DOI: 10.56511/JIPBS.2015.v2.i04.pp439-451

Journal of Innovations in Pharmaceuticals and Biological Sciences
www.jipbs.com

JIPBS

ISSN: 2349-2759

Research article

Pharmacognostical and Physico-Chemical Standardization of Triphala Guggulu Vati: An official Ayurvedic Formulation

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Abstract

Ayurveda is considered as the "science of life," because the ancient Indian system of health care focused views of man and his illness. India has an age old heritage of traditional herbal medicine. Herbal drugs are being preferred to synthetic antibiotics. Triphala-guggulu vati is official in Ayurvedic Formulary of India and is prescribed for the treatment of cough and fever. Currently, Triphala is being extensively researched for its various therapeutic effects including its anti-caries, antioxidant, anti-collagenase, and anti‑microbial activities. It is a polyherbal preparation containing five ingredients. In this research paper, an attempt has been made to develop standardization methods for some of the ingredients of Triphala-guggulu vati. A standard laboratory reference sample of Triphala-guggulu vati and two marketed samples were evaluated as per the developed method. All the formulations were standardized on the basis of organoleptic, physical characteristic, physico chemical properties and various pharmacognostical parameters. The standardization study shows that the commercial formulation matches with the authentic standards as per WHO guidelines. The inference from this study can be used as reference standard in further quality control researches.

Key words: Triphala-guggulu vati, Ayurvedic official formulation, standardization, WHO guidelines.

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1. Introduction

Ayurveda, an Indian System of medicine is known for its significant contribution in maintaining the health care of human society. However, the scientific evidence to prove the rationale of using these formulations in health care is not well established. The need to explore time-tested, though less-scientifically proven, Ayurvedic system of medicine in health care has been realized of late [1]. The World Health Organization estimates that about 80% of the populations living in the developing countries rely almost exclusively on traditional medicine for their primary health care needs [2]. Herbal medicines were in great demand in

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the developed as well as in developing countries for primary health care because of their wide biological and medicinal activities, higher safety margin, and lower costs [3]. But the most important challenges faced by these formulations arise because of their lack of complete standardization. Herbal medicines are prepared from materials of plant origin which are prone to contamination, deterioration and variation in composition. Therefore, quality control of herbal medicines offers a host of problems [4]. Standardization and quality control have remained grey areas in the preparation of Ayurvedic medicines. Incomplete understanding of the process coupled with insufficient scientific evidence for some of the preparation steps have been partly responsible for lack of standardization and quality control. Hence, the concepts of Good Manufacturing Practices (GMP) and Process Validation could not be adopted effectively for the preparation of Ayurvedic medicines. With the tireless initiatives of the Government of India, the Department of AYUSH (Ayurveda, Yoga, Unani, Siddha and Homeopathy) has been publishing Ayurvedic pharmacopeia and Formulary from time-to-time. It needs to be borne in mind that the establishment of protocols for quality control in preparation of Ayurvedic medicines is an ongoing process that requires multidisciplinary approaches [5]. Herbal medicines are generally available as a mixture of more than one plant constituent. It is important to quantify the maximum possible number of markers in such herbal formulations through which the quality of the formulation may be assessed [6]. Triphala Guggulu Vati is an official Ayurvedic formulation as per Ayurvedic Formulary of India [7]. Triphala guggul is a traditional Ayurvedic herbal formulation consisting of the dried fruits of three medicinal plants, *Terminalia chebula* (Combretaceae), *Terminalia belerica* (Combretaceae) and *Emblica officinalis* (Euphorbiaceae), these are combined with *Commiphora wightii* (Burseraceae) and *Piper longum* (Piperaceae) for the treatment of sinusitis, allergies, boils, constipation, piles, high cholesterol, mal-absorption and as a purgative, blood purifier, anti-inflammatory and anti-rheumatic [8-11].

