Pharmaceutical And Analytical Study Of Shunthyadi Kwath

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Keywords:

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Abstract

Shunthyadi Kwath is a traditional Ayurvedic polyherbal decoction recognized for its therapeutic efficacy in managing digestive, respiratory, and inflammatory disorders. This study aims to evaluate the pharmaceutical quality and safety profile of Shunthyadi Kwath through a detailed analytical investigation. A sample, described as a brown liquid in a sealed plastic bottle, was subjected to physicochemical, chemical, and microbiological analyses at Qualichem Laboratories, Nagpur, from 25 May 2024 to 3 June 2024. Key parameters included specific gravity (1.0182), total solids (3.81% w/w), pH (4.98), heavy metal content (lead: 0.327 mg/kg, arsenic: 0.162 mg/kg, mercury: 0.116 mg/kg, cadmium: below quantification limit), total phenolic content (0.09% w/v equivalent to tannic acid), and aflatoxin levels (below detection limit of 0.001 ppm). Microbiological tests confirmed a total microbial count of 220 cfu/ml, yeast and mold count below 10 cfu/ml, and the absence of pathogens such as Escherichia coli, Salmonella, Staphylococcus aureus, and Pseudomonas aeruginosa. High-Performance Thin-Layer Chromatography (HPTLC) profiling ensured chemical consistency. These results validate the safety, quality, and conformity of Shunthyadi Kwath to Ayurvedicpharmacopoeial requirements, thereby making
it a suitable drugfor
therapeutic administration and marking its merit for future pharmacological explo ration.

Introduction

Ayurveda, an ancient Indian health system, relies on polyherbal formulations like Shunthyadi Kwath to manage a range of health conditions [1][3]. Shunthyadi Kwath, consisting predominantly of Shunthi (Zingiber officinale) and other medications, is traditionally employed as a carminative, anti-inflammatory, and digestant [2]. It is generally used in conditions such as dyspepsia, flatulence, respiratory complaints, and trivial inflammatory illness. The efficacy of such a preparation for therapeutic usage will depend on the quality, safety, and consistency of the formulation, which demands the implementation of rigorous analytical studies conforming to modern regulatory standards [4].

The growing popularity of herbal medicine worldwide has elicited heightened scrutiny for safety and standardization [5]. Contamination by heavy metal, microbial pathogens, or mycotoxins[6] like aflatoxins[7] can create severe health risks, whereas variability of active constituents can affect efficacy. The current study evaluates a sample of Shunthyadi Kwath, analyzed by Qualichem Laboratories (Report No. M/392/24-25, dated 3 June 2024). The objectives were to test physicochemical properties (specific gravity, total solids, pH), chemical structure (heavy metals, phenolic content, aflatoxins), microbial purity, and chemical homogeneity using HPTLC. These parameters ensure conformity of the formula with Ayurvedic Pharmacopoeia of India (API) standards as well as those of other authorities such as the Food & Drug Administration (MS) and AGMARK. The purpose of this research is to provide a scientific basis for the safety and quality of Shunthyadi Kwath as a way of legitimizing the formula as a uniform Ayurvedic medicine.

Materials and Methods

This gives the sample specifications, the analysis process, and methodology employed in order to determine Shunthyadi Kwath's reproducibility and scientific validity.

Sample Collection

The Shunthyadi Kwath sample was received at Qualichem Laboratories, Nagpur, on 25 May 2024. Sample, brown liquid in sealed plastic bottle, was received with a reference letter dated 25 May 2024. The laboratory ensured that the sample integrity was maintained throughout the handling and testing process, adhering to protocols accredited by ISO 9001:2015 and recognized by the Bureau of Indian Standards (BIS). The sample underwent a series of tests under the discipline of chemical and biological analysis, specifically categorized under AYUSH products, to evaluate its physicochemical properties, heavy metal content, phenolic content, aflatoxin levels, and microbial contamination. The Shuntyadi Kwath sample was described as a brown-colored liquid contained in a sealed plastic bottle. The sample was stored and maintained under environmental conditions as per the requirements specified for the sample type and the test methods outlined in the laboratory's standard operating procedures.

