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PHARMACOGNOSTICAL AND PHARMACEUTICAL ANALYSIS OF BILWADI GHANA VATI - A HERBAL FORMULATION IN THE MANAGEMENT OF OVERWEIGHT CHILDREN

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ABSTRACT

Introduction: *Bilwadi Ghana Vati* (BGV) is a classical polyherbal Ayurvedic preparation traditionally prescribed for *Sthualya* (obesity) in Sharangdhar Samhita. Although some clinical studies have investigated its effects, there has been no research so far focused on establishing quality control parameters for this formulation**.** Additionally, there are currently no official pharmacopeial standards available for BGV, meaning that recognized reference criteria for assessing its quality have not yet been developed. **Aim:** The aim is to assess *Bilwadi Ghana Vati* (BGV) using pharmacognostical and physicochemical evaluations, along with High-Performance Thin-Layer Chromatography (HPTLC) fingerprinting. **Materials and Methods:** Authenticated raw materials for BGV were procured and the *Bilwadi Ghana Vati* was formulated at the pharmacy of the Institute of Teaching and Research in Ayurveda (ITRA), Jamnagar. Organoleptic evaluation and microscopic studies of the formulation were performed at the Pharmacognosy Department, ITRA, Jamnagar. The physicochemical assessments were conducted in the Pharmaceutical Laboratory at ITRA, Jamnagar and HPTLC analysis was conducted in the Vasu Research Centre, Makarpura, Vadodara. **Result:** The microscopic characteristics of BGV were compared with the Ayurvedic Pharmacopoeia of India (API) reference standards for each individual ingredient, and all expected features of the constituent herbs were

observed. In the physicochemical evaluation, BGV showed a pH of 6.5, water-soluble extractive value of 19.5 % w/w, alcohol-soluble extractive value of 14.1 % w/w, total ash content of 10.9 % w/w, and loss on drying of 12.69 % w/w. HPTLC profiling revealed seven spots at 254 nm & 366 nm and ten spots at 540 nm. **Conclusion:** The present study provides preliminary data on the pharmacognostical and physicochemical parameters, along with HPTLC fingerprinting of BGV. The generated chromatographic profile may serve as a reference for future studies, aiding in the reproducibility of the formulation and in the establishment of quality control parameters for *Bilwadi Ghana Vati*.

KEYWORDS: Pharmaceutical analysis, Pharmacognostical analysis, *Bilwadi Ghana Vati*, *Sthaulya*, Overweight.

INTRODUCTION

Childhood obesity is identified by the World Health Organization as one of the most serious public health challenges of the 21st century, representing a rapidly growing epidemic that affects children worldwide and demands urgent action from health systems and societies.[1],[2],[3] According to estimates from the World Health Organization, millions of children around the world were projected to be overweight or obese by the mid-2010s, reflecting a significant rise in excess weight among young populations globally.[4] One of the most serious consequences of childhood obesity is that excess weight often continues into adulthood, increasing the likelihood of long-term health problems. Children who are overweight or obese are at higher risk for conditions such as cardiovascular disease, type 2 diabetes, osteoarthritis, gallbladder disorders, and certain hormone-related cancers later in life. This risk is particularly strong when excess weight begins in late childhood or adolescence**,** and persistent obesity also raises the risk of premature death. Globally, about 10 % of school-aged children between 5 and 17 years old are estimated to be overweight or obese, indicating a widespread public health issue. In India, research shows that the prevalence of overweight and obesity among adolescents varies widely, with many studies reporting rates ranging approximately from 1 % up to over 30 % depending on the region and population studied. These figures highlight the growing burden of excess weight among children and young people and the importance of addressing diet, activity, and lifestyle factors early in life.[5],[6],[7],[8],[9] The CDC reports that over the past few decades, obesity prevalence among U.S. children and adolescents has risen sharply, with rates more than

doubling in younger children and increasing even more in teens compared with the late 20th century. This rise is largely linked to poor diet, inactivity, and unhealthy lifestyles.[10]