2. Material and Methods

Plant material

Raw material i.e. *Terminalia chebula, Terminalia belerica, Emblica officinalis* , *Piper longum* and *Commiphora wightii* were collected from Botanical Garden of Nagpur, Maharashtra and was authenticated by Dr. Mrs. Chaturvedi, Professor and Head of Department, Department of Botany, Post Graduate Teaching Department, Rashtra Sant Tukdoji Maharaj Nagpur University, Nagpur. Herbarium is deposited of *Terminalia chebula* -9896, *Terminalia belerica* -9897, *Emblica officinalis*-9898, *Piper longum*-9899 and *Commiphora wightii*-9902 in the department.

Formulation profile:

Sr. No.	Sanskrit name/ Scientific Name	Part used	Quantity
1	Haritaki / *Terminalia chebula*	Pericarp	48g
2	Bhibitaki / *Terminalia belerica*	Pericarp	48g
3	Amalaki / *Emblica officinalis*	Pericarp	48g
4	Pippali / *Piper longum*	Fruit	48g
5	Guggulu-suddha / *Commiphora wightii*	Oleo resin	240g

Formulation 1(Marketed): It is in powdered form, purchased from local market in Nagpur. Coded as TGM-I.
Formulation 2 (Marketed): It is in powdered form, purchased from local market in Nagpur. Coded as TGM-II.
Formulation 3 (Laboratory): It is in powdered form, prepared in Laboratory of Natural Product, Sudhakarrao Naik, Institute of Pharmacy, Pusad and Coded as TGL
Take all the ingredients of the pharmacopoeial quality. Wash, dry and powder the ingredients number 1 to 4 of the formulation composition separately and pass through sieve number 85, weigh them separately in the required quantities and mix. Crush weighed quantity of Guggulu-suddha, add fine powder of other mixed ingredients to it and pound well. Add Ghrita to an extent required to facilitate the pounding and continue pounding till a semi-solid uniformly mixed mass of suitable plasticity is obtained. Expel the mass through Vati machine fitted with a suitable die and cut the Vatis to a desired weight. Roll the Vatis on flat surface to round them by circular motion of palm covered with a glove and smeared with Ghrita or use suitable mechanical device. Dry the rounded Vatis in a tray-dryer at a temperature not exceeding 600 for 8 to 10 h. The Formulation of Shatavari Churna was prepared as per The Ayurvedic Formulary of India [12].

Methods

Organoleptic study

The development of organoleptic character i.e. sensory character provides simplest and quickest means to establish the identity, purity and quality of crude drug in terms of color, odour and taste. The Marketed formulation and In-house formulation were examined for color, odour and taste along with individual ingredient. For determination of color examine the untreated sample under diffuse day light, if required artificial light source with wavelength similar to those of day light. For determination of odour place the small quantity of material in palm of the hand or a beaker of suitable size, slowly and repeatedly inhale the air over the material. If required crush the material between thumb and index finger. For determination of taste if specifically required should be done by placing minimum quantity of material (crushed/powdered) on taste buds of tongue. Interval of 15 minutes between two samples was kept to make available the taste buds fresh every time [13].

Microscopical study

Take about 5gm of sample, powder and add chloroform (20 ml); stir for 10 mins over a water bath; pour out chloroform. Repeat the process thrice adding fresh quantities of chloroform; discard chloroform. Wash the sediment thoroughly in hot water. Take a few mg of washed material, stain with iodine solution and mount in 50 % glycerin. Clarify a few mg with chloral hydrate and mount in 50% glycerin. Observe the characteristic in various mount [14].

Physical characteristic study

The raw material of Triphala Guggula vati i.e. *Terminalia chebula*, *Terminalia belerica*, *Emblica officinalis, Piper longum* and *Commiphora wightii* were subjected to evaluation of physical characteristic which were determined by Tap density, Bulk density, Angle of repose, Hausner ratio, Carr's index etc.