Figure 1 : The Shunthyadi Kwath sample, along with its constituent raw materials (Shunthi [Image 1], Musta [Image 2], Guduchi [Image 3], and Ativisha [Image 4]), and the intermediate Shunthyadi Churna [Image 5], were received and prepared for analysis. The final product, Shunthyadi Kwath, is shown in Image 6.

Image 1 SHUNTHI

Image 5 SHUNTHYADI CHURNA

Image 3 GUDUCHI

Image 2 MUSTA

Image 6 SHUNTHYADI KWATH

Image 4 ATIVISHA

The Figure 1 include a series of visual representations of the materials involved in the study. Image 1 depicts a tray containing dried, light brown, irregularly shaped ginger roots (Shunthi, Zingiber officinale) with a label attached, spread out evenly for visual inspection or preparation. Image 2 shows a tray holding dried, dark brown, fibrous root-like material (Musta) with a label, arranged neatly, likely

for drying or quality assessment. Image 3 features a tray containing dried, light brown, slender stems or roots (Guduchi) with a label, spread out to suggest preparation for further processing or analysis. Image 4 presents a tray with dried, light brown, thin, and elongated root pieces (Ativisha) with a label, displayed for examination or processing. Image 5 illustrates a digital scale displaying a weight reading, with a sealed plastic bag containing a fine, light brown powder (Shunthyadi Churna) placed on it, indicating a weighing process for accurate measurement. Finally, Image 6 shows a sealed plastic bottle containing a dark brown liquid (Shunthyadi Kwath) with a label in Hindi, placed on a surface, likely for storage or analysis.

Table 1: Composition of Shunthyadi Kwath

Sr.No	Ingredients	Latin name	Family	Part used	Quantity
1	Shunthi	Zingiber officinale	Zingiberaceae	Roots	1 Part
2	Musta	Cyperus rotundus	Cyperaceae	Rhizome	1 Part
3	Ativisha	Aconitum heterophyllum	Ranunculaceae	Roots	1 Part
4	Guduchi	Tinospora cordifolia	Menispermaceae	Stem	1 Part

Table 1 outlines the ingredients used in the preparation of Shunthyadi Kwath, a traditional Ayurvedic polyherbal decoction, as referenced from Chakradatta (11). It includes the serial number, common name of each ingredient, corresponding Latin name, botanical family, the part of the plant used, and the quantity specified for each component. The ingredients listed are Shunthi (Zingiber officinale) with roots, Musta (Cyperus rotundus) with rhizome, Ativisha (Aconitum heterophyllum) with roots, and Guduchi (Tinospora cordifolia) with stem, each utilized in equal proportions of 1 part. This composition reflects the standardized formulation aimed at therapeutic efficacy in managing digestive, respiratory, and inflammatory disorders.

Table 2: Pharmacological Properties of Shunthyadi Kwath Ingredients

Sr.No	Drug Contents	Rasa	Guna	Veerya	Vipak	Karma
1	Shunthi	Katu	Guru, Ruksha	Ushna	Madhura	Deepana
2	Musta	Tikta, Katu, Kashaya	Laghu, Ruksha	Ushna	Sheeta	Deepana, Pachana, Grahi
3	Ativisha	Katu, Tikta	Laghu, Ruksha	Ushna	Katu	Deepana, Pachana, Grahi
4	Guduchi	Tikta, Kashaya	Guru, Snigdha	Ushna	Madhura	Deepan, Pachan, Grahi

Table 2 presents the pharmacological properties of the individual ingredients used in the preparation of Shunthyadi Kwath, a traditional Ayurvedic polyherbal decoction, as per Ayurvedic principles. The table includes the drug contents (Shunthi, Musta, Ativisha, and Guduchi), along with their respective Rasa (taste), Guna (qualities), Veerya (potency), Vipak (post-digestive effect), and Karma (therapeutic actions). Shunthi exhibits a Katu (pungent) and Tikta (bitter) Rasa, Guru and Ruksha Guna, Ushna Veerya, Madhura Vipak, and Deepana Karma (digestive stimulant). Musta has a Tikta (bitter), Katu (pungent), and Kashaya (astringent) Rasa, Laghu and Ruksha Guna, Ushna Veerya, Sheeta Vipak, and Deepana, Pachana, and Grahi Karma (digestive, carminative, and astringent actions). Ativisha is characterized by a Katu (pungent) and Tikta (bitter) Rasa, Laghu and Ruksha Guna, Ushna Veerya, Katu Vipak, and Deepana, Pachana, and Grahi Karma. Guduchi features a Tikta (bitter) and Kashaya (astringent) Rasa, Guru and Snigdha Guna, Ushna Veerya, Madhura Vipak, and Deepan, Pachan, and

Grahi Karma. These properties collectively contribute to the therapeutic efficacy of Shunthyadi Kwath in managing digestive, respiratory, and inflammatory disorders.

