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PHARMACEUTICO-ANALYTICAL STANDARDIZATION OF GORAKHAMUNDI (Sphaeranthus indicus Linn.) GHANAVATI, KANCHANAR (Bauhinia variegata Linn.) GHANAVATI AND GORAKHAMUNDI-KANCHANAR GHANAVATI USING HPTLC

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ABSTRACT

Hypothyroidism is a prevalent endocrine disorder for which Ayurveda offers classical botanical interventions through herbs such as *Gorakhamundi* (*Sphaeranthus indicus* Linn.) and *Kanchanar* (*Bauhinia variegata* Linn.), both indicated in *Galaganda* (thyroid/glandular disorders) and *Kapha-Meda* conditions. Converting their decoctions into *Ghanavati* (solid tablet form) improves stability, palatability, and convenience of administration while preserving therapeutic activity. This study aimed to prepare three standardized *Ghanavati* formulations - *Gorakhamundi Ghanavati* (G.G.), *Kanchanar Ghanavati* (K.G.), and *Gorakhamundi-Kanchanar Ghanavati* (G.K.G.) - under GMP conditions, and to evaluate their pharmaceutico-analytical profile through organoleptic characteristics, physicochemical parameters (per PLIM/API guidelines), preliminary phytochemical screening, and HPTLC fingerprinting using a CAMAG Linomat V system at 254 nm, 366 nm, and 540 nm. All three formulations satisfied pharmacopoeial standards for hardness, friability (<1%), disintegration time (<30 min), water-soluble extractives, and total ash. The combined formulation G.K.G. demonstrated the greatest phytochemical diversity with maximum HPTLC spots (9 at 254 nm; 13 at 366 nm; 11 at 540 nm), indicating synergistic phytochemical enrichment consistent with the Ayurvedic principle of *Samyoga* (combination). These findings establish a pharmaceutico-analytical framework supporting standardization and evidence-based use of these formulations in the management of hypothyroidism.

KEYWORDS: Sphaeranthus indicus, Bauhinia variegata, Kwatha Kalpana

INTRODUCTION

Ayurveda, one of the world's oldest systems of medicine, provides a rich repository of phytotherapeutic resources for managing endocrine disorders. *Gorakhamundi* (*Sphaeranthus indicus* Linn., family Asteraceae) and *Kanchanar* (*Bauhinia variegata* Linn., family Fabaceae) are well-documented classical herbs recommended in conditions of the neck region including *Galaganda* (goitre/thyroid disorders), *Gandamala* (glandular swellings), and *Apachi* (cervical lymphadenopathy)[1].

Hypothyroidism - characterized by deficient thyroid hormone production - is among the most prevalent endocrine disorders worldwide, presenting with fatigue, cold intolerance, weight gain, dry skin, hair loss, constipation, and menstrual irregularities.

Conventional management involves lifelong levothyroxine replacement, which may not fully resolve the underlying metabolic dysfunction [2].

Kwatha Kalpana (decoction-based formulations) is a primary preparation of significant clinical value in Ayurvedic pharmaceutics. Its limitations - short shelf life, bitter taste, and inconvenience in storage and transport - are addressed by converting the decoction into *Ghanavati* (concentrated solid tablet form). The concept of *Ghana* or *Rasakriya*, described in *Sharangdhara Samhita*, involves gently reducing a decoction to a semi-solid concentrate suitable for tablet formulation [3].

Earlier individual studies on *Gorakhamundi Ghanavati* and *Kanchanar Ghanavati* have established their basic pharmaceutico-analytical profiles[4, 5]. The present study extends this work by simultaneously preparing and comparatively evaluating all three formulations - G.G., K.G., and G.K.G. - under identical GMP conditions using comprehensive organoleptic, physicochemical, phytochemical, and HPTLC analytical methods. The aims were: (i) to prepare the three *Ghanavati* formulations under standardized GMP conditions, and (ii) to establish their pharmaceutico-analytical standardization profiles for quality control and regulatory purposes.