Bulk density (ρB)

It is defined as the mass of a powder divided by the bulk volume. It was being

determined by Fixed funnel method. A sample of 50 cm3 of powder that has been passed through sieve no. 20 is carefully introduced into a 100 ml graduated cylinder. The cylinder is dropped at 2 sec intervals on hard wooden surface three times from a height of 1 inch. The bulk density is obtained by dividing the weight of the sample in gm by the final volume in cm3 of the sample contained in the cylinder [15].

Tap density (ρT)

It is defined as the mass of the powder divided by the tapped volume. A powder sample about 5.0g is transferred into the tarred 10 ml cylinder with the help of a funnel. The 250 ml measuring cylinder is placed on the tapping apparatus. The content is tapped and the volume occupied is recorded. The ratio of mass of powder to the tapped volume represents Tapped density [16].

Angle of repose (θ)

A glass funnel is held in place with a clamp on ring support over a glass plate. The glass plate is placed on a micro-lab jack. Approximately 100g of powder is transferred in to the funnel which has been passed through number 10 size mesh, keeping the orifice of funnel blocked by the thumb. The lab-jack is so adjusted so that the gap of about 6-7 mm is maintained between top of powder pile and bottom of funnel stem. When the powder is emptied from the funnel, the angle of heap to the horizontal plane is measured with a protector. Measure the height of the pile (h) and the radius of the base (r) with the ruler. The angle of repose is thus estimated by the formula.

$$\theta = \tan^{-1} (h / r)$$

Flow property	Angle of repose (degrees)
Excellent	25 – 30
Good	31 – 35
Fair-aid not needed	36 – 40
Passable – may hang up	41 – 45
Poor – must agitate, vibrate	46 – 55
Very poor	56 – 65
Very, very poor	>66

Hausner ratio

The Hausner ratio is the ratio of Tap density divided by Bulk density, it is named after the engineer Henry H. Hausner, A Hausner ratio greater than 1.25 is considered to be an indication of poor flowability. It is calculated by the formula [17],

$$H = \rho T / \rho B$$

Carr's index

The Carr index represents the flowability and compressibility of powder. It is named after the pharmacologist Charles Jelleff Carr (1910–2005). It measures the relative significance of interparticle interactions. A Carr index greater than 25 is considered to be an indication of poor flowability, and below 15, of good flowability.

Flow property	C.I (%)	Hausner ratio
Excellent	≤10	1.00 – 1.11
Good	11 – 15	1.12 – 1.18
Fair	16 – 20	1.19 – 1.25
Passable	21 – 25	1.26 – 1.34
Poor	26 – 31	1.35 – 1.45
Very poor	32 – 37	1.46 – 1.59
Very, very poor	>38	>1.60

It is calculated by the formula [17],

$$C = 100\frac{V_B - V_T}{V_B}$$

OR

$$C = 100 \times (1 - \frac{\rho_B}{\rho_T})$$

Physico- chemical Study

The activity of any herb is dependent on the class of phytoconstituents or specific phytoconstituents being present in it. In majority, of the herbals which are in use the knowledge about these is fairly known. Therefore, it is necessary to devise a method of standardization based upon the presence of these chemicals. Physico-chemical constants like ash value, water soluble extracts, alcoholic extracts, loss on drying and pH values were determined of all the formulations and dried crude drug as per method described in The Ayurvedic Pharmacopoeia of India [18].