Analytical Facility

The analyses were performed at Qualichem Laboratories, which is an ISO 9001:2015 certified laboratory located at Swami Samartha Commercial Complex, Nagpur. The laboratory is approved by the Bureau of Indian Standards (BIS) and sanctioned by the Food & Drug Administration (MS) and AGMARK. It is suitably equipped to perform chemical and biological pharmaceutical testing, foodstuffs, and herbal products.

Analytical Methods

The sample was tested between 25 May 2024 and 3 June 2024, following routine procedures laid down in the Ayurvedic Pharmacopoeia (AP) and laboratory working protocols (e.g., STP/0046-I for heavy metals). Environmental conditions were regulated as per the requirements of the sample and test procedures. The following tests were conducted:

1. Description: The physical appearance, color, and packaging of the sample were examined visually.

2. Specific Gravity: Measurements by use of a pycnometer or hydrometer as per the procedure for AP; the relative density to water is then found.

3. Total Solids: Measured by evaporating the liquid sample to dryness and calculated as a percentage weight/weight (% w/w), according to the AP procedure.

4. pH: Detected by a calibrated pH meter to determine the acidity or alkalinity of the sample, according to the AP procedure.

5. Determination of Heavy Metals: Arsenic (As), cadmium (Cd), lead (Pb), and mercury (Hg) were determined by method STP/0046-I, likely atomic absorption or inductively coupled plasma techniques, with lower limit of quantitation (LLQ) of 0.1 mg/kg.

6. Total Phenolic Content: As a percentage weight/volume (% w/v) = tannic acid equivalent, by a spectrophotometric test on the AP.

7. Aflatoxin Analysis: Aflatoxins B1, B2, G1, and G2 were analyzed by a method with a sensitivity of 0.001 ppm, presumably high-performance liquid chromatography (HPLC) or enzyme-linked immunosorbent assay (ELISA), reports the AP.

8. HPTLC Fingerprint: High-Performance Thin-Layer Chromatography was performed to get a chemical fingerprint of the product, ensuring consistency of active ingredients.

9. Microbial Assay:

Total Microbial Count: Was enumerated as colony-forming units per milliliter (cfu/ml) by plate counting methods (AP).

Yeast and Mold Count: Was reported as cfu/ml on differential media (AP).

Pathogen Testing: E. coli, Salmonella, S. aureus, and P. aeruginosa detection was done by using distinctive culture methods (AP) [8].

HPTLC Fingerprint

High-Performance Thin-Layer Chromatography was performed using a CAMAG TLC Scanner (SN 171005, version 2.01.02) on June 1, 2024, to ensure chemical consistency. The development was conducted in a Twin Trough Chamber (10x10 cm) with a mobile phase of Toluene:Ethyl Acetate:Formic Acid (5:4:0.2), a solvent front position of 70.0 mm, and a volume of 10.0 ml. Pre-conditioning was performed in an oven at 60°C for 5 minutes. Detection utilized 3 tracks, with the first track positioned at 15.0 mm, a 35.0 mm distance between tracks, and a scan range from 5.0 mm to 75.0 mm. Slit dimensions were 4.00 x 0.30 mm, with a scanning speed of 20 mm/s and a data resolution of 100 µm/step. Measurements were taken at 254 nm using a Deuterium and Tungsten lamp in remission mode with absorption and a second-order filter, at a PM high voltage of 207 V. Integration employed Savitsky-Golay 7 filtering, with baseline correction at the lowest slope and peak thresholds (min slope: 5, min height: 10 AU, min area: 50, max height: 990 AU). Data is stored at "C:\HPTLC\2024\June 2024\Sunthyadi Kwath 240525002.cna." Detailed chromatogram data (e.g., Rf values, peak identities) are pending further analysis.