Bilwadi Ghana Vati is an Ayurvedic polyherbal preparation comprising of comprising of *Bilwa* (*Aegle marmelos* Corr.), *Agnimantha* (*Clerodendrum phlomidis* Linn.), *Aralu* (*Ailanthus excelsa* Roxb.), *Gambhari* (*Gmelina arborea* Roxb.), and *Patala* (*Stereospermum suaveolens* DC.)[11] As per the *Rasapanchaka* of the ingredients of the *Bilwadi Ghana Vati* the drugs like *Bilwa, Agnimantha, Aralu, Gambhari* and *Patala* mostly have *Kashya-Tikta Rasa, Ruksha-Laghu Guna, Ushna Veerya, Katu/Madhur Vipaka* hence they together have *Kapha-Medhohara* properties along with *Lekhaniya* and *dipaneeya* action.[12] They work by the principle of *Guru* and *Atarpana* (heavy and non-nourishing diet) which regulates the hunger and satiety center thereby regulating the energy intake of a person. This aids in the proper utilization of stored fat to fulfill the energy needs. As it is in *Ghana Vati* form its intake is very easy and does not create any difficulty for the subjects for its consumption.

MATERIALS AND METHODS

Procurement, identification, and authentication of raw drugs

Authenticated raw materials were obtained from the Pharmacy of Institute of Teaching and Research in Ayurveda (ITRA), Jamnagar, and the details of the ingredients along with the plant parts used are listed in Table No. 1.

Table No. 1. Ingredients of *Bilwadi Ghana Vati.* (शा सं. मध्यखण्ड 2/115)

Sr. No.	Drug	Botanical Name	Part Used	Proportion
1	*Bilwa*	*Aegle marmelos* Corr.	Root	1 part
2	*Agnimantha*	*Clerodendrum phlomidis* Linn.	Root	1 part
3	*Syonaka**	*Oroxylum indicum* Vent.	Root	1 part
	Aralu	*Ailanthus excelsa* Roxb.	Root	
4	*Gambhari*	*Gmelina arborea* Roxb.	Root	1 part
5	*Patala*	*Stereospermum suaveolens* DC.	Root	1 part

**Aralu* as a substitute of *Syonaka* will be adopting in this study.

Method of Preparation *Bilwadi Ghana Vati*

All the ingredients numbered 1-5 were individually ground into a fine powder and passed through an 85-mesh sieve to ensure uniform fineness. Each powdered ingredient was then weighed separately. Equal amounts of these powders were combined and mixed thoroughly until a homogeneous blend was achieved. To this mixture, sixteen parts of water were added

and the blend was heated; the decoction was boiled down until only one-eighth of the original volume remained. This concentrated decoction was further boiled until it reached a thick, semi-solid consistency. Finally, the mass was shaped into pills weighing 500 mg each.

Pharmacognostical study

The pharmacognostical study of BGV was carried out at the Pharmacognosy Laboratory, ITRA, Jamnagar. The Pharmacognostical study comprises of organoleptic study and microscopic study of the finished product.

1. Organoleptic study

The organoleptic characteristics of Ayurvedic drugs are crucial as they offer an initial indication of the sample's authenticity. Parameters such as taste, color, odor, and texture were systematically evaluated in the Pharmacognosy Laboratory at ITRA, Jamnagar under expert supervision.[13]

2. Microscopic Study

Bilwadi Ghana Vati was powdered and dissolved with water and microscopy of the sample was done without stain and after staining with Phloroglucinol + HCL. Microphotographs of *Bilwadi Ghana Vati* was also taken under a Corl-ziesstrinocular microscope.[14]

Pharmaceutical parameters

Bilwadi Ghana Vati was subjected to pharmaceutical parameters like hardness, uniformity of weight, loss on drying at 110°C, ash value, water-soluble extractive, methanol-soluble extractive, and pH value of the finished product, which were studied in the Modern Pharmaceutical Chemistry Laboratory at ITRA, Jamnagar.

