

Journal of Ayurveda Medical Sciences

*Refereed, Indexed, Peer reviewed, Open access, Quarterly
Journal for Rapid Publication of Ayurveda and Other
Traditional Medicine Research*



ISSN: 2456-4990

www.jayumedsci.com

©Journal of Ayurveda Medical Sciences – HRGS' Ayurveda Journal



Pharmaceutical Standardization of *Guggulu Śodhana*

Kruti Yagneshkumar Vyas,^{1*} Vinay Janaradan Shukla,² Galib Ruknuddin,³ Pradeep Kumar Prajapati⁴

¹Department of Rasa Shastra and Bhaishajya Kalpana, Shri OH Nazar Ayurveda Mahavidhyalaya, Surat, Gujarat 395003. ²Pharmaceutical Chemistry Laboratory, Institute for Post Graduate Teaching & Research in Ayurveda, Gujarat Ayurved University, Jamnagar, Gujarat 361008. ³Department of Rasa Shastra and Bhaishajya Kalpana, All India Institute of Ayurveda, New Delhi 110076, India.

*Correspondence: Email: vyas_krt@yahoo.co.in, Mobile: +91-9426393726

ABSTRACT

Introduction: *Śodhana* is a preliminary process that helps in eliminating possible physical or chemical blemishes from raw material and making them suitable for therapeutic application. *Guggulu* (*Commiphora wightii* (Arn) Bhandari) is a well-known herb in Āyurveda, which is gaining its attention in world market. Exudate of the plant is therapeutically active and need to process before it is converted into formulations. As a little data is available on standard manufacturing procedure of *Guggulu Śodhana*; the current attempt is planned to evaluate the same. **Methods:** *Guggulu* was procured from Gujarat state forest department corp. Ltd., Vadodara. *Śodhana* was done in 10 batches in *Gomūtra*. Organoleptic characters, loss on drying, ash value, acid insoluble ash, water soluble extractives, methanol soluble extractives, pH and volatile oil content, HPTLC, HPLC, FTIR, Heavy metal analysis and Microbial over load were carried out. **Results:** Average 80.56% yield was observed after *Śodhana*. Differences were found in physico-chemical, HPLC and FTIR analysis that show the impact of *Śodhana* procedure on *Guggulu*. **Conclusion:** The adopted method for *Guggulu Śodhana* can be considered as easy, convenient and standard procedure and the values of physico-chemical parameters may be taken for quality assurance.

KEYWORDS

Guggulu, *Gomūtra*, *Śodhana*, Standardization

Received: 25.03.2017

Accepted: 27.06.2017

DOI: 10.5530/jams.2017.2.12

INTRODUCTION

Āyurvedic pharmaceuticals is enriched by various processes and techniques. *Śodhana* (preliminary processing techniques), *Mārana* (incineration), *Bhāvana* (levigation), *Mardana* (grinding) etc. procedures are described in classics to achieve perfect formulation composition and to get desired efficacy. Among them, *Śodhana* is a preliminary process that helps in eliminating possible physical or chemical blemishes from raw material and making them suitable for therapeutic application.^[1] *Guggulu* (*Commiphora wightii*, (Arn) Bhandari) is a well known herbal drug, which is being used in vast range of diseases since Vedic period. It is advocated in *Kuṣṭha* (skin diseases), *Medoroga* (lipid disorders), *Āmavāta* (rheumatoid arthritis), *Sandhigatavāta* (osteoarthritis), *Gulma* (Abdominal lump), *Śoṭha* (odema) etc.^[2]

Guggulu is also popular as dietary supplement to reduce cholesterol.^[3] Many modern pharmaceuticals prepare *Guggulu* formulations by using *Guggulu* in extract form. *Guggulu* is gaining its attention in world market nowadays.^[4] Around 90 tonnes per annum of *Guggulu* extract powder is demanded in Indian market.^[5] To meet increased market demand, many Āyurvedic pharmacies are preparing these formulations on large scale. The exudate of this plant is therapeutically active and need to be processed by following classical guidelines before its utilization in therapeutics.

Some studies reported adverse effects like skin rashes, irregular menstruation, diarrhoea, headache, mild nausea, eructation, hiccough, and with very high doses, liver toxicity too.^[6] On the other hand, studies reported reduced Gastric irritancy^[7] and increased pharmacological action with *Śodhita Guggulu*.^[8] But, unfortunately, no standard manufacturing procedure of *Guggulu Śodhana* is available till date. Considering this, it has been attempted to develop standard manufacturing procedure of *Guggulu Śodhana* of laboratory scale.

Various *Guggulu Śodhana* medias are described in Āyurveda like *Godughdha*, *Gomūtra*, *Triphalā Kvātha*, *Gudūchī Kvātha* etc.^[9-10] *Gomūtra* is dominated by *kṣārīya* (alkaline) substances, *kaṭu-tikta rasa*, *tikṣṇa* and *laghu guṇa*, *uṣṇa vīrya* and *kaṭu vipāka*. *Gomūtra* is also reported to have bio-enhancer,^[11] anti diabetic, anti oxidant,^[12] and anti cancer^[13] activities. Research works regarding *Guggulu Śodhana* are less in number.^[14] Only one work is found on standardization *Guggulu Śodhana* in *Triphalā Kaṣāya*,^[15] but no work is reported on Standardization of *Guggulu Śodhana* in presence of *Gomūtra* till date. Considering this, it is planned to develop pharmaceutical standardization of *Guggulu Śodhana*.