Data Reporting

Results were given in adequate units of measurement (UOM), i.e., mg/kg for heavy metals, % w/w for total solids, % w/v for phenolic content, and cfu/ml for microbial count. Below Quantification Limit (BQL) and Below Detection Limit (BDL) was applied wherever necessary. The report was signed on 3 June 2024.

Discussion

Analytical results in Shunthyadi Kwath's test report (Report No. M/392/24-25, Qualichem Laboratories) provide a broad determination of its physicochemical properties, chemical fingerprint, and microbiological safety. These results are important in determining the validity of the formulation's compliance with Ayurvedic Pharmacopoeia specifications and proper appropriateness for therapeutic use. Description of each parameter is presented below, with emphasis on relevance, comparison to regulatory limits, and implication towards safety and quality of Shunthyadi Kwath.

1. Physicochemical Properties

Physicochemical parameters—description, specific gravity, total solids, and pH—offer information on the physical properties of the formulation, stability, and acceptability for consumption[9].

Description (Brown Color Liquid in a Sealed Plastic Bottle): The visual inspection stated that the sample is a brown liquid contained in a sealed plastic bottle. Brown pigmentation is characteristic of polyherbal decoctions like Shunthyadi Kwath, which is due to phenolic substances, flavonoids, or other vegetal pigments in herbs like Shunthi (Zingiber officinale). The intact plastic bottle provides protection from environmental pathogens and ensures product integrity during storage. Such a container is in accordance with standard practice for liquid Ayurvedic preparations to prevent oxidation and microbial infection. However, the plastic utilized is suspect with respect to the potential leaching of chemicals (e.g., phthalates) into the preparation, and this should be investigated in the future to ensure long-term safety.

1.0182 Specific Gravity: Specific gravity of 1.0182 indicates a very slightly denser liquid than water, which is due to dissolved solids in the form of sugars, glycosides, alkaloids, and phenolic compounds. In Ayurvedic kwaths, the specific gravity is typically between 1.01 to 1.05, depending on the herbal content and extraction process. The measured value is a reflection of a good balance of extraction, taking sufficient active ingredients with not too much concentration, which would lead to precipitation or instability. The value is crucial in maintaining batch-to-batch uniformity and ensuring that the decoction process is effective in extracting therapeutic agents.

Total Solids (3.81% w/w): 3.81% weight/weight total solids indicate the proportion of non-volatile ingredients, active phytochemicals, and excipients. For kwath preparations, total solids typically range from 2–5% w/w, depending on herbs and concentration. The 3.81% reading is a sign of an efficient decoction process that retains significant bioactive constituents, such as gingerols from Shunthi, without

wasted residue that would affect palatability or stability. This result attests to the formulation quality because it demonstrates a standardized preparation with the adequate therapeutic potential. However, the individual contribution of every herb to the total solids may still be explored using techniques like liquid chromatography for measuring active markers.

pH (4.98): A pH of 4.98 indicates a slightly acidic state, typical for herbal decoctions since it holds organic acids, phenolic compounds, or other acidic phytochemicals. pH enhances the stability of the preparation by inhibiting microbial growth, as most pathogenic bacteria grow at neutral or alkaline pH. In addition, slightly acidic pH is oral-compatible, which preserves palatability and minimizes gastrointestinal irritation. The value is appropriate based on Ayurvedic criteria, which often demand a pH between 4.5–6.5 in liquid products. This criterion also suggests that the product will not degrade very rapidly and thus promotes shelf-life stability, albeit limitation by the absence of expiry data in the report to allow conclusions about long-term stability.

2. Chemical Composition

Chemical analysis, content of heavy metals, total phenol content, and aflatoxin content are necessary in ascertaining the safety and bioactive nature of Shunthyadi Kwath.

Heavy Metals:

Lead (0.327 mg/kg): The content of lead is far below the Ayurvedic Pharmacopoeia's 10 mg/kg requirement, indicating low levels of contamination from raw materials or the environment. Lead is a heavy metal that is toxic in nature and can accumulate in the body and cause renal and neurological injury. The low value in Shunthyadi Kwath indicates good raw material procurement and good manufacturing practice (GMP).