OBJECTIVES

1. To prepare *Gorakhamundi Ghanavati (G.G.*), *Kanchanar Ghanavati (K.G.)* and *Gorakhamindi- Kanchanar Ghanavati (G.K.G.)* under standardized GMP conditions following classical Ayurvedic pharmaceutical procedures.
2. To evaluate the pharmaceutico-analytical profile of all three formulations through organoleptic characteristics, physicochemical parameters (as per PLIM guidelines), preliminary phytochemical screening and HPTLC fingerprinting.
3. To comparatively assess the phytochemical synergy of the combined formulation G.K.G. in relation to its individual components.

MATERIALS AND METHODS

1. Collection and Authentication of Raw Materials

Dried fruits of *Gorakhamundi* (*Sphaeranthus indicus* Linn.) with seeds and dried bark of *Kanchanar* (*Bauhinia variegata* Linn.) were procured from local herbal markets in Vadodara, Gujarat. Both raw drugs were authenticated through macroscopic examination against herbarium specimens at the Department of Dravyaguna, Parul Institute of Ayurveda, as per internal Standard Operating Procedure (SOP). Further authentication and certification were obtained from Biotrik Organization Private Limited, Midnapur, West Bengal (Voucher IDs: AD/22/059, AD/22/061, March 2022).

2. Preparation of Ghanavati

All three *Ghanavati* formulations were prepared at the GMP-certified Parul Ayurved Pharmacy, Parul Institute of Ayurveda, Limda, Vadodara, in three sequential stages:

(a) Preparation of Decoction (*Kwatha*): Authenticated herb powder (2 kg) was combined with sixteen times its quantity (32 L) of potable water and heated gently at 80-90°C with occasional stirring, with the vessel kept uncovered, until the volume reduced to one-eighth (1/8th) of the original quantity. The decoction was filtered through double-

layered muslin cloth and the residue discarded [6].

(b) Preparation of *Ghana* (*Rasakriya*): The filtered *Kwatha* was re-heated on a mild flame with continuous stirring until a semi-solid consistency was achieved, then transferred to a water bath to prevent scorching. The resulting dark brown semi-solid *Ghana* was spread on stainless steel trays and dried in a hot air oven at approximately 50°C [7].

(c) Preparation of Tablet (*Ghanavati*): The dried *Ghana* was passed through a #16 sieve to form granules, which were compressed into 500 mg tablets using a single-punch press. Tablets were tray-dried at 50-60°C for 10-12 hours and stored in airtight containers protected from light and moisture [8].

DRUG PREPARATION

A

B

C

D

E

F

Figure 1: Preparation of samples. A- Raw Kanchnar Bark, B- Kanchanar powder, C- Gorakhmundi, D- Gorakhmundi powder, E- Kwatha preparation, F- Filtration of Kwatha, G- Preparation of Ghana, H- Drying of prepared ghana, I- Packaging of samples, J- Prepared samples.

3. Physicochemical and Phytochemical Analysis

Physicochemical evaluation was conducted at Vasu Research Centre, Makarpura, Vadodara, following PLIM guidelines and Ayurvedic Pharmacopoeia of India (API) standards. Parameters assessed included: hardness, average weight, friability, disintegration time, water-soluble extractive, total ash, acid insoluble ash, and loss on drying. Organoleptic characteristics (colour, taste, shape, smell, diameter, width) were also recorded.

Preliminary phytochemical screening for secondary metabolites - alkaloids, glycosides, flavonoids, tannins, saponins, steroids, triterpenoids, carbohydrates, protein, and starch - was performed using standard qualitative tests.