MATERIALS AND METHODS

Collection of drug: Raw *Guggulu* [*Commiphora wightii* (Arn) Bhandari.] was procured from Gujarat State Forest Department Corp. Ltd., Vadodara during Feb 2012 (Batch no. B 01, Code-128500). Fresh *Gomūtra* was collected locally from Jamnagar.

Pharmaceutical evaluation

Śodhana procedure: *Guggulu Śodhana* was done by *Parīśravaṇa* (dissolving and filtering) method.^[16] External impurities like stone, bark, wood etc. from raw material were removed manually. Raw *Guggulu* was made into small pieces. Four litres of *Gomūtra* was added to 1 kg of *Aśudhdha Guggulu* (AG) in a stainless steel vessel. Proportion of *Gomūtra* and *Guggulu* was decided as per the reference of *Bṛhat Rasarāja Suñdara*.^[17] The contents were subjected to mild heat maintaining temperature between 70-85°C to facilitate dissolution of *Guggulu*. After complete dissolution, the contents were filtered through cotton cloth (madarpat fabric) in hot condition. Contents remained as residue in cloth were discarded. The filtrate was subjected to further heating at 70°C till complete evaporation of liquid. Obtained semisolid mass was shifted to ghee smeared stainless steel trays, spread into thin uniform layers and dried in under sun. The dried mass was carefully collected as *Śudhdha Guggulu* (SG) and stored (Fig. 1).

Figure 1. *Guggulu Śodhana* Procedure



Physico-chemical evaluation

Physico-chemical parameters like loss on drying, ash value, acid insoluble ash, water soluble extractives, methanol soluble extractives, pH and volatile oil content were carried out by following standard procedures.^[18]

High Performance Thin Layer Chromatography (HPTLC): For HPTLC study, 5 g of drug was extracted with methanol by soxhlate extract method. It was then combined with methanol to adjust the volume to 25 ml. A CAMAG (Switzerland, version 1.2.1)) HPTLC system equipped with a sample applicator Linomat V was used for application of samples. CAMAG TLC Scanner 3, Reprostar and Wincats 4.02 were used for scanning the plates. CAMAG twin through glass chamber was used for developing the plates. Pre-coated silica gel GF 254 plate was used as stationary phase. Petroleum ether (60-80° C): Ethyl acetate: Methanol (6:2:0.5) v/v was used as mobile phase as per reference of ICMR database.^[19] After 30 minutes of chamber saturation, plate was developed, and then scanned under short UV (254 nm) and long UV (366 nm) and thereafter sprayed with Vaniline-sulphuric acid reagent for color reaction.

High Performance Liquid Chromatography (HPLC): Chromatographic conditions for estimation of Guggulsterone-E and Guggulsterone-Z through HPLC are Column: ODS (Octadecasilane) C 18(2), 5 microne size, 250×40 mm (Merck) RP-18 Lichrocart 250-4; Detection: SPD-20A prominence UV- Visible detector, Wavelength detection: 242 nm; Mobile Phase: Water:Acetonitrile (55:45); Temperature: Room temperature; Flow Rate : 1 ml/min; Pressure: 153 kgf; Note : 47.6 mg sample in 50 ml Acetonitrile.

Fourier transform infrared spectroscopy (FTIR): FTIR spectrometer specifications are as follows: Instrument: Nicolet Instrument Corporation, USA, MAGNA 550; Method: KBr pallet, Ratio (100mg KBr:1mg Sample) Range: 4000 to 50 cm^{-1} Spectral Resolution: 0.4 cm^{-1}

Microbial overload: Culture medium was prepared by following method: As per requirement weighed solid sample was dissolved in appropriate distilled water and agar (Mac conkey Agar for bacteria and Sabroud's for yeast and mould) was added. The solution was heated and final volume was made. The medium was distributed in flasks and sterilized by autoclaving at 121°C for 15 min. In the sterilized area, the solution was poured into plates and kept for cooling. After that, weighed sample spread on plates in sterilized area. Plates were kept downwards. Plates were observed after 24 h for bacteria and 36 to 48 h for yeast and moulds.

Heavy metal content test (ICP - OES): Heavy metal analysis was done by ICP-OES (Inductive Coupled Plasma – Optical Emission Spectrometer) method. [Make : Perkin Elmer; Model : Optima 3300 RL] Sample Preparation : For acid digestion of sample, take 0.25 g sample and add 5ml of HCl + 5ml of HNO₃ + 1ml H₂O₂ in a closed device using temperature control microwave heating at 200° C for 15 minutes then after cooling vessel device, solution filter it and wash by de-ionized water and make up 25ml solution. Instrument calibrated with reference standard 100 ppm.

RESULTS AND DISCUSSION

Guggulu Śodhana was done in 10 batches; the average details of which are shown in Table 1. Average 80.56% yield was observed during *Guggulu Śodhana*. To check the percentage of *Gomūtra* in each sample of *Śodhita Guggulu*, attempts were made to calculate solid contents of *Gomūtra* individually, which was found to be 4.6 at an average.

Guggulu Śodhana is described mainly by two methods in classics. In one method, *Dolayantra Svedana* (boiling) is advised in *pottali*^[20] and in another method, *Svedana* by *Parīśravaṇa* method.^[16] Pilot batches were attempted by following these two methods before commencing the actual pharmaceutical procedure. Excessive loss and difficulty in drying was noticed in first batch done by following *Svedana* method. In this procedure, *Gomūtra* was added repeatedly in increments to keep *Pottali* immersed completely. Thirteen litres of *Gomūtra* was required to complete the processing of 0.5kg *Guggulu*. Squeezing of *Pottali* was also done repeatedly to avoid blocking of cloth pores by *Guggulu* gum-resin. For obtaining maximum yield, *Svedana* was continued for three days. The contents obtained at the end of boiling were subjected for drying in sun rays and later in hot air oven. But, complete drying was not observed and the contents remained semi liquid in consistency. Due to these practical difficulties, method of *Parīśravaṇa* was adopted in the second pilot batch.

Table 1. Results of Śodhita Guggulu

Batch No.	Wt of Guggulu (g)		Yield (%)	Loss (g)	Loss (%)	Residue(g)
	Before Śodhana	After Śodhana				
1	1000	755	75.5	245↓	24.5	239
2	1000	854	85.4	146↓	14.6	140
3	1000	780	78.0	220↓	22.0	212
4	1000	808	80.8	192↓	19.2	185
5	1000	776	77.6	224↓	22.4	218
6	1000	745	74.5	255↓	25.5	248
7	1000	876	87.6	124↓	12.4	118
8	1000	807	80.7	193↓	19.3	188
9	1000	793	79.3	207↓	20.7	199
10	1000	862	86.2	138↓	13.8	132
Average	1000	805.6	80.56	194.4	19.44	187.9

↓=loss

As *Guggulu* is plant exudates, it contains impurities like pieces of stem bark, thorn, leaves etc. The percentage of these foreign matters should not be exceeded to 4%.^[21] These physical impurities were removed manually from *Aśuddha Guggulu* and found negligible in amount. *Aśuddha Guggulu* was crushed in small pieces which facilitates better and easy solubility in *Gomūtra*. *Guggulu* was dissolved in *Gomūtra* by heating and maintaining the temperature in between 75-80°C for 3 hours. (Table-2)

Table 2. Average time and duration of process

Process		Duration	Temp
Heating	Before filtering	3 hrs	75-80°C
	After filtering	4 hrs	65-70°C
Drying	Sun rays	9 hrs	28-32°C
Drying	Sun rays	9 hrs	28-32°C
Drying	Sun rays	9 hrs	28-32°C

Amber yellow colour of *Gomūtra* turned to creamish - yellow after dissolution of *Guggulu* and mixed smell of *Gomūtra* and *Guggulu* was perceived. After 3 hours of continuous heating, almost all *Guggulu* got dissolved. During heating, mixed smell of *Gomūtra* and *Guggulu* was perceived. After complete dissolution, solution became further sticky and the contents were squeezed through the cotton cloth in hot condition. The residual part in cotton cloth containing physical and insoluble impurities was discarded that is whitish and rubbery, may be a part of resin. Filtrate was further heated to evaporate the moisture content. During this process, temperature was maintained between 65-70⁰ C. More heat leads to excessive frothing and spilling of the material. Hence, large sized containers should be used. In the evaporating stage, intense (ammonic) smell, and irritation of eyes was perceived that may be due to liberation of ammonia present in *Gomūtra*. Continuous stirring was needed in last stages to avoid sticking and burning of the material. After obtaining semi-solid consistency, mass was shifted into stainless steel trays. At this stage, *Guggulu* was very sticky, hence to avoid loss and for easy collection tray was smeared with ghee. After sun drying, the material become harder and colour turned to dark brown. As this method is convenient; further followed in 10 batches to develop standard manufacturing methods of 1 kg each of *Aśuddha Guggulu* and 4 l of *Gomūtra*. Average 7 h was the time duration required for dissolving and evaporation procedure. For sun drying it took 3 days. An average of 80.56% yield was obtained. Average 187.9 g residue was found.

In Organoleptic evaluation, Yellowish brown colour of AG was turned to dark brown after *Śodhana* in *Gomūtra*. Significant balsamic odor was perceived in Raw *Guggulu* sample while after *Śodhana*, mixed smell of *Gomūtra* and *Guggulu* was perceived in SG. Taste of AG is bitter- astringent while SG has bitter taste. *Guggulu* became stickier after *Śodhana* due to *Gomūtra*.

Physico-chemical parameters of *Guggulu* samples were given in Table 3. All parameters of *Aśodhita Guggulu* samples were found within the limits given by API.^[21] The pH of *Śodhita* sample was increased to 6 from 5. *Gomūtra* was used as *Śodhana* media, which is alkaline (pH=7.40) in nature may contribute to increase in pH. Loss on drying was found more (15.33%) in SG in comparison to AG indicating presence of more moisture content in *Śodhita* sample. This loss in weight in the *Śodhita* samples, would be due to *Gomūtra* used in *Śodhana*. *Gomūtra* consist a lot of *Kṣariya* substances which are hygroscopic in nature. SG had more Ash value (12.69%) than AG. It may be due to some inorganic substances incorporated during *Śodhana* procedure. Water soluble extractive was found more in SG. It may be because of *Śodhana* in *Gomūtra* that extracted some aqueous principles. Methanol soluble extractive was found decreased after *Śodhana* procedure. No significant Changes were observed in volatile oil values of *Aśudhdha* and *Śodhita Guggulu*. It may because content in *Gomūtra* was clutched the volatile oil of *Guggulu*.

Table 3. Physico-chemical parameters of *Aśuddha* and *Śuddha Guggulu*

Parameters	API For plain Guggulu	AG	SG
pH	-	5.0	6.0
Loss on drying (110°C)%	Not>14	12.76	15.33
Ash value (w/w)%	Not >5	4.73	12.69
Acid insoluble ash (w/w)%	Not > 1	2.30	3.90
Water soluble extractive (w/w)%	Not <53	45.65	63.86
Methanol soluble extractive (w/w)%	Not <27	38.83	25.49
Volatile oil (w/w)%	Not <1	0.99	0.97

In HPTLC study, methanolic extract of AG showed 13 numbers of spots at 254 nm wavelength and 11 spots at 366 nm wavelength and SG showed 12 numbers of spots at 254 nm wavelength and 10 spots at 366 nm wavelength (Table 4 and Fig. 2). Variable number of spots was found in different groups. In Spectral comparison, common component at 0.05, 0.10, 0.43, 0.55, 0.67, 0.77, 0.88 and 0.97 Rf was found in both *Guggulu* samples.

In HPLC study, marker compound was estimated (Table-5) *Guggulsterone-E* was found more (0.326%) in AG, while it was 0.215% in SG. Simultaneously *Guggulsterone -Z* was found more (0.722%) in AG and in SG it was 0.567%. HPLC profile of both *Guggulu* samples showed decreased concentration of *Guggulsterone-E* and *Z* after *Śodhana* of *Guggulu*. The active components of the plant are the *Guggulsterones*, specifically the stereoisomers, *Guggulsterone E* and *Guggulsterone Z*.^[22] It is found to be responsible for lowering blood lipids.^[23] Concentration of bio active component are influenced by many factors like Season, collection area, annual rain fall, geographical variation, Planting, harvesting practices, solvent system, mobile phase etc.^[24]

Impact of reduction of these sterones after *Śodhana* is not justifiable here and needs more data from experimental and clinical trials.

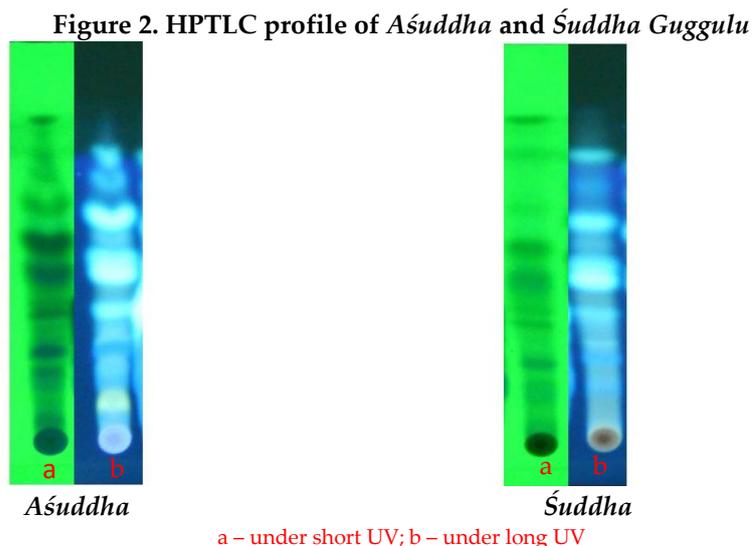


Table 4. HPTLC profile of *Aśuddha* and *Śuddha Guggulu*

No	Samples	254 nm		366 nm	
		No. of spots	R _f	No. of spots	R _f
1	AG	13	0.04, 0.10, 0.24, 0.33, 0.36, 0.44, 0.55, 0.67, 0.77, 0.84, 0.91, 0.96, 0.99	11	0.04, 0.10, 0.14, 0.24, 0.36, 0.44, 0.61, 0.72, 0.82, 0.88, 0.99
2	SG	12	0.05, 0.09, 0.17, 0.21, 0.31, 0.39, 0.43, 0.55, 0.67, 0.79, 0.93, 0.97	10	0.05, 0.09, 0.18, 0.21, 0.34, 0.49, 0.59, 0.71, 0.88

Table 5. HPLC profile of *Aśuddha* and *Śuddha Guggulu*

No.	Sample name	Guggulsteron-E (%w/w)	Guggulsteron-Z (%w/w)
1	AG	0.326	0.722
2	SG	0.215	0.567

FTIR evaluation

In FTIR study, observed frequencies are given in Table-6 and 7. AG has alkanes, alcohol & phenols, amines, aldehydes & ketones, carboxylic acids & derivatives, sulphur, phosphorous and silicon fictional groups, whereas SG has alkanes, alcohol & phenols, carboxylic acids & derivatives, sulphur and phosphorous as functional groups (Fig. 3).

FTIR spectroscopy allows the qualitative determination of organic compounds as the characteristic vibrational mode of each molecular group causes the appearance of bands in the infrared spectrum at a specific frequency, which is further influenced by the surrounding functional groups^[25] FTIR spectra of both samples were taken in the region of 400-4000 cm⁻¹. General overview of all the samples indicates presence of large number of functional groups.

Differentiation between *Aśuddha* and *Śodhita* sample can seen at the range of 1200 to 500 cm⁻¹ s. Six wavelength were selected for matrix plotting. i.e. 1161, 1062, 818, 777, 751, 556 cm⁻¹ for easy discrimination. These frequencies are associated with Alcohol and Phenols, Amine, Carboxylic acid, Sulphur fuctional group and Phosphorus function group. Among them, *Śodhita* and *Aśodhita* samples can easily differentiated at λ 1161, λ1062 and λ556 with all combination. Similarity was also found between the wavelength range 1000 to 600 cm⁻¹. Five wavelengths were selected for matrix plotting. i.e.1023, 945, 712, 647, 660cm⁻¹. samples are found similar at this range which suggests that compounds at this range do not change after *Śodhana* procedure.

Table 6. Observed frequencies of *Aśuddha Guggulu* in FTIR study

Observed peak	Range	Intensity	Assignment	Vibration	Functional group
2928.25	2850-3000	str	CH ₃ , CH ₂ & CH	Asymmetric	Alkanes
2858.74			2 or 3 bands	strech	
1376.46	1350-1470	Med	CH ₂ & CH ₃	Symmetric band	
1455.71	1370-1390	Med	deformation CH ₃ deformation		

3421.60	3200-3550	Str	O-H (H-bonded), usually broad	Asymmetric stretch	Alcohols & Phenols
1376.46	1330-1430	Med	O-H bending (in-plane)	Symmetric band	
3421.60	3400-3500 (dil. soln.)	Wk	N-H (1°-amines), 2 bands	Asymmetric stretch	Amines
1659.22	1550-1650	med-str	NH2 scissoring (1°-amines)	Symmetric band	
1711.33	1710-1720	Str	C=O (saturated ketone)	Asymmetric stretch	Aldehydes & Ketones
1455.71	1400-1450	Str	a-CH2 bending	Symmetric band	
1659.22	1630-1695 (amides)	Str	C=O (amide I band)	Asymmetric stretch	Carboxylic Acids & Derivatives
1517.05	1500-1560	Med	N-H (2 _i -amide) II band	Symmetric band	
1164.88	1050-1200	Str	C=S thiocarbonyl	stretch	Sulphur Functions
1125.11					
1036.58	1030-1060	Str	S=O sulfoxide	stretch	
1376.46 & 1164.88	1365± 5 & 1180± 10	Str	sulfonyl chloride	Asymmetric & symmetric both stretch	
1036.58	900-1050	Str	P-OR esters	stretch	Phosphorous Functions
1125.11	1100-1200	Str	P=O phosphine oxide/ phosphate	stretch	
1243.88	1230-1260	Str	Phosphonate/ Phosphoramidate	stretch	
	1200-1275				
	1250± 10	str & shp	Si-CH3	Stretch	Silicon Functions

Str - Strong, Med - Medium, Wk - Weak, Shp - Sharp

Table 7. Observed frequencies of Śuddha Guggulu in FTIR study

Observed peak	Range	Intensity	assignment	vibration	Functional group
2861.14	2850-3000	strong	CH3, CH2 & CH	Asymmetric stretch	Alkanes
2929.84			2 or 3 bands		
1385.09	1350-1470	Med	CH2 & CH3	Symmetric bend	
1453.03			deformation		
1385.09	1370-1390	Med	CH3 deformation		
3422.72	3200-3550	Str	O-H (H-bonded), usually broad	Asymmetric stretch	Alcohols & Phenols
1385.09	1330-1430	Med	O-H bending (in-plane)	Symmetric bend	
1040.88	1040-1100	Str	O-C	Asymmetric stretch	Carboxylic Acids & Derivatives
1074.42					
1658.90	1630-1695 (amides)	Str	C=O (amide I band)	stretch	
525.75	500-540 (wk)	Wk	S-S disulfide	stretch	Sulphur Functions
1040.88	1030-1060 (str)	Str	S=O sulfoxide	stretch	
2333.68	2280-2440 cm-1	med & shp	P-H phosphine	Stretch	Phosphorous Functions
1040.88	900-1050	Str	P-OR esters		

Str - Strong, Med - Medium, Wk – Weak, Shp - Sharp

Microbial overload and Heavy metal content test

Results of Microbial overload and Heavy metal analysis were placed at Table 8 and 9.