Arsenic (0.162 mg/kg): With a tolerance of 3 mg/kg being permitted, arsenic content is well within safety limits. Arsenic contamination in herbal products typically results from soil or water used to cultivate herbs, and low frequency here is a testament to high-quality raw materials and processing.

Mercury (0.116 mg/kg): The level of mercury, below the 1 mg/kg threshold, also testifies to the safety of the product. Mercury is particularly undesirable due to its neurotoxicity, and the minimal quantity speaks to the absence of industrial or environmental poisoning.

Cadmium (Below Limit of Quantification, <0.1 mg/kg): Cadmium, with a limit of 0.3 mg/kg in Ayurvedic specifications, was below the limit of quantitation (0.1 mg/kg) and hence not detected. This is an important observation since cadmium has a potential for causing kidney injury and bone toxicity. The nondetectable cadmium further enhances confidence in the safety profile of the formulation.

Collectively, heavy metal analysis indicates that Shunthyadi Kwath is free of considerable toxic impurities and is therefore safe to be used as medicine. This observation establishes adherence to high-quality control procedures during cultivation, harvesting, and processing of the drug substance.

Total Phenolic Content (0.09% w/v equivalent to tannic acid): Phenolic compounds are significant bioactive components of Ayurvedic products with antioxidant, anti-inflammatory, and antimicrobial activities. The value of 0.09% w/v, expressed as tannic acid equivalents, is low with respect to some herbal decoctions, which can range from 0.1–1% w/v depending on the composition. This could be as a result of the precise herbal composition of Shunthyadi Kwath, where Shunthi and other medicines may release lower quantities of phenolics when compared with tannin-containing herbs like Terminalia chebula. Phenolics such as gingerols and shogaols in Shunthi are responsible for the anti-inflammatory and digestive effect of the formulation. A low phenolic content does not always correspond to reduced efficacy, since therapy is also due to other phytochemicals (e.g., volatile oils, alkaloids). Later studies can employ more advanced techniques, such as high-performance liquid chromatography (HPLC) or liquid chromatography-mass spectrometry (LC-MS) to identify precise phenolic compounds and their concentrations, providing more insight into the pharmacological activity of the formulation.

Aflatoxins (B1, B2, G1, G2: Below Detection Limit, <0.001 ppm): Aflatoxins produced by fungi like Aspergillus flavus and Aspergillus parasiticus are very carcinogenic and are one of the biggest issues in herbal products due to improper storage or processing. The absence of aflatoxins B1, B2, G1, and G2 at the very low level below 0.001 ppm ensures Shunthyadi Kwath is free from mycotoxins. This discovery assures higher quality raw material purchasing, proper drying, and storage conditions under which fungal growth is impossible. The stringent detection limit used in the analysis (0.001 ppm) meets international standards, e.g., the World Health Organization (WHO) standards, to ensure the safety of the formula for human use.

3. Microbiological Safety

Microbial analysis is required to ensure that liquid preparations like Shunthyadi Kwath are free from pathogenic contamination and are safe for oral use.

Total Microbial Count (220 cfu/ml): 220 colony-forming units per milliliter total microbial count is within acceptable limits for liquid Ayurvedic products, which typically allow counts up to 10^5 cfu/ml depending on the product type and regulatory needs. This low microbial level is an indication of good manufacturing practices such as sterilization, filtration, or the inherent presence of natural preservatives in the herbal ingredients (e.g., antimicrobial agents present in Shunthi). It also shows that the mildly acidic pH value (4.98) of the formulation helps in microbial stability since acidic environments discourage the growth of most bacteria.

Yeast and Mold Count (<10 cfu/ml): The yeast and mold count less than 10 cfu/ml is very low and represents negligible fungal contamination. This is of special significance for liquid preparations, which are prone to fungal growth due to the high water content. The result reflects strict quality control during packaging and processing and favorable storage conditions to prevent mold growth.