4. HPTLC Analysis

HPTLC fingerprinting was conducted using a CAMAG Linomat V applicator and Scanner III on Merck Silica Gel 60 F_{254} aluminium plates. Solvent system (mobile phase): Toluene: Ethyl Acetate: Glacial Acetic Acid (7:2:1 v/v). Application volume: 2 µL per track; chamber saturation: 30 min; run distance: 80 mm. Tracks were: T1 - *Kanchanar Ghanavati* (K.G.); T2 - *Gorakhamundi Ghanavati* (G.G.); T3 - Combined *Ghanavati* (G.K.G.). Plates were scanned under UV at 254 nm and 366 nm.

After derivatization with anisaldehyde-sulphuric acid spray reagent, plates were scanned at 540 nm. Method suitability was confirmed through triplicate analyses (n=3) demonstrating reproducible Rf values.

OBSERVATIONS AND RESULTS

I. Pharmaceutical Preparation Observations

Table 1: Yield and Process Details of Ghanavati Preparations

S. No.	Formulation	Raw Material Taken (kg)	*Kwatha* Obtained (L)	*Ghana* Obtained (g)	Time Duration for *Ghana* Preparation (hrs)	Final Yield of *Ghanavati* (g & %)
1	*Gorakhamundi Ghanavati*	30 kgs	58.5 L	5,900 (after drying)	18-20 hrs	5.500Kgs (18.33%)
2	*Kanchanar Ghanavati*	30 kgs	58.5 L	6,300	18-20 hrs	5.800Kgs (19.33%)
3	*Gorakhamundi–Kanchanar Ghanavati*	30 kgs	58.5 L	6,000	18-20 hrs	5.600Kgs (18.67%)

II. Organoleptic Characteristics

Table 2: Organoleptic characteristics of the three *Ghanavati* formulations

Character	G.G.V	K.G.V	G.K.V
Color	Dark brown	Dark brown	Dark brown
Odour	Characteristic	Characteristic	Characteristic
Taste	Bitter	Astringent-Bitter	Bitter-Astringent
Texture	Rough, Hard	Rough, Hard	Rough, Hard

III. Physicochemical Parameters

Table 3: Physicochemical parameters of the three *Ghanavati* formulations (Mean, n=3)

Sr.	Physico-chemical character		G.G.V	K.G.V	G.K.V
1.	Tablet dimensions	Diameter (mm)	11.16	11.39	11.26
		Thickness (mm)	7.09	6.94	7.82
2.	Hardness (Kg/cm^2)		4.9	4.9	4.9
3.	Average weight (mg)		714.9	654.6	855
4.	Friability (%)		0.93	0.82	0.97
5.	Disintegration time (minutes.seconds)		27.56	17.54	28.12
6.	Water-soluble extractive value (%)		75.30	84	79.46
7.	Total ash value (%)		15.60	9	13

IV. Phytochemical Screening

Table 4: Preliminary phytochemical screening of the three formulations

Sr. No.	Phytochemical Constituent	G.G.V	K.G.V	G.K.V
1	**Alkaloids**	+	+	++
2	**Glycosides**	–	–	–
3	**Flavonoids**	++	++	++
4	**Tannins**	+++	+++	+++
5	**Saponins**	–	–	–
6	**Steroids**	++	–	+
7	**Triterpenoids**	++	+	+
8	**Carbohydrates**	+	+	+
9	**Proteins**	–	–	–
10	**Starch**	–	–	–

+, ++, +++ = present in increasing intensity; – = absent

V. HPTLC Fingerprint Analysis

Table 5: Summarized details of spot observed in HPLTC analysis of test samples at different wavelengths

Wavelength	Formulation	Track	Rf Range Observed	Number of Spots
254 nm	***KGV***	**T1**	0.12 – 0.79	5
	GGV	**T2**	0.12 – 0.73	8
	GKV	**T3**	0.12 – 0.79	9
366 nm	***KGV***	**T1**	0.56 – 0.83	6
	GGV	**T2**	0.19 – 0.89	12
	GKV	**T3**	0.19 – 0.89	13
540 nm (Post-derivatization)	***KGV***	**T1**	0.12 – 0.79	6
	GGV	**T2**	0.12 – 0.89	8
	GKV	**T3**	0.12 – 0.89	11