High performance thin layer chromatography

HPTLC was carried out at the Vasu Research Centre, Makarpura, Vadodara. It was carried out with a methanolic extract of BGV on a precoated silica gelGF-254 aluminum plate in 5 mm bands, 5 mm apart, and 1 cm from the edge of the plates, by means of a Camag Linomat V sample applicator fitted with a 100 - µL Hamilton syringe. The mobile phase used was Toluene: Ethyl acetate: Acetic acid (7:2:1 V/V). The plates were developed in a Camag twin trough chamber (20 × 10 cm), and spots were detected in UV-254 nm, UV-366 nm and UV-540 nm, followed by photo documentation, and the images were transformed into a

densitogram using R Studio 1.1.463. Rf = distance travelled by solute/distance travelled by solvent was used to calculate the retention factor.

RESULTS

Pharmacognostical study

BGV was found to have the below-mentioned organoleptic characteristics [Table No. 2].

Table No. 2: Organoleptic characters of *Bilwadi Ghana Vati.*

Shape	Round
Color	Greyish Ash
Odor	Slightly Aromatic
Taste	Astringent
Touch	Hard

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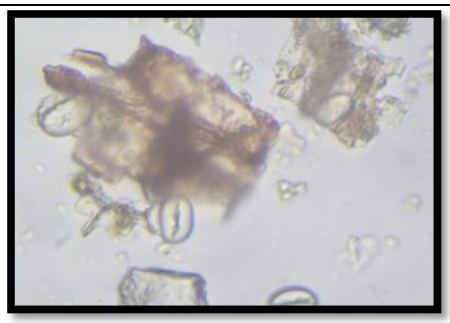
<td> 
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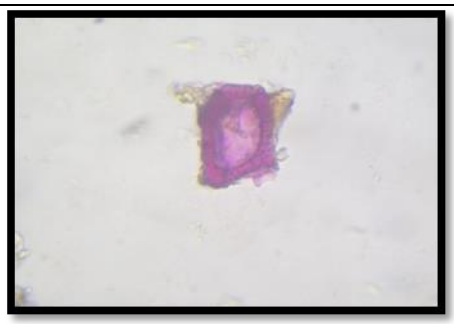
<td> 
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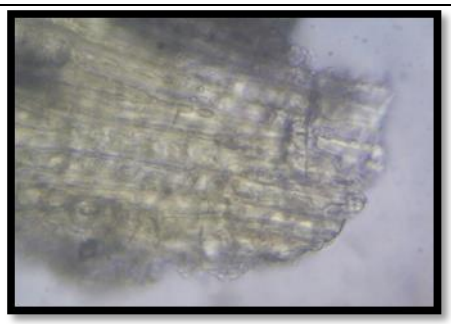
<td> 
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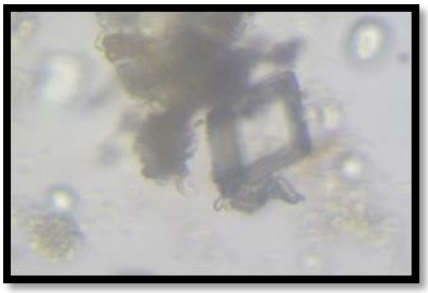
<td> 
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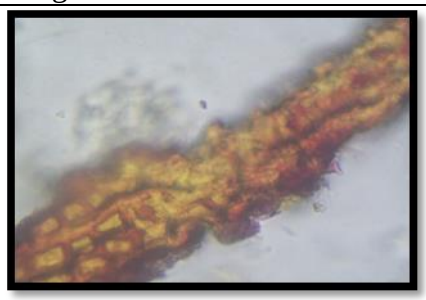
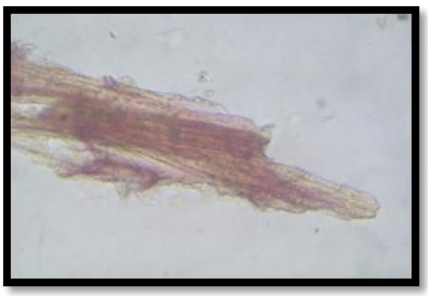
<td> 
Fibers along with brown content of *Bilwa*</td>
<td> 
Fibres of *Agnimantha*</td>
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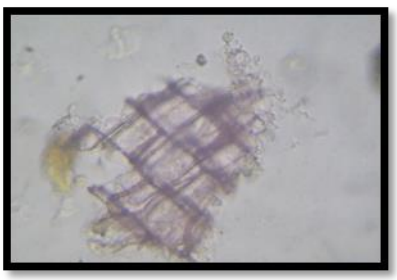
Fibres of *Gambhari*</td>
<td> 
Lignified cork cells of *Patala*</td>
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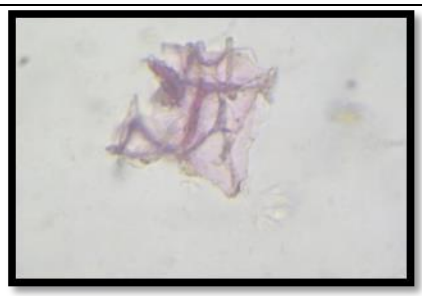
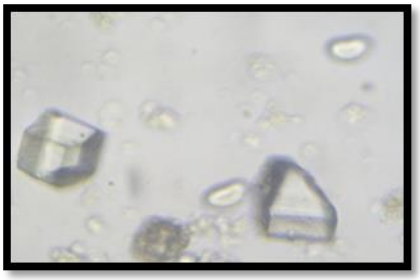
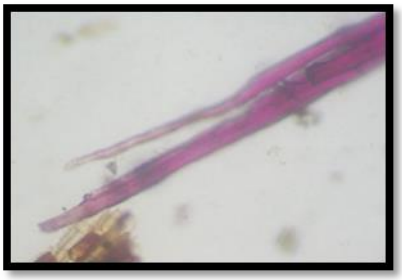
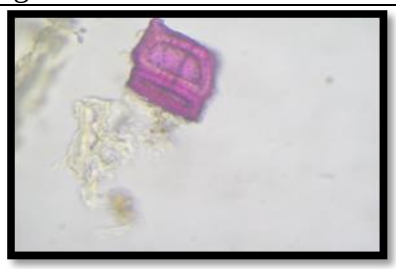
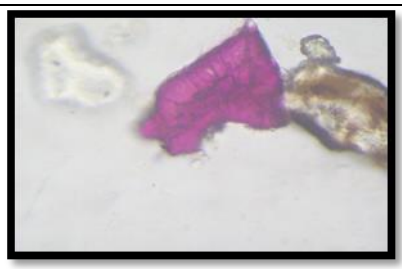

Ligniffied cork cells of *Gambhari*


Rhomboidal crystal of *Bilwa*


Ligniffied fibers of *Gambhari*


Lignified stone cells of *Bilwa*


Lignified stone cells of *Gambari*

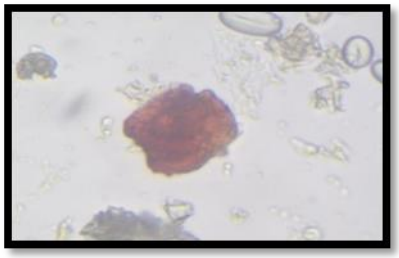

Tannin content of *Aralu*

Figure No. 1: Main Constituents Seen in A Microscopic Study of *Bilwadi Ghana Vati.*

Pharmaceutical analysis of BGV

Tables 3 and 4 show the results of pharmaceutical parameters.

Table No. 3: Physical analysis of *Bilwadi Ghana Vati.*

Sr. No.	Parameters		Results
1.	Shape		Round
2.	Hardness		2.5 kg/cm^2
3.	Uniformity	Max. wt.	527.4 mg
		Min wt.	436.8 mg
		Avg. wt.	463.4 mg

Table No. 4: Chemical analysis of *Bilwadi Ghana Vati.*

Sr. No.	Parameters	Results
1.	pH	6.5
2.	Loss on drying at 110º	12.69 %
3.	Ash value	10.90 %
4.	% Water solubility extractive	19.5 %
5.	% Alcohol soluble extractive	14.1 %

HPTLC

Table 5 summarizes the HPTLC findings of the current study. Figure 2a, 2b and 2c depicts the densitogram of the BGV sample used in this study.

