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Review Article

THERAPEUTIC CATEGORIZATION AND PHYSICOCHEMICAL PROFILING OF PROPRIETARY AYURVEDIC HERBAL *LEHYAMS* AND GELS MARKETED IN INDIA

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ABSTRACT

Ayurvedic *Lehyams* and gels are widely marketed in India for therapeutic and cosmetic applications; however, the absence of defined physicochemical reference ranges for many proprietary formulations limit's objective quality assessment and regulatory comparability. This study evaluates the physicochemical characteristics of commercially available Ayurvedic *Lehyam* and gel formulations based on data generated during routine quality-control testing. Twelve *Lehyam* formulations and fourteen gel formulations were analyzed using established wet chemical and instrumental methods. Parameters evaluated included loss on drying (LOD), total solids, fat content, pH, ash values, water-soluble matter (WSM), alcohol-soluble matter (ASM), and acid-insoluble ash. Descriptive statistical analysis and box-plot visualization were used to characterize central tendency, dispersion, and outliers. *Lehyams* exhibited wide variability in LOD (2.21–62.54%; median 11.74%, mean 14.96%, SD 15.47) and total solids (4.96–35.00%; median 12.56%, mean 14.92%, SD 8.82). Fat content ranged from 0.22 to 15.07% (median 1.20%, mean 3.03%, SD 4.42), with higher values corresponding to lipid-enriched formulations. Gel formulations showed substantial variation in pH (3.08–8.28; median 4.97, mean 5.19, SD 1.29). Ash values were generally low (0.10–0.57%) except for one aloe-based gel (36.40%). WSM ranged from 0.04 to 36.40% (median 3.42%, mean 7.48%), while ASM ranged from 3.24 to 20.20% (median 6.82%, mean 9.31%). Acid-insoluble ash was below detection limits in all samples. Although these values cannot be considered pharmacopoeial specifications, the derived analytical ranges provide indicative reference windows to support routine quality control, regulatory oversight, and future standardization of proprietary Ayurvedic *Lehyams* and gels.

INTRODUCTION

Unlike allopathic pharmaceuticals, Ayurvedic formulations comprise complex matrices of plant-derived constituents whose chemical profiles are influenced by geographical origin, harvesting season, processing methods, and storage conditions. Although the Ayurvedic Formