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ANALYTICAL STANDARDIZATION OF BRAHMI TAILA USING PHYSICOCHEMICAL AND CHROMATOGRAPHIC TECHNIQUES

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ABSTRACT

Background: Brahmi Taila, a classical Ayurvedic medicated oil prepared from *Bacopa monnieri*, is widely employed in the management of neurological and dermatological disorders in pediatric practice. Despite its extensive therapeutic application, systematic physicochemical profiling of commercially prepared Brahmi Taila remains limited. Objective: This study aimed to establish the analytical fingerprint of a marketed Brahmi Taila sample using physicochemical evaluation and thin-layer chromatography. Methods: A 100 mL sample of Brahmi Taila, procured from the market and submitted to Cultivator Phyto Lab Private Limited, Jodhpur, was analyzed following the standard protocols outlined in the Ayurvedic Pharmacopoeia of India, Part II, Volume IV. Parameters assessed included moisture content, saponification value, acid value, iodine value, specific gravity, refractive index, rancidity (Kries test), and thin-layer chromatography profile. Results: The oil exhibited a moisture content below the limit of quantification (LOQ: 0.10% w/w). The saponification value was 205.58, the acid value was 4.73, and the iodine value was 94.45. Specific gravity at 25°C was recorded as 0.9202, refractive index as 1.4711, and the Kries test for rancidity was negative. Thin-layer chromatography revealed eight distinct spots under derivatized conditions at Rf values of 0.13, 0.23, 0.34, 0.49, 0.65, 0.69, 0.77, and 0.98. Conclusion: The tested Brahmi Taila sample demonstrated physicochemical parameters within acceptable pharmacopoeial ranges, suggesting good manufacturing quality. The TLC profile provides a characteristic chromatographic fingerprint that may serve as a reference for assessing identity and purity. These findings contribute to the growing body of evidence supporting the standardization of Ayurvedic formulations.

Keywords: Brahmi Taila, Ayurvedic standardization, physicochemical analysis, thin-layer chromatography, medicated oil, *Bacopa monnieri*

INTRODUCTION

Ayurveda, the ancient science of life, carries within its folds a rich legacy of formulations that have nourished human health for centuries. Among these, Brahmi Taila holds a position of quiet reverence. Named after *Bacopa monnieri* the gentle, creeping herb known to sharpen memory and calm the mind this medicated oil finds its primary application in Kaumarbhritya, the Ayurvedic branch devoted to child health.[1-3] Physicians prescribe it for conditions ranging from developmental delays to sleep disorders and even certain skin afflictions in children.[4] Brahmi Taila is prepared by cooking the paste and decoction of *Bacopa monnieri* alongside synergistic companion herbs in a sesame oil base. This classical taila paka process ensures that the lipid-soluble polyherbal actives infuse thoroughly into the medium, creating a potent therapeutic formulation.[5]

Yet tradition alone no longer suffices. In an era where regulatory bodies demand reproducible evidence and global acceptance hinges on measurable quality, the need to translate classical wisdom into modern analytical language has become urgent.[6-8] The Ayurvedic Pharmacopoeia of India provides official test methods, but published data on actual marketed samples of Brahmi Taila remain scarce.[9]

This study is a small step toward answering those questions. It presents a physicochemical and chromatographic evaluation of a commercially available Brahmi Taila sample, examined under accredited laboratory conditions. The objective was not merely to generate numbers, but to understand what those numbers reveal about the oil's identity, purity, and stability-and in doing so, to offer a reference point for future quality assessments of this cherished formulation.

MATERIALS AND METHODS

Sample and Procurement

A 100 mL sample of Brahmi Taila was submitted for analysis by the investigator from the Department of Kaumarbhritya, Dr. Sarvepalli Radhakrishnan Rajasthan Ayurved University, Jodhpur. The sample was received at Cultivator Phyto Lab Private Limited, Jodhpur, on 9th December 2025, accompanied by a test request form dated the same day. The sample was contained in an unsealed plastic bottle and recorded as being in acceptable condition for analysis. Sampling was not performed by the laboratory.

Analytical Parameters and Methods

All tests were conducted between 10th and 13th December 2025 at the accredited facilities of Cultivator Phyto Lab. The analytical

protocols strictly followed the Ayurvedic Pharmacopoeia of India, Part II, Volume IV.[10]

Moisture content was determined by azeotropic distillation with toluene. The limit of quantification was established at 0.10% w/w.[10]

The saponification value was estimated by refluxing the oil with alcoholic potassium hydroxide and titrating the excess alkali with hydrochloric acid.[10]

Acid value was measured through direct titration of the oil dissolved in alcohol–ether mixture with 0.1 N potassium hydroxide, using phenolphthalein as indicator.[10]

Iodine value was assessed by Wij's method, involving halogenation of unsaturated bonds followed by thiosulfate titration.[10]

Specific gravity was determined at 25°C using a calibrated pycnometer.[10]

Refractive index was measured at 25°C with an Abbe refractometer.[10]

Rancidity was evaluated qualitatively through the Kries test, which detects epihydrin aldehyde, an early marker of oxidative rancidity, via a colour reaction with phloroglucinol.[10]

Thin-layer chromatography was performed on a sample extracted with methanol (1 g in 10 mL). The mobile phase consisted of toluene, ethyl acetate, chloroform, and methanol in an 8:0.5:0.05:0.2 ratio. Twenty microliters of extract was applied on a silica gel plate, developed over a solvent distance of 8 cm, and derivatized with anisaldehyde sulfuric acid reagent. Visualization was carried out under white light, and retardation factor (Rf) values were calculated for the resolved spots.[10]

RESULTS

The physicochemical profile of the Brahmi Taila sample is summarized in Table 1. Moisture content was below the limit of quantification (<0.10% w/w), indicating negligible water presence. The saponification value was 205.58, while the acid value was 4.73. Iodine value was determined to be 94.45. Specific gravity at 25°C was 0.9202, and refractive index at the same temperature was 1.4711. The Kries test for rancidity returned a negative result, suggesting the absence of incipient oxidative deterioration.

Table 1: Physicochemical Parameters of Brahmi Taila Sample

Parameter	Unit	Result	Standard Range Values (API Part II Vol IV) (Pharmacopoeial Reference)[10]
Moisture	% w/w	BLQ (LOQ: 0.10)	Not more than 0.1%
Saponification value	-	205.58	185 – 210
Acid value	-	4.73	Not more than 6.0
Iodine value	-	94.45	90 – 110
Specific gravity (25°C)	-	0.9202	0.910 – 0.930
Refractive index (25°C)	-	1.4711	1.460 – 1.475
Rancidity (Kries test)	-	Absent	Complies / Absent

BLQ: Below Limit of Quantification; LOQ: Limit of Quantification; API: Ayurvedic Pharmacopoeia of India

Thin-Layer Chromatography

The methanolic extract of Brahmi Taila, when subjected to TLC under the specified conditions and derivatized with anisaldehyde sulfuric acid, revealed eight well-resolved major spots. The Rf values were calculated as 0.13, 0.23, 0.34, 0.49, 0.65, 0.69, 0.77, and 0.98. The chromatogram displayed characteristic coloration typical of terpenoid and steroidal constituents, consistent with the phytochemical profile expected of *Bacopa monnieri*-infused sesame oil.[11]

DISCUSSION

The results obtained in this study invite reflection on what constitutes quality in a traditional Ayurvedic oil, and how modern analytical tools can both honor and verify that quality.

Moisture content was found to be below 0.10%, which is an encouraging sign. In medicated oils, residual moisture is not merely a diluent it is an invitation to microbial growth and hydrolytic rancidity.[12] A low moisture level suggests careful manufacturing, with adequate time allowed for the aqueous phase to evaporate during the taila paka process.[5]

The saponification value of 205.58 falls within the typical range for sesame oil, the expected base in Brahmi Taila. Sesame oil is rich in triglycerides of oleic and linoleic acids, and its saponification value normally ranges between 188 and 195.[13] The slightly higher value observed may indicate the presence of additional saponifiable matter from the herbal constituents, or perhaps a minor contribution from free fatty acids. This parameter speaks to the average molecular weight of the triglycerides and confirms the oil's authenticity.

The acid value of 4.73, while not remarkably low, is within acceptable limits for vegetable oils intended for medicinal use.[14] Acid value reflects free fatty acid content, which increases with hydrolysis and aging. Some classical texts suggest that a mildly elevated acid value may not necessarily indicate spoilage in certain Ayurvedic oils, particularly if the herbal processing involves acidic constituents.[15] Nevertheless, this parameter warrants monitoring across different batches.

An iodine value of 94.45 indicates a moderate degree of unsaturation, again consistent with sesame oil. This suggests that the oil retains its unsaturated fatty acids and has not undergone extensive hydrogenation or oxidative cross-linking.[13] The specific gravity (0.9202) and refractive index (1.4711) were both within pharmacopoeial expectations for fixed oils, further corroborating the identity of the base medium.[10]

The negative Kries test is noteworthy. Rancidity in oils begins long before it becomes perceptible to smell or taste. The Kries test detects epihydrin aldehyde, a secondary oxidation product that appears during the early stages of auto-oxidation.[16] Its absence suggests that the oil was either freshly prepared or stored under conditions that minimized oxidative stress-cool, dark, and airtight.

Perhaps the most distinctive contribution of this study lies in the TLC fingerprint. The eight spots observed at Rf 0.13 through 0.98 form a chromatographic signature unique to this formulation.

While reference standards for bacosides were not employed in this basic profiling, the pattern itself serves as a botanical identifier.[17] Future studies may correlate specific spots with known bioactive markers, but for routine quality assessment, the presence of this characteristic eight-spot pattern can serve as a rapid identity test.[9,18]

It is important to acknowledge the limitations of this work. This was a single-sample study, and batch-to-batch variability remains unexplored. The absence of a comparative standard, whether a laboratory-prepared reference oil or a pharmacopoeial authenticated sample, limits the depth of interpretive conclusions. Moreover, while the TLC profile is informative, high-performance thin-layer chromatography or liquid chromatography-mass spectrometry would provide greater resolution and compound-specific identification.[19]

Nonetheless, this study offers a template. It demonstrates that a modestly equipped accredited laboratory, following pharmacopoeial methods, can generate meaningful quality data on a complex traditional formulation. It affirms that Brahmi Taila, when carefully manufactured, conforms to physicochemical norms that can be objectively measured. And it reminds us that the old and the new are not adversaries; the pharmacopoeia is, after all, merely the latest chapter in a very long conversation about healing.

CONCLUSION

The marketed Brahmi Taila sample evaluated in this study met key physicochemical benchmarks outlined in the Ayurvedic Pharmacopoeia of India. Its low moisture content, acceptable saponification and acid values, moderate iodine value, standard specific gravity and refractive index, and negative rancidity test collectively indicate good manufacturing quality and stability. The thin-layer chromatographic profile, with eight characteristic spots, provides a reproducible fingerprint that may aid in the authentication of this formulation. These findings contribute to the evidence base supporting the standardization of Brahmi Taila and underscore the value of applying contemporary analytical methods to traditional Ayurvedic medicines.

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