Table No. 5: Results of HPTLC of *Bilwadi Ghana Vati.*

Wave lengths	254 nm	366 nm	540 nm
No of spots	07	07	10
Rf value	0.20, 0.42, 0.48, 0.62, 0.69, 0.73, 0.81	0.29, 0.42, 0.48, 0.55, 0.62, 0.69, 0.78	0.13, 0.16, 0.20, 0.25, 0.32, 0.38, 0.42, 0.50, 0.67, 0.83

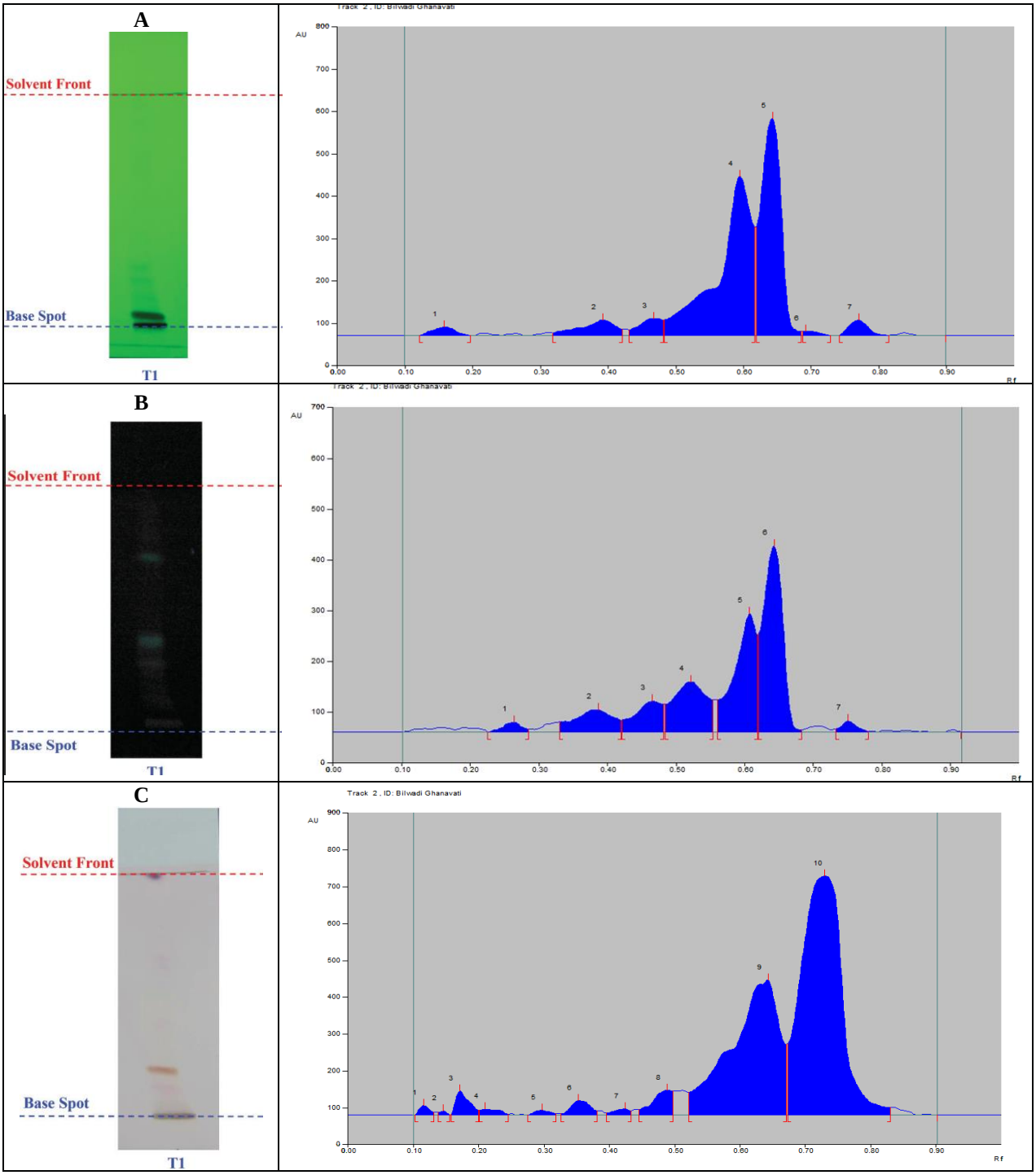


Figure 2: Chromatogram of HPTLC of BGV. (A: HPTLC Plate and Chromatogram of BGV with 254 nm. B: HPTLC Plate and Chromatogram of BGV with 366 nm. C: HPTLC Plate and Chromatogram of BGV with 540 nm)

DISCUSSION

The data from this study represent an initial step toward establishing quality control (QC) parameters for this BGV in the future. These preliminary QC data have been generated as part of the current investigation.

The color of BGV in this study was greyish ash. It may be due to a combination of five drugs. Taste of BGV was astringent. The presence of *Kashaya Rasa* of *Bilwa*, contributes to the *Kashaya Rasa*.

In the present study, the microscopic features observed in BGV confirmed the presence of all five herbal ingredients: *Bilwa* (*Aegle marmelos* Corr.), *Agnimantha* (*Clerodendrum phlomidis* Linn.), *Aralu* (*Ailanthus excelsa Roxb.*), *Gambhari* (*Gmelina arborea Roxb.*), and *Patala* (*Stereospermum suaveolens DC.*) This result indicates that the phytochemicals and microscopic structure of the raw drugs do not change significantly during the pharmaceutical processes of *Ghana Vati* formulation.

The pH value is useful to note the acidity or alkalinity of the aqueous solution of the drug. In the present study, pH is 6.5, so it is slightly acidic in nature. The loss on drying in the current sample is 12.69 % w/w. Less loss on drying indicates that the final drug was well dried before they were examined. The drying of herbs before their procedure, after the procedure, and storing them in a dry area are important to reduce the chances of their decay. Because excess moisture content increases the chance of microbial overgrowth. Because in combination with a suitable temperature, moisture will lead to the activation of enzymes, which gives a suitable condition microorganism to proliferation. Hence, moisture contents may affect the quality of the drug.