Table 6: HPTLC fingerprint profile - number of spots and Rf values

Wavelength	K.G. (Kanchanar)	G.G. (Gorakhamundi)	G.K.G. (Combined)
254 nm	5 spots Rf: 0.12, 0.44, 0.56, 0.73, 0.79	8 spots Rf: 0.12, 0.19, 0.27, 0.44, 0.56, 0.65, 0.68, 0.73	9 spots Rf: 0.12, 0.19, 0.27, 0.44, 0.56, 0.65, 0.68, 0.73, 0.79
366 nm	6 spots Rf: 0.56, 0.60, 0.70, 0.73, 0.79, 0.83	12 spots Rf: 0.19, 0.24, 0.27, 0.51, 0.56, 0.65, 0.68, 0.70, 0.73, 0.79, 0.83, 0.89	13 spots Rf: 0.19, 0.24, 0.29, 0.51, 0.56, 0.60, 0.65, 0.68, 0.70, 0.73, 0.79, 0.83, 0.89
540 nm (post-derivatization)	6 spots Rf: 0.12, 0.34, 0.44, 0.56, 0.73, 0.79	8 spots Rf: 0.12, 0.24, 0.27, 0.40, 0.51, 0.73, 0.79, 0.89	11 spots Rf: 0.12, 0.24, 0.27, 0.34, 0.40, 0.44, 0.51, 0.56, 0.73, 0.79, 0.89

Note: Rf 0.56 - tentative identification as kaempferol/rutin (antioxidant, thyroid-protective); Rf 0.79 - tentative β-sitosterol (immunomodulatory). Confirmation requires co-chromatography with authentic standards and LC-MS/MS.

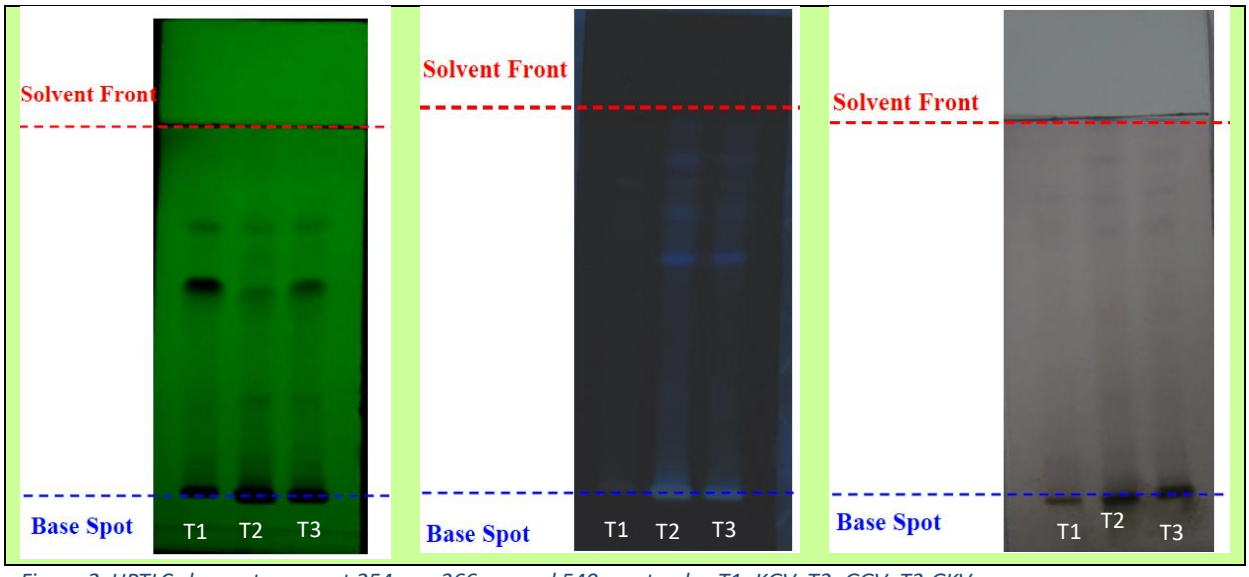

Figure 2: HPTLC chromatogram at 254 nm, 366 nm and 540 nm. tracks- T1- KGV, T2- GGV, T3-GKV

