample A	Sample B	Sample C	Sample D	Sample E
Ras (Taste)	Bitter, after taste pungent (tikta,kashay)	Bitter (tikta)	Bitter (tikta)	Bitter (tikta)	Less Bitter

5) *Gandh parikshan*:

In order to do this, the resin was burnt over a flame and its smoke was inhaled. Without burning also resin were inhaled and observation noted.

Table 5: *Gandh parikshan* of genuine and market samples of *Guggulu*

Parameter	Sample A	Sample B	Sample C	Sample D	Sample E
Gandh without burning	Aromatic	Aromatic	Less Aromatic	Aromatic	Aromatic
Gandh after burning	Balasmic	Balsamic	-	Balasmic	-

Macroscopy Study^[6]:

In the organoleptic evaluation, parameters such as color, aroma, taste, texture, and fracture characteristics were assessed. Macroscopic evaluation included the examination of resin size, shape, fracture and emulsification behavior in hot water.

Table 6: Macroscopy of genuine and market samples of *Guggulu*

	Sample A	Sample B	Sample C	Sample D	Sample E
Size	1.5cm-2cm	2cm	2.5cm -3cm	1.5cm-2cm	1cm -2cm
Shape	Vermicular	Vermicular	More like block	Vermicular	Crumbly/ Granular
Fracture	Brittle, Waxy surface	Brittle, Waxy surface	Hard	Brittle , Waxy surface	Brittle
Emulsion in hot water	Intense milky emulsion	Milky white emulsion	Milky white Emulsion	Milky white emulsion	Poor emulsion

**(1) Sample a****(2) Sample b****(3) Sample c****(4) Sample d****(5) Sample e****Image 1:** Images of a) genuine Sample and b), c), d), e) market samples of *Guggulu***Physicochemical Study****Table 7:** Observation of Physicochemical study of genuine and market samples of *Guggulu*

Sr no	Parameters	Sample A	Sample B	Sample C	Sample D	Sample E	API standard values
1	Foreign matter %	1%	0.95%	3.3%	1.1%	1.5%	Not More Than 4%
2	Total ash %	3.6%	6.5%	8.4%	2.7%	6.9%	Not More Than 5%
3	Acid insoluble ash %	1.08%	5.1%	5.7%	0.54%	2.3%	Not More Than 1%
4	Alcohol soluble extractive %	38.08%	16.15%	10.55%	31.08%	5.51%	Not Less Than 27%
5	Aqueous soluble extract %	57.19%	48.96%	59.26%	58.50%	78%	Not Less Than 53%
6	Ph (1% solution)	4.99	5.33	5.17	4.43	5.49	-

Phytochemical Study

Methanolic extract:

Table 8: Observation of phytochemical study of genuine and market samples of *Guggulu* (Methanolic extract)

Phytoconstituents	Sample A	Sample B	Sample C	Sample D	Sample E
Alkaloids	+ve	+ve	+ve	+ve	-ve
Carbohydrate	+ve	+ve	+ve	-ve	-ve
Flavonoids	-ve	-ve	-ve	-ve	-ve
Glycoside	+ve (weakly)	+ve	+ve (weakly)	-ve	+ve (Weakly)
Triterpenoids	-ve	-ve	-ve	-ve	-ve
Resin	++ve	+ve	+ve	+ve	+ve (less turbid)
Phenol	+ve	-ve	+ve	+ve	-ve
Saponins	-ve	-ve	-ve	-ve	-ve
Steroid	+ve	-ve	+ve (weakly)	+ve (weakly)	-ve
Tannins	+ve (gallo tannin)	+ve (pseudo tannin)	-ve	+ve (gallo tannin)	-ve

Aqueous Extract:

Table 9: Observation of phytochemical study of genuine and market samples of *Guggulu* (Aqueous extract)

Phytoconstituents	Sample A	Sample B	Sample C	Sample D	Sample E
Alkaloids	-ve	-ve	-ve	-ve	-ve
Carbohydrate	-ve	-ve	-ve	-ve	-ve
Flavonoids	-ve	-ve	-ve	-ve	-ve
Glycoside	-ve	-ve	-ve	-ve	-ve
Triterpenoids	-ve	-ve	-ve	-ve	-ve
Resin	++ve	+ve	(Weakly)+ve	++ve	-ve
Phenol	-ve	-ve	-ve	-ve	-ve
Saponins	-ve	-ve	-ve	-ve	-ve
Steroid	-ve	-ve	-ve	-ve	-ve
Tannins	-ve	-ve	-ve	-ve	-ve

5. Discussion

Organoleptic evaluation is a qualitative examination that reveals the identity and purity of a crude drug. Morphological characters play a significant role in its identification, characterization, and taxonomic delimitation on the basis of available markers. In the present study, organoleptic evaluation was carried out by *Panchabhautika Pariksha* (sensory evaluation), comprising *Shabda* (fracture sound), *Sparsha* (texture), *Rupa* (color), *Rasa* (taste), and *Gandha* (odour). Macroscopic evaluation was also performed, as it is another essential qualitative step in the identification and verification of a crude drug. It analyses external traits such as size, shape, color, surface texture, and fracture, which help in judging the quality of the drug.

The genuine sample (Sample A) conformed to the API description in all organoleptic parameters, namely *Shabda*, *Sparsha*, *Rupa*, *Rasa*, and *Gandha*. The organoleptic characters of Samples B and D closely matched those of the genuine sample. Sample C was irregular, hard, and clumped, whereas Sample E was less sticky, crumbled or granular rather than occurring as whole pieces, slightly orange-yellowish brown in color, and less bitter than the other samples.

In the macroscopic study, the size, shape, and texture of Sample A matched the standard references (API). Samples B and D nearly matched the genuine sample. Sample C was extremely hard and difficult to break, and Sample E was distinctly different from the others because of its crumbled texture.

The emulsification behaviour of the resin in hot water is a specific characteristic of *Guggulu*, and it is mentioned in the API, the QSIMP, and the Bhavaprakasha Nighantu (K.C. Chunekar). Sample A gave an intense milky white emulsion. Samples B, C, and D also produced a milky white emulsion, but it was less intense than that of Sample A. Sample E gave a poor emulsion compared with all the other samples. Overall, the organoleptic and macroscopic findings show that the authentic sample (Sample A) conforms to the standard references. Samples B, C, and D are closer to the genuine sample, while Sample E lacks several key characteristics of *Guggulu*.

- 1) Physicochemical Evaluation:** Physicochemical analysis was carried out after organoleptic and macroscopic examination to assess the quality and purity of the genuine and market samples of *Guggulu*. These parameters help detect contamination, adulteration, and variations arising from processing, storage, and geographic origin.
- 2) Foreign matter:** All samples complied with the API limit (NMT 4%). Values were lower in Samples A (1%), B (0.95%), and D (1.1%) and higher in Samples C (3.3%) and E (1.5%), suggesting some extraneous material in the latter two, probably from differences in handling, storage, and processing.
- 3) Total ash:** A high total ash value indicates contamination, substitution, adulteration, or careless preparation. Only Samples A (3.6%) and D (2.7%) complied with the API limit (NMT 5%). Samples B (6.5%), C (8.4%), and E (6.9%) exceeded it, with Sample C showing the highest inorganic contamination,

possibly due to inadequate cleaning or extraneous debris.

- 4) **Acid-insoluble ash:** This estimates siliceous matter such as sand and soil. Sample D (0.54%) met the API limit (NMT 1%). Sample A (1.08%) was marginally above it, probably due to natural dust picked up during field collection. Samples B (5.1%), C (5.7%), and E (2.3%) clearly exceeded the limit, indicating contamination with dirt and sand.
- 5) **Alcohol-soluble extractive:** This reflects resins, steroids, volatile constituents, and other alcohol-soluble compounds. Samples A (38.08%) and D (31.08%) complied with the API limit (NLT 27%), whereas B (16.15%), C (10.55%), and E (5.51%) fell well below it.
- 6) **Water-soluble extractive:** This reflects gums, sugars, tannins, and other polar compounds. Samples A (57.19%), C (59.26%), D (58.50%), and E (78%) complied with the API limit (NLT 53%); only Sample B (48.96%) failed. The very high value in Sample E, with its very low alcohol-soluble value, suggests mostly gummy matter and little resin.
- 7) **pH:** The pH of the 1% solution ranged from 4.43 (D) to 5.49 (E), with A at 4.99. All were mildly acidic, with no clear relation to quality.
- 8) **Phytochemical Evaluation:** Preliminary phytochemical screening was carried out on the methanolic and aqueous extracts of all samples to compare the market samples with the genuine drug.
- 9) **Methanolic extract:** The genuine sample (A) showed alkaloids, carbohydrates, phenols, steroids, gallotannins, and a strong resin reaction (++), with weakly positive glycosides. Sample D was closest to A, with alkaloids, phenols, gallotannins, weak steroids, and resin, but no carbohydrates or glycosides. Sample C showed alkaloids, carbohydrates, phenols, resin, and weak steroids and glycosides, but no tannins. Sample B lacked phenols and steroids, and its tannins were pseudo-tannins rather than gallo tannins, which may point to a different or mixed source. Sample E was the poorest, lacking alkaloids, carbohydrates, phenols, steroids, and tannins, with only weak glycosides and a less turbid resin reaction. Steroids are important because guggulsterone are the principal bioactive constituents of Guggulu. They were detected in A, C (weak), and D (weak) but not in B and E, suggesting a lower content of active markers in the latter two.
- 10) **Aqueous extract:** Only resin was detected: strong in A and D, moderate in B, weak in C, and absent in E. This agrees with the alcohol-soluble extractive values and emulsion behavior, and again places Sample E as the most deviant.

Flavonoids, triterpenoids, and saponins were negative in all samples, including the genuine one, so they did not discriminate between samples. This may reflect the sensitivity of the tests or the solvent used.

Overall, Samples A and D showed the most complete profile, B and C were intermediate, and E lacked most characteristic constituents, consistent with the organoleptic and physicochemical findings.

6. Conclusion

The present study compared a genuine sample of Guggulu (Sample A) with four market samples from Mumbai (B), Delhi (C), Karnataka (D), and Kolkata (E) using organoleptic, physicochemical, and phytochemical parameters. The genuine sample conformed to the standard organoleptic and macroscopic descriptions, complied with the API limits for foreign matter, total ash, and extractive values, and showed a strong resin reaction along with steroids, phenols, and Gallo tannins.

Among the market samples, Sample D was closest to the genuine drug and met most API standards. Samples B and C were organoleptically acceptable but exceeded the limits for total and acid-insoluble ash and had low alcohol-soluble extractive values, with missing or weak steroid and tannin reactions. Sample E was the most substandard, with a crumbled form, poor emulsion, very low alcohol-soluble extractive value, and absence of most phytoconstituents.

These findings indicate that three of the four market samples did not meet the quality standards of genuine Guggulu, probably because of adulteration, exhausted resin, or poor processing and storage. Qualitative assessment is an essential first step before any quantification, because organoleptic, physicochemical, and phytochemical evaluation is simple, rapid, and low-cost, and it screens out unauthentic or substandard samples so that costly instrumental analysis is used only on material that has passed this stage. No single qualitative parameter was sufficient to judge quality on its own, and these methods cannot identify or quantify specific marker compounds. Chromatographic examination (TLC, HPTLC, or HPLC), including fingerprinting and quantification of Guggulsterone E and Z, is therefore important in future work to confirm authenticity and detect adulterants more precisely.

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