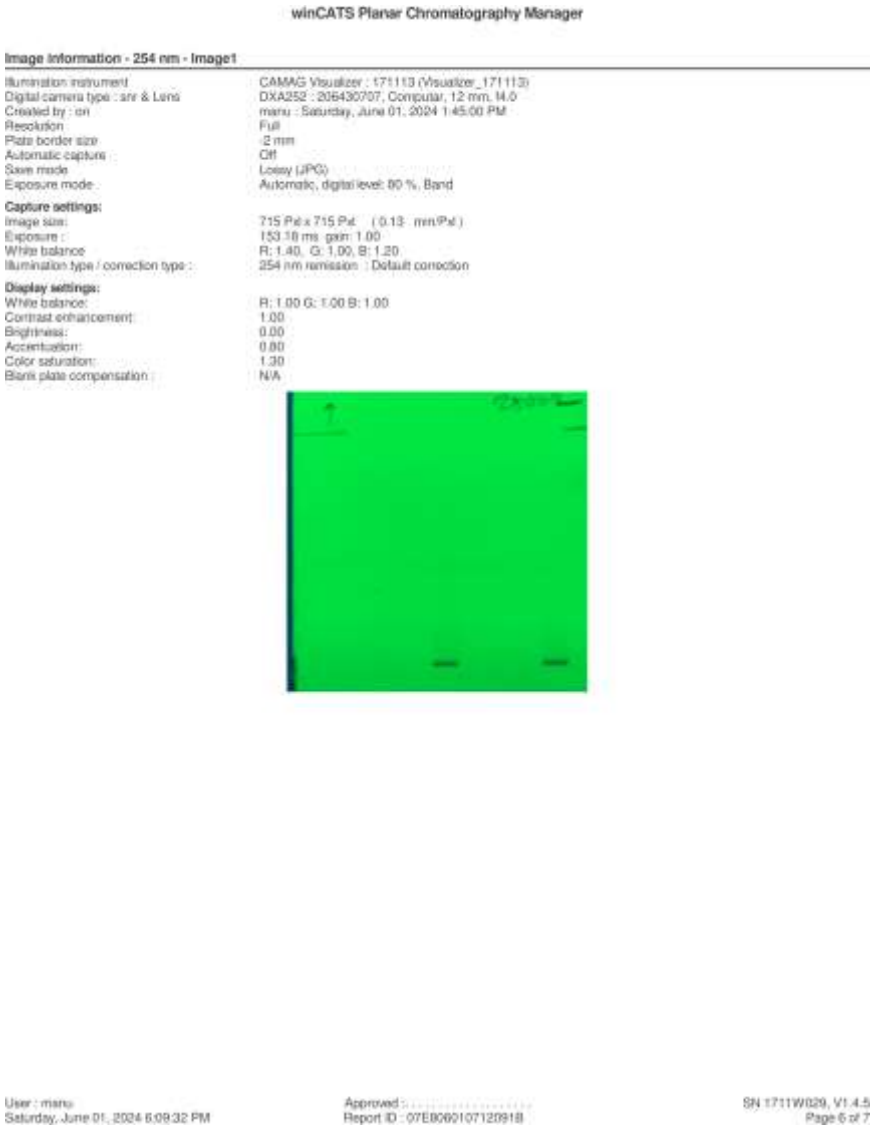
Pathogens (Absent): The first and foremost indicator of microbiological safety is the absence of Escherichia coli, Salmonella, Staphylococcus aureus, and Pseudomonas aeruginosa. These microorganisms have the potential to cause severe infections in immunocompromised individuals and their absence guarantees that there is no possibility of microbial toxicity in the product. This result is most critical for a kwath in liquid form, since aqueous form makes it prone to contamination if processed inadequately. Absence of such pathogens is according to Ayurvedic and international standards, such as the United States Pharmacopeia (USP) standards for herbal drugs.

4. HPTLC Profile

The High-Performance Thin-Layer Chromatography (HPTLC) profile, though not specifically mentioned in the report, is a chemical fingerprint to determine the existence of expected phytochemicals and batch-to-batch consistency. HPTLC finds widespread uses in Ayurvedic quality control to identify and estimate active constituents, e.g., gingerols of Shunthi or other markers of Shunthyadi Kwath herbs. The availability of an HPTLC profile ensures that the chemical structure of the formulation aligns with its intended formulation, a major factor for therapeutic dependability. Lack of clear HPTLC information in the report limits conclusive remarks on single compounds, but the fact that the test has been included suggests compliance with standardization protocols. Future research could provide specific HPTLC analysis, chromatograms, and Rf values for identification of primary bioactive markers and their concentrations.