DISCUSSION

All three *Ghanavati* formulations satisfied pharmacopoeial quality standards. The conversion of *Kwatha* into *Ghanavati* form successfully addressed the limitations of the decoction - namely short shelf life, unpalatability, and dosing inconvenience - while preserving the phytochemical integrity of both herbs[6, 7].

Hardness (4.9 kg/cm²) and friability (<1%) confirmed adequate mechanical strength for all formulations. Disintegration time was fastest in K.G. (17 min 54 sec) and slightly longer in G.K.G. (28 min 12 sec), though all

remained within the API limit of NMT 30 minutes. The higher water-soluble extractive value in K.G. (84.00%) compared to G.G. (75.30%) reflects greater water solubility of *Bauhinia variegata* bark constituents. Total

ash was highest in G.G. (15.6% w/w), consistent with the known mineral content of *Sphaeranthus indicus*, and remained well within the API permissible limit of NMT 23%.

Phytochemical screening revealed significant flavonoid and tannin content across all three formulations. Flavonoids support *Shothahara* (anti-inflammatory) and antioxidant actions, while tannins correspond to *Kashaya rasa* (astringent taste) and *Vranaropaka* (wound-healing) properties. The increased alkaloid intensity in G.K.G. compared to individual formulations indicates synergistic potentiation through *Samyoga* (combination), consistent with classical Ayurvedic principles of polyherbal formulation. Steroids and triterpenoids, predominant in G.G. and G.K.G., are associated with immunomodulatory and anti-inflammatory activities reported for *Sphaeranthus indicus* [9].

HPTLC fingerprinting demonstrated progressively increasing phytochemical complexity from K.G. to G.G. to G.K.G. at all three wavelengths. The combined G.K.G. showed the highest number of spots (9, 13, and 11 at 254, 366, and 540 nm respectively), indicating additive and synergistic extraction of bioactive compounds. The tentatively identified Rf 0.56 corresponds to kaempferol or rutin - compounds with established thyroid-protective and antioxidant properties - while Rf 0.79 corresponds to β-sitosterol with immunomodulatory effects[10]. The Ayurvedic correlation of these findings is consistent: alkaloids reflect *Teekshna-Ushna* properties reducing *Kapha-Vata*; tannins and flavonoids support *Shothahara* and *Rasayana* actions; and triterpenoids correspond to *Deepana* (metabolic activation) effects that address the *Agnimandya* (impaired metabolic fire) underlying hypothyroidism.

Limitations of the present study include the assessment of only select physicochemical parameters; future studies should incorporate alcohol-soluble extractives, pH, heavy metal profiling, microbial load, and pesticide residues to fully align with WHO guidelines. Quantitative phytochemical analysis via LC-MS/MS would also strengthen the standardization profile.

CONCLUSION

This study establishes a comprehensive pharmaceutico-analytical framework for *Gorakhamundi Ghanavati* (G.G.), *Kanchanar Ghanavati* (K.G.), and *Gorakhamundi-Kanchanar Ghanavati* (G.K.G.). All three formulations conformed to pharmacopoeial standards. The combined G.K.G. formulation demonstrated superior phytochemical diversity and HPTLC complexity, providing a scientific basis for the Ayurvedic principle of *Samyoga Chikitsa* (synergistic therapy). The findings support the future inclusion of these standardized *Ghanavati* formulations in the Ayurvedic Formulary of India for the management of hypothyroidism (*Galaganda*). Further pharmacological, toxicological, and clinical validation is recommended.

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