Determination of Ash Value

The total ash method is designed to measure the total amount of material remaining after ignition, including physiological and non-physiological ash. Acid insoluble ash is a parameter obtained after boiling the ash with dilute hydrochloric acid, about 4g of dried material under study is accurately weighed and placed in a previously ignited and tarred silica crucible. The material is spread in an even layer and ignited by gradually increasing the heat to a temperature of about 500-6000C until it is white, indicating the absence of carbon. The material is cooled in a desiccator and weighed. The content of total ash is calculated in mg per g of air dried material. Acid insoluble ash is determined by following procedure, to the crucible containing the total ash, 25 ml of hydrochloric acid is added, covered with a watch-glass and boiled gently for 5 minutes. The watch glass is rinsed with 5ml of hot water and this liquid is added to the crucible. The insoluble matter is collected on the as ash less filter paper and washed with hot water until the filtrate is neutral. The filter paper containing the insoluble matter is transferred to the original crucible, dried on hot plate and ignited to constant weight. The residue is allowed to cool in suitable desiccator for 30 minutes and then weighed without delay. The content of acid insoluble ash is calculated in mg per gm of air dried material [19].

Determination of Extractives

The percent extractive values were determined in water and alcohol. The extractive values were determined for all the Formulations SCM-I, SCM-II, SCL and dried crude drug [20].

Determination of Foreign matter

500 g of the drug sample was examined by spread it out in a thin layer. The foreign matter was detected by inspection with the unaided eye or by the use of a lens (6x). Separated and weighed the foreign matters and calculate the percentage of foreign matter present [21].

Determination of Moisture content

LOD of the powdered drug was carried out to find out the percentage of moisture present in the drug since moisture facilitates the enzyme hydrolysis or growth of microbes lead to deterioration. 10 g of sample (without preliminary drying) were placed after accurately weighing it in a tarred evaporating dish. After placing the above said amount of the sample in the tarred evaporating dish dry at 105o C and continue the drying and weighing at 10 minutes interval until difference between two successive

weightings corresponds to not more than 0.25 per cent. Constant weight is reached when two consecutive weightings after drying for 30 minutes and cooling for 30 minutes in a desiccator, show not more than 0.01 g difference [22]. Finally moisture content was measured directly in percentage.

Determination of pH

The pH of different formulations in 1% w/v and 10% w/v of water soluble portions were determined using pH paper (Range 3.5–6) and (6.5–14) with standard glass electrode [23].

Qualitative phytochemical studies

The detection of presence of various phytoconstituents in the formulations and in dried crude drug is performed on the various extracts of all the formulation along with crude drug. The qualitative analysis of alkaloid, carbohydrate, tannins, Saponins, phenols, phytosterol, oils, fat, gum, mucilage, etc., was done [24].

Quality control of finished product

In the pharmaceutical industry, total quality of the product must be ensured in order to prevent the kind of product which does not comply with the specifications laid down by the Pharmacopoeias, and at the same time it is also necessary for controlling the errors during the production process. Tablets are solid dosage forms usually prepared with the aid of suitable pharmaceutical excipients. They may vary in size, shape, weight, hardness, thickness, disintegration and dissolution characteristics and in other aspects depending on their intended use and method of manufacture. The Tablet quality control (TQC) tests are Uniformity of container content test, Uniformity of weight test, Friability test, Disintegration test, Hardness test.

Uniformity of container contents test

Select a sample of 10 containers and count the number of tablets in each container. The average number of the contents in the 3-10 containers is not less than the labelled amount and the number in any single container is not less than 98 percent and not more than 102 percent of the labelled amount. If the requirement is not met, count the number of the contents in 10 additional containers. The average number in the 20 containers is not less than the labelled amount, and number is not less than 98 percent and not more than 102 percent of the labelled amount.

Uniformity in weight test

Weigh individually 20 units selected at random or, for single-dose preparations in individual containers, the contents of 20 units, and calculate the average weight. Not more than two of the individual weights deviate from the average weight by more than the percentage shown below and none deviates by more than twice that percentage [25].

Weight variation limits for Tablets

Indian Pharmacopoeia/BP	Limit	USP
80 mg or less	10%	130 mg or less
More than 80 mg or less than 250mg	7.5%	130 mg to 324 mg
250 mg or more	5.0%	More than 324 mg

Friability test

For tablets with an average weight of 0.65 g or less take a sample of whole tablets corresponding to about 6.5 g and for tablets with an average weight of more than 0.65 g take a sample of 10 whole tablets. Dedust the tablets carefully and weigh accurately the required number of

tablets. Place the tablets in the drum and rotate it 100 times. Remove the tablets, remove any loose dust from them and weigh them accurately. The test is run only once unless the results are difficult to interpret or if the weight loss is greater than the targeted value, in which case, the test is repeated twice and the mean of the three tests is determined. A maximum loss of weight (from a single test or from the mean of the three tests) not greater than 1.0 per cent is acceptable for most tablets. If obviously cracked, chipped or broken tablets are present in the sample after tumbling, the sample fails the test [26].

Disintegration test

Introduce one tablet into each tube and add a disc to each tube. Suspend the assembly in the beaker containing the specified liquid and operate the apparatus for the specified time. Remove the assembly from the liquid. The tablets pass the test if all of them have disintegrated. If 1 or 2 tablets fail to disintegrate, repeat the test on 12 additional tablets; not less than 16 of the total of 18 tablets tested disintegrate. If the tablets adhere to the disc and the preparation under examination fails to comply, repeat the test omitting the disc. The preparation complies with the test if all the tablets in the repeat test disintegrate [27].

Hardness test

The resistance of tablets to capping, abrasion or breakage under conditions of storage, transportation and handling before usage depends on its hardness. Tablet hardness is defined as the load required crushing or fracture a tablet placed on its edge. Sometime it is also termed as tablet crushing strength. The hardness test was performed using Monsanto type (Make: Singhla) hardness tester. The instrument measures the force required to break the tablet when the force generated by anvils to the tablet. The tablet was placed between two anvils; force applied to the anvils, and the crushing strength that just causes the tablet to break was recorded. The crushing strength test was performed on 20 tablets from each formulation [28].

Result and Discussion

Organoleptic study

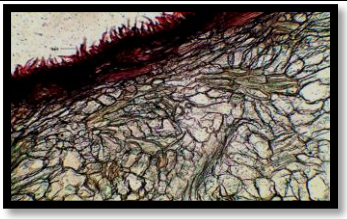
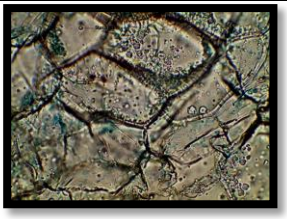
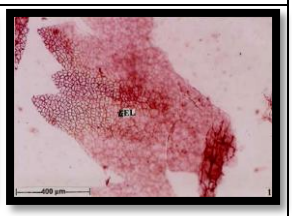
All the purified ingredients and formulations of Triphala guggulu vati were evaluated as per WHO guidelines. The sensory and organoleptic study reveals that the Formulation TGM-I , TGM-II AND TGL shows Blackish brown color, Aromatic and characteristic odor and Astringent taste which seems to be identical (Table No. 1).

Table no. 1 Sensory characters of characters of *Terminalia chebula*, *Terminalia belerica*, *Emblica officinalis*, *Commiphora wightii*, TGM-I, TGM-II and TGL.

Sr. No.	Name	Color	Odor	Taste
1	*Terminalia chebula*	Yellowish brown	Characteristic	Astringent
2	*Terminalia belerica*	Yellowish brown	Aromatic	Astringent
3	*Emblica officinalis*	Blackish brown	Characteristic	Sour & Astringent
4	*Piper longum*	Blackish green	Pungent	Acrid & Bitter
5	*Commiphora wightii*	Brownish yellow	Aromatic	Bitter
6	TGM-I	Blackish Brown	Characteristic	Astringent
7	TGM-II	Blackish Brown	Characteristic	Astringent
8	TGL	Blackish Brown	Aromatic & Characteristic	Astringent

Microscopical study

All the purified ingredients and formulations of Triphala guggulu vati were evaluated as per WHO guidelines for their microscopical characters. The microscopical study reveals that the *Terminalia chebula* purified ingredient shows covering trichomes, elongated stone cells, parenchymatous cell containing crystals, vessels with simple pits, etc. *Terminalia belerica* shows the presence of thick lignified trichomes with stone cells, abundant starch grains, crude fibre, spiral vessels, etc. *Emblica officinalis* shows the presence of Rosette type of calcium oxylate crystals, crude fibre, lignified vascular bundles i.e. xylem and phloem, epidermal cells, etc. spikes of *Piper longum* shows the presence of parenchymatous cells along with aleurone grains, lignified Mesocarp along with abundant starch grains present in endosperm, endocarp, vascular bundles with lignified xylem vessels, etc. Oleo-gum-resin of *Commiphora wightii* shows brownish yellow pigments, pitted cells, starch grains and prismatic crystals, etc. The formulation TGM-I shows starch grains, vascular bundles with lignified xylem vessels, crude fibers, etc. indicating the presence of Triphala and guggulu. Formulation TGM-II sows the presence of rosette calcium oxylate crystals, vascular bundles with lignified xylem vessels, spiral vessels, crude fibers, etc. indicating the presence of Triphala and guggulu. The formulation TGL shows the presence of covering trichomes, pitted cells, crude fibers, starch grains, etc. confirming the presence of Triphala and guggulu. (Figure No. 1).

Terminalia chebula	 Covering trichome	 Elongated Stone cells	 Parenchyma cell, crystal	 Vessels, simple pits
Terminalia belerica	 Trichomes & stone cells	 Starch Grains	 Spiral vessels	 Fibre
Emblica officinalis	 Rosette Cal. oxalate	 Fibers	 Vascular Bundles	 Epidermal cell

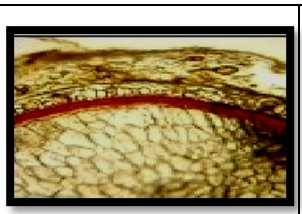
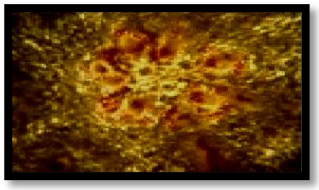
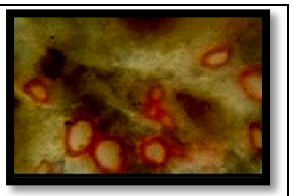
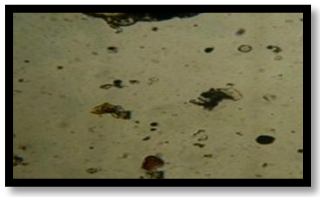
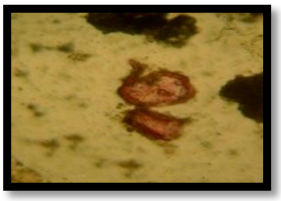
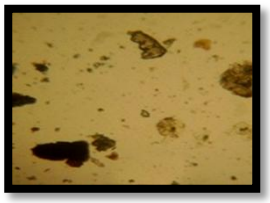
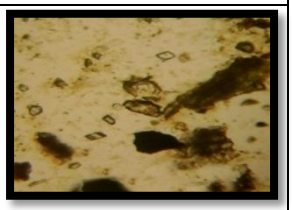
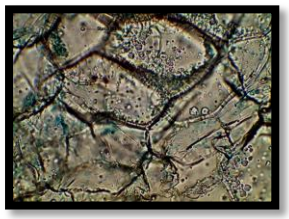
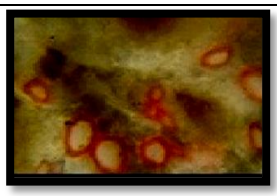
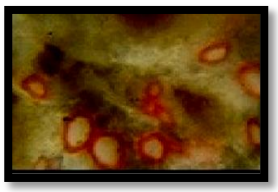
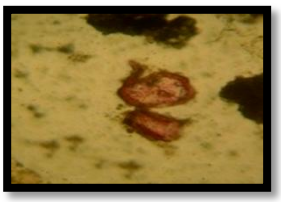
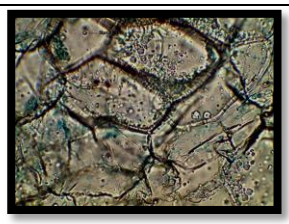
Piper longum	 Parenchyma, Aleu. grain	 Mesocarp, Starch gr.	 Endocarp	 Lig. Vascular bundle
Commiphora wightii	 Brownish content	 Pitted cells	 Starch grains	 Prism crystals
TGM-I	 Starch Grains	 Lig. Vascular bundle	 Fibers	 Fibers
TGM-II	 Fibers	 Rosette Cal. oxalate	 Lig. Vascular bundle	 Spiral vessels
TGL	 Fibers	 Pitted cells	 Starch Grains	 Covering trichome