Table 8. Results of microbial overload in *Aśuddha* and *Śuddha Guggulu*

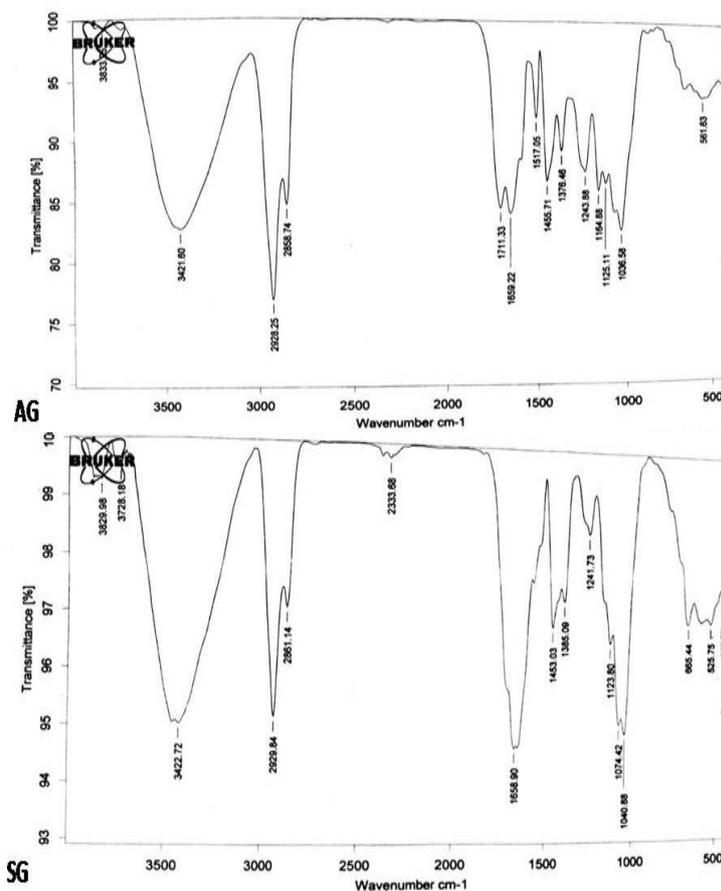
Microbial growth	Samples		Permissible Limit (API)
	AG	SG	
Total plate count	722cfu/g	852cfu/g	10 ⁵ cfu/g
Total fungal count	Absent	Absent	10 ³ cfu/g
<i>Escherichia coli</i>	Absent	Absent	Absent
<i>Pseudomonas aeruginosa</i>	Absent	Absent	Absent
<i>Staphylococcus aureus</i>	Absent	Absent	Absent
<i>Salmonella spp.</i>	Absent	Absent	Absent

Table 9. Result of Heavy metal analysis in *Aśuddha* and *Śuddha Guggulu*

Heavy metals	Samples		Permissible Limit (API)
	AG	SG	
Lead (Pb)	Not Detected	Not Detected	10ppm
Cadmium (Cd)	Not Detected	0.100ppm	0.30 ppm
Arsenic (As)	Not Detected	0.606ppm	3 ppm
Mercury (Hg)	0.575ppm	Not Detected	1 ppm

ppm= parts per million

Figure 3. FTIR graph of AG and SG



Total plate counts were within the normal range in all drug samples and total fungal count, *Escherichia coli*, *Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Salmonella spp* were absent. In the heavy metal analysis lead was not detected in any sample. Cadmium was present in minimum amount viz. 0.100 ppm in SG which is within the permissible limits. Arsenic was found 0.606ppm in SG which is also within the permissible limits. Mercury was found 0.575ppm in AG which is nearer to

permissible limits. As *Guggulu* is plant product and collected from arid area, chances of contamination of arsenic, cadmium and mercury may be during storage process. The microbial load and heavy metal analysis authenticated the safety aspect of the formulation from the analytical perspective.

CONCLUSION

Guggulu Śodhana procedure is very important in Āyurvedic pharmaceuticals. *Guggulu Śodhana* was carried out in ten batches of 1 Kg each of *Aśuddha Guggulu* and 4 l of *Gomūtra*. Average 7 h was the time duration required for dissolving and evaporation procedure. For sun drying it took 3 days. An average of 80.56% yield was obtained. Average 187.9 g residue was found. Alteration was found in physico-chemical, HPLC and FTIR analysis which show the impact of classical *Śodhana* procedure on *Guggulu*. The adopted method for *Guggulu Śodhana* can be considered as easy, convenient and standard manufacturing procedure. Data obtained from the present study is reproducible. The values of physicochemical parameters can be taken for quality assurance.

ACKNOWLEDGEMENT

Authors acknowledge authority of IPGT & RA, Jamnagar for the financial assistance and providing facilities for the study.

CONFLICT OF INTEREST

Nil

REFERENCES

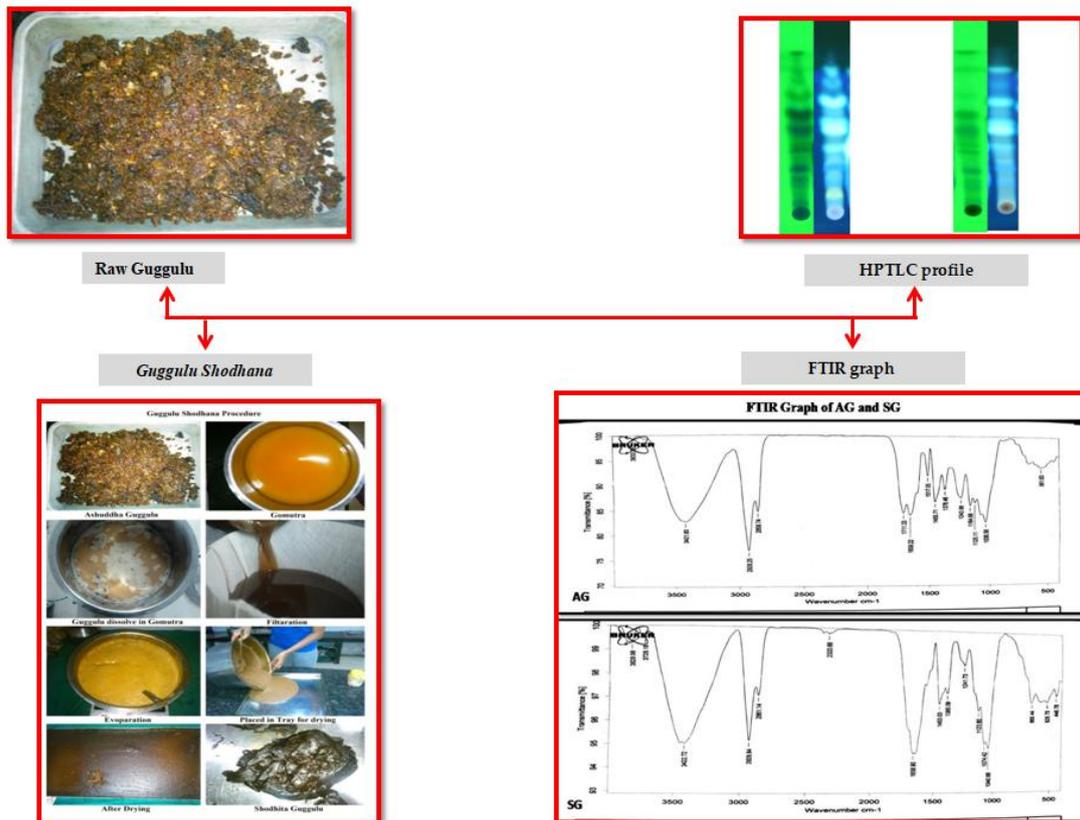
1. Ācharya Sadānada Sharma. Rasa Taraṅgiṇī, In: 2nd Taraṅga/52, 11th ed, New Delhi: Motilālā Banārsidas; 2004; p.21.
2. Ācharya Suśruta. Suśruta Saṁhitā of Suśruta, In: Sūtra sthāna 15/32. YT Ācharya Ed. Varānasi: Chaukhambha Surbhārti Prakāśan; 2003; p.73.
3. Nagarajan M, Waszkuc TW, Sun J. Simultaneous determination of E-and Z-guggulsterones in dietary supplements containing *Commiphora mukul* extract. J Assoc Off Anal Chem Int 2001;84(1):24-8.
4. newhope.com [New Hope Network] Boulder, CO 80301:Nutrition Business Journal, Ingredient 5: Ayurveda gains ground in US market on strength of specific herbs Oct-2012. [cited 2016 Aug 8]. Available from: <http://www.newhope.com/ingredients-general/ayurveda-gains-ground-us-market-strength-specific-herbs>. Retrieved date:12/8/2016
5. krishna.nic.in [Krishna District Official Website] Plantation and Extraction of Guggul [cited 2016 Nov 23]. Available from : [http://krishna.nic.in/PDFfiles/MSME/Herbal/guggul\[1\].pdf](http://krishna.nic.in/PDFfiles/MSME/Herbal/guggul[1].pdf)
6. Masten SA. Gum guggul and some of its steroidal constituents: review of toxicological literature. Integrated Laboratory Systems, Inc. Research Triangle Park, North Carolina, USA. Document prepared for National Toxicology Program (NTP), National Institute of Environmental Health Sciences (NIEHS), National Institutes of Health, U.S Department of Health and Human Services 2005;2(1):1-49.
7. Sangle VD, Nadkarni SD, Vahalia MK, Darp MS. The study of effect of ayurvedic processing of *Commiphora wightii* on gastric irritancy index in experimental animals. Indian Drugs 2004;41:268-71.
8. Rachana Kamble, Sadhana Sathaye, Shah DP. Evaluation of antispasmodic activity of different *Śodhit guggul* using different *Śodhan* process. Indian J Pharm Sci 2008;70(3):368-72.
9. Vyas KY, Dhruve K, Prajapati PK. Methods of *Guggulu Śodhana* in *Ayurveda* – A Review. Int J Ayu Med 2014;5(2):154-60.
10. The Ayurvedic Formulary of India, second revised English edition. Delhi: Controller of publication 2003.
11. Randhawa GK. Cow urine distillate as bioenhancer. J Ayurveda Integr Med 2010;1:240-1.
12. Devender O, Sachdev, Devesh D, Gosavi, Salwe KJ. Evaluation of antidiabetic, antioxidant effect and safety profile of *Gomūtra* ark in Wistar albino rats. Anc Sci Life 2012;31(3): 84-9.
13. Jain NK, Gupta VB, Garg R, Silawat N. Efficacy of cow urine therapy on various cancer patients in Mandsaur District, India - A survey. Int J Green Pharmacy 2010; 4(1):29-35.
14. Pimpale SA, Patil A, Desai S. Comparative analytical study of *Guggulu (Commiphora mukul) Śodhana* done in different media. Int Ayu Medi J 2014;2(5):761-4.
15. Sharma K, Lather A, Kumar V, Tyagi V, Lather NA. Study On Standardization Of *Triphalā Śodhita Guggulu (Commiphora mukul Hook)*. World J of Pharma Res 2014;3(2):2156-62.
16. Ācharya Hārīta, Hārīta Saṁhitā, In: Kalpa Sthāna 5/9, Hariprasad Tripathi ed. Varanasi: Chaukhambha Krishnadas Academy 2009; p.511.
17. Dattaram Chaube. Bṛhat Rasarāja Suṅdar, In: Madhyam khaṇḍa-Shilajita prakaraṇa, 3rd ed. Varanasi: Chaukhambha Orientalia; 2000; p.185.
18. Anonymous, The Ayurvedic Pharmacopoeia of India. 1st ed, Vol I, Part-II. New Delhi: Controller of publication, Dept. of I.S.M. and H. Ministry of Health and Family Welfare, Govt. of India. 2007, Appendix 2.
19. Gupta AK, Tandon N, Sharma M. Quality standards of Indian Medicinal Plants, Vol 3. New Delhi: ICMR; 2005; p.179.
20. Sharma S. Ras Taraṅgiṇī 24/579-580, Haridatta Shastri ed, Delhi: Motilāl Banārsidas Prakāśhana; 1986; p.754.
21. The Ayurvedic Pharmacopoeia of India, Vol I, Part-I. New Delhi: Controller of publication, Dept of ISM and H, Ministry of Health and Family Welfare, Govt. of India; 2001; p.43.
22. Shishodia S, Kuzhuvilil HB, Dass S, Krishan SG, Agarwal BB. The Guggul for Chronic Diseases: Ancient Medicine, Modern Targets. Anticancer Research 2008;28:3647-64.
23. Jasuja ND, Choudhary M, Sharama P, Sharma N, Joshi SC. A review on bioactive compounds and medicinal uses of *Commiphora mukul*. J Plant Sci 2012;7:113-37.
24. Kulhari A, Sheorayan A, Chaudhary A, Sarakar S, Kalia R. Quantitative determination of guggulsterone in existing natural populations of *Commiphora wightii* (Arn.) Bhandari for identification of germplasm having higher guggulsterone content. Physiol Mol Biol Plants 2015;21(1):71-81.
25. Grube M, Muter O, Strikauska S, Gavare M, Limane B. Application of FT-IR spectroscopy for control of the medium composition during the biodegradation of nitro aromatic compounds. J Ind Microbiol Biotechnol 2008;35:1545-9.