lthough the loss in weight in the samples is principally due to water, a small amount of other volatile materials will also contribute to the weight loss. The minimum loss on drying found in the present study indicates that it has minimum moisture, which could be considered good for having a longer shelf life. The ash value of the present sample is 10.90 %. It indicates that 11.8% of the material remains after ignition.

Water and alcohol soluble extractive values can be used to calculate the amount of active constituents in a given preparation. In the current study, the water and alcohol-soluble extracts of BGV were 19.5 % and 14.1 %, respectively. Here, it is important to note that,

though *Ghana Vati* formulation is *Upkalpana* of *Kashaya Kalpna* and has only water as a media, during pharmaceutical procedure, still there is 14.1 % alcohol-soluble substance available in BGV. This infers that despite boiling the herbal medicines for long time, till it become hard in consistency, they still preserve their alcohol-soluble active principles.

HPTLC profiling of BGV revealed seven distinct spots at 254 nm & 366 nm and seven distinct spots at 540 nm. These data show the presence of typical phytochemicals of BGV, and hence, the data of this HPTLC can be used as fingerprinting for BGV by future researchers.

CONCLUSION

This study generated preliminary data on the pharmacognostical, pharmaceutical, and HPTLC parameters of BGV. The chromatographic fingerprint developed here may serve as a reference for future researchers to reproduce this formulation and facilitate the establishment of robust quality control parameters for BGV.

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Conflicts of interest

There are no conflicts of interest.

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