Figure No. 1. Microscopical characters of *Terminalia chebula*, *Terminalia belerica*, *Emblica officinalis*, *Commiphora wightii*, TGM-I, TGM-II and TGL.

Physical characteristic study

All the purified ingredients of Triphala guggulu vati were evaluated as per WHO guidelines for their physical characteristic studies which includes determination of Bulk density, Tap density, Angle of repose, Calculations of Hausner ratio and Compressibility index i.e. Carr's index. The physical characters are summarized in Table No. 2.

Physico chemical study

All the ingredients and formulations of Triphala guggulu vati were evaluated as per WHO guidelines for physico chemical studies which include Total ash content, Acid insoluble ash, Water soluble

extractives, Alcohol soluble extractives, foreign organic matter, Loss on drying, pH at 1% and 10 %. The physico chemical characters are summarized in Table No. 3.

Table No. 2. Physical characters of *Terminalia chebula, Terminalia belerica, Emblica officinalis* and *Commiphora wightii.*

Sr. No.	Name	Bulk density (g/cm³)	Tap density (g/cm³)	Angle of repose(⁰)	Hausner ratio	Carr's index (%)
1	*Terminalia chebula*	0.52±0.001	0.65±0.001	28.5±1.02	1.25±0.001	20.0±0.01
2	*Terminalia belerica*	0.41±0.002	0.54±00002	30.5±1.05	1.31±0.002	24.07±0.02
3	*Emblica officinalis*	0.4±0.002	0.5±0.001	31.6±1.25	1.25±0.001	20.0±0.01
4	*Piper longum*	0.7±0.001	0.85±0.001	25.7±0.95	1.21±0.002	17.64±0.01
5	*Commiphora wightii*	0.61±0.003	0.75±0.002	24.7±1.52	1.22±0.001	18.22±0.02

Mean ±SD N=3

Table No. 3. The Physico chemical characters of *Terminalia chebula*, *Terminalia belerica*, *Emblica officinalis*, *Commiphora wightii*, TGM-I, TGM-II and TGL.