ABOUT AUTHORS

Dr. Kuti Yagneshkumar Vyas MD (Ayu) PhD presently serving as Assistant Professor in Sri O H Nazar Ayurveda College, Surat, India obtained her MD and PhD from Gujarat Ayurveda University, Jamnagar in 2015. Contributed to concept, design, literature study, Definition of intellectual content, Pharmaceutical experiments, Data acquisition, Data analysis, Manuscript preparation, Manuscript editing, Manuscript review and Guarantor of this

article. **Dr. Vinay Janardan Shukla Msc PhD** is currently serving as Head in department of Pharmaceutical Laboratory, IPGT & RA, Gujarat Ayurved University, Jamnagar. He obtained his PhD degree in Analytical chemistry from Sauratra University, Rajkot, Gujarat. He has 30 yrs of research experience. He is Author of 201 research papers, 3 monographs, 1 chapter in book. He is co-investigator in 18 projects of CCRAS and chief investigator in other projects. Contributed to Concept, Design, Pharmaceutical experiments, Data analysis, Manuscript editing and Manuscript review of this article. **Dr. Galib Ruknuddin, MD (Ayu) PhD** is currently serving as Associate Professor in department of Rasashastra and Bhaishajya Kalpana at All India Institute of Ayurveda, New Delhi. Previously, he served at IPGT & RA, Gujarat Ayurved University, Jamnagar till October 2016. He has more than 10 Years PG Teaching in concerned subject. Guided more than 20 theses, contributed around 10 chapters and investigated 3 projects as PI / Co-PI. Contributed to Concept, Design, Definition of intellectual content, Data analysis, Manuscript editing and Manuscript review of this article. **Dr. Pradeep Kumar Prajapati, MD (Ayu) PhD** is working as Dean, Prof and Head, Department of Rasashastra and Bhaishajya Kalpana, All India Institute of Ayurveda, New Delhi, India. He is a former Director of IPGT & RA, GAU Jamnagar and In - Charge Director of Pharmacy Gujarat Ayurved University Jamnagar, Head, Dept of RS & BK, IPGT& RA, Jamnagar. He obtained Teachers excellence award by CEE, Rasaccharya Award for contributions to Rasashastra, Nagarajuna Silver Medal for MD dissertation, Best Research article Award. He has authored 264 research articles and 3 monographs. Contributed to concept, design, Definition of intellectual content, Data analysis, Manuscript editing and Manuscript review of this article.

GRAPHICAL ABSTRACT



Cite this article as: Kruti Y Vyas, Shukla VJ, Galib R, Prajapati PK. Pharmaceutical Standardization of *Guggulu Shodhana*. J Ayu Med Sci 2017;2(2):165-73. DOI: 10.5530/jams.2017.2.12



©Journal of Ayurveda Medical Sciences
– Herbal Research Guidance and Solutions' (HRGS) Ayurveda Journal