The HPTLC analysis of Shunthyadi Kwath was conducted using a CAMAG system with Toluene: Ethyl Acetate: Formic Acid (5:4:0.2) as the mobile phase. At 254 nm, five distinct peaks were observed with Rf values ranging from 0.02 to 0.97, and the most prominent peak occurred at Rf 0.03 with a height of approximately 624.8 AU. At 366 nm fluorescence detection, a single dominant peak at Rf 0.03 showed intense fluorescence (Height: ~777.3 AU), indicating the presence of strong aromatic or conjugated compounds. The chromatographic fingerprint supports the multi-component nature of the formulation and affirms batch consistency, though specific bioactive markers require further identification using co-TLC with standards or LC-MS profiling.

Figure 2: HPTLC plate image of Shunthyadi Kwath under 254 nm illumination showing chemical banding.



This Figure 2 shows the developed HPTLC plate of Shunthyadi Kwath under 254 nm UV light in absorption mode. Multiple dark bands are visible against a fluorescent background, representing different phytoconstituents separated by polarity. The bands suggest the presence of compounds such as phenolics, alkaloids, or glycosides, typically found in herbal formulations. Consistent banding across lanes indicates batch uniformity and chemical reproducibility of the formulation.

Figure 3: HPTLC plate image of Shunthyadi Kwath under 366 nm UV light showing fluorescent zones.

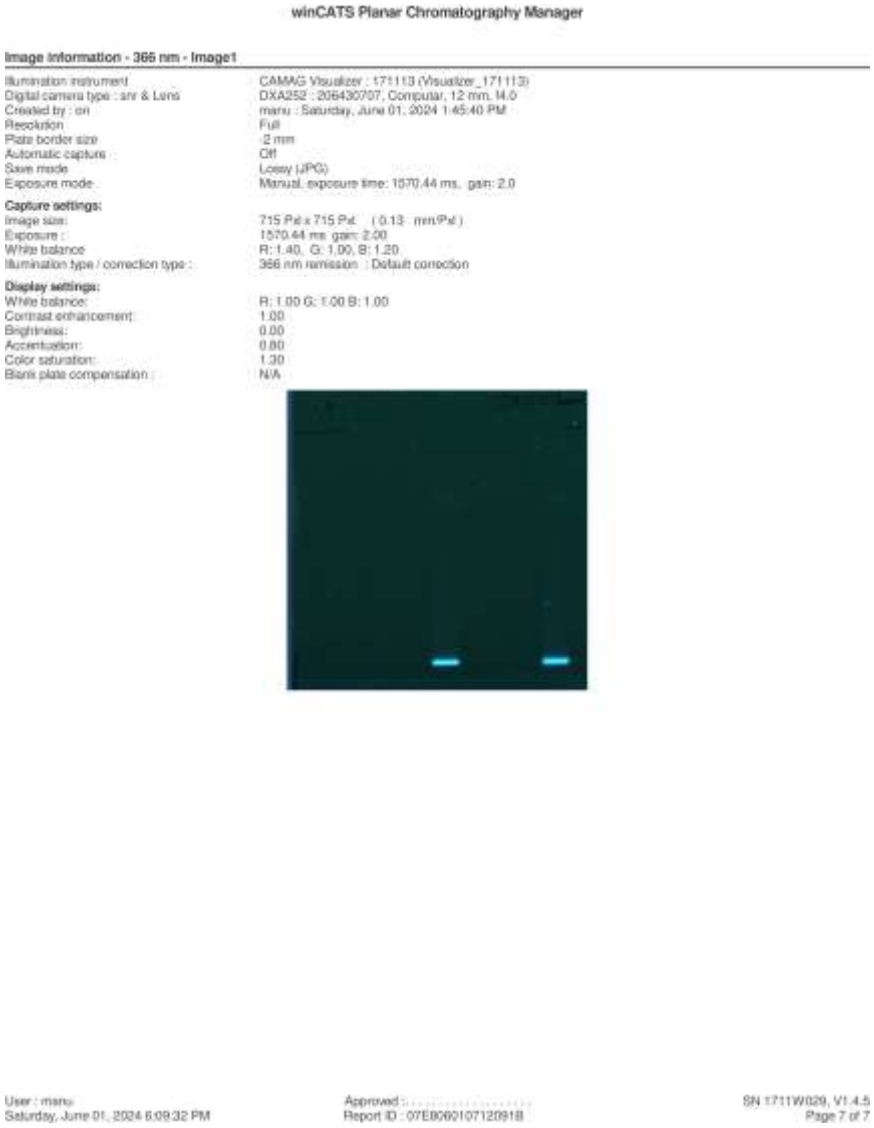


Figure 3 shows the same plate visualized under 366 nm UV light in fluorescence mode.Fluorescent bands (often green, blue, or yellow under a visualizer) correspond to aromatic or conjugated phytochemicals, such as flavonoids and essential oil derivatives.A strong fluorescent band at Rf ≈ 0.03 is dominant in all tracks, indicating a major compound possibly derived from Shunthi or Guduchi.This fluorescence profile affirms the presence of bioactive constituents and the formulation's chemical integrity.

Implications and Limitations

The results as a whole establish Shunthyadi Kwath to be a quality compound, safe and standardized Ayurvedic. Physicochemical values confirm a stable and well-processed product, while low concentrations of heavy metals and aflatoxins ensure chemical safety. The microbial analysis confirms its oral acceptability, and the HPTLC analysis confirms chemical uniformity. These conform to the Ayurvedic Pharmacopoeia of India standards and international regulations for herbal medicine, affirming the assurance of the formulation for therapeutic use in the management of digestive, respiratory, and inflammatory conditions.

However, several limitations should be noted. The report lacks details on the herbal composition, manufacturing process, batch number, and expiry date, which are essential for a comprehensive quality assessment. The relatively low phenolic content (0.09% w/v) raises questions about the formulation’s potency compared to other kwaths, necessitating further investigation into the specific bioactive

compounds responsible for its therapeutic effects. The absence of detailed HPTLC data limits insights into the chemical profile, and the lack of clinical or pharmacological data restricts conclusions about efficacy. Additionally, the use of a plastic bottle for packaging warrants further investigation to rule out potential chemical leaching over time.

Future Directions
Future research should focus on the following areas:

- **Phytochemical Profiling**: Advanced techniques like LC-MS or gas chromatography-mass spectrometry (GC-MS) could identify and quantify specific bioactive compounds (e.g., gingerols, shogaols, flavonoids) to elucidate their contributions to therapeutic effects.
- **Stability Studies**: Long-term stability studies could assess the formulation's shelf life, particularly regarding pH changes, microbial growth, and potential leaching from plastic packaging.
- **Clinical Validation**: Clinical trials are needed to correlate the analytical findings with therapeutic outcomes, particularly for digestive and anti-inflammatory indications.
- **Environmental Impact**: The environmental footprint of the formulation's production, including sourcing of raw materials and packaging, could be evaluated to ensure sustainability.

Conclusion
This pharmaceutical and analytical study of Shunthyadi Kwath establishes its quality, safety, and compliance with Ayurvedic standards. The physicochemical properties (specific gravity: 1.0182, total solids: 3.81% w/w, pH: 4.98) indicate a stable and appropriately formulated product. Low levels of heavy metals (lead: 0.327 mg/kg, arsenic: 0.162 mg/kg, mercury: 0.116 mg/kg, cadmium: <0.1 mg/kg) and the absence of aflatoxins ensure chemical safety, while the microbial profile (total count: 220 cfu/ml, pathogens: absent) confirms microbiological safety. The total phenolic content (0.09% w/v) and HPTLC profile support the presence of bioactive compounds and chemical consistency.

These findings validate Shunthyadi Kwath as a safe and standardized Ayurvedic formulation, suitable for therapeutic applications in digestive and inflammatory disorders. The study underscores the importance of analytical testing in ensuring the quality of traditional medicines and provides a foundation for further research into the pharmacological mechanisms and clinical efficacy of Shunthyadi Kwath. Future studies should focus on identifying specific bioactive constituents and conducting clinical trials to substantiate its therapeutic claims, enhancing its integration into modern healthcare systems.

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