Sr. No	NAME	Total Ash (%)	Acid insoluble ash (%)	Water soluble extractive (%w/v)	Alcohol soluble extractive (%w/v)	Foreign organic matter (%w/v)	LOD (%w/v)	pH	
								1%	10%
1	*Terminalia chebula*	5.2 ±0.5	0.5 ±0.09	35 ±1.5	29.5 ±0.95	0.5 ±0.01	9.5 ±0.3	4.5 ±0.0	4.9 ±0.01
2	*Terminalia belerica*	7.6 ±0.6	1.65 ±0.1	60.5 ±2.5	32.0 ±0.8	0.6 ±0.01	6.7 ±0.2	3.5 ±0.0	3.7 ±0.01
3	*Emblica officinalis*	7.5 ±0.5	1.2 ±0.11	55.5 ±1.9	31.6 ±0.9	0.1 ±0.01	5.5 ±0.3	3.7 ±0.0	4.2 ±0.01
4	*Piper longum*	4.1 ±0.45	0.17 ±0.9	21.75 ±1.0	9.75 ±0.5	0.2 ±0.02	4.12 ±0.25	4.8 ±0.01	5.0 ±0.02
5	*Commiphora wightii*	2.5 ±0.15	0.5 ±0.12	5.5 ±1.5	7.0 ±0.6	0.1 ±0.01	12.5 ±0.5	5.2 ±0.02	5.5 ±0.01
6	TGM-I	5.6 ±0.25	1.5 ±0.9	45 ±2.5	35 ±0.8	Nil	7.5 ±0.4	5.3 ±0.1	5.5 ±0.1
7	TGM-II	5.8 ±0.35	1.8 ±0.9	52 ±2.9	38 ±0.8	Nil	7.9 ±0.45	5.3 ±0.1	5.6 ±0.2
8	TGL	5.5 ±0.2	1.3 ±0.85	59 ±2.5	39 ±0.6	Nil	6.9 ±0.56	5.4 ±0.1	5.5 ±0.1

Mean ±SD N=3

Qualitative phytochemical studies

All the ingredients and formulations of Triphala guggulu vati were evaluated as per WHO guidelines for qualitative phyto chemical studies. The extracts were analyzed for their phyto chemical content. The qualitative phytochemical results are summarized in Table No. 4.

Quality control of finished product

The quality control parameters for finished product are very much essential for standardization of dosage form. All the formulations i.e., TGM-I, TGM-II and TGL were analyzed as per WHO guidelines. Various quality control methods were developed for standardization of all the formulations. The results are summarized in Table No. 5.

Table No. 4. The Qualitative phytochemical characters of *Terminalia chebula*, *Terminalia belerica*, *Emblica officinalis*, *Commiphora wightii*, TGM-I, TGM-II and TGL.

Name / Plant Const.	*T. chebula*	*T. belerica*	*E. officinalis*	*P. longum*	*C. wightii*	TGM-I	TGM-II	TGL
Alkaloid	-	-	+	+	-	+	+	+
Glycoside	+	+	+	+	-	+	+	+
Carbohydrate	+	+	+	+	+	+	+	+
Gum & Mucilage	+	+	+	+	+	+	+	+
Tannin	+	+	+	-	-	+	+	+
Saponin	-	-	+	+	+	+	+	+
Phytosterol	+	+	-	+	+	+	+	+
Fat	-	-	-	+	-	+	+	+
Volatile oil	-	-	-	+	+	+	+	+

+ Present - Absent

Table No. 5. The Quality control study of TGM-I, TGM-II and TGL.

Test / Sample	TGM-I	TGM-II	TGL
Uniformity of container content test	60±0.0	60±0.0	30±0.0
Uniformity of weight test (mg)	251.35±0.05	252.25±0.07	250.95±0.15
Friability test (% w/w)	0.92±0.001	0.94±0.002	0.93±0.002
Disintegration test (Min)	32±0.25	34±0.50	31±0.50
Hardness test (Kg/m^2)	2.85±0.01	3.10±0.02	2.95±0.02

Mean ±SD N=3

Conclusion

The present study indicate that the Pharmacognostical and physico-chemical standardization confirm the ingredients present in the finished product and there is no major change in the microscopic structure of the raw drugs during the pharmaceutical processes of preparation of Triphala Guggulu vati which is prepared as per the procedure given in The Ayurvedic Pharmacopoeia of India which by hand rolling technique. Further the TGL i.e. Triphala Guggulu vati prepared in laboratory is superior in some parameters such as weight variation, Disintegration time, etc., as compare to TGM-I and TGM-II. The results of this study may be used as the reference standard in further research undertakings of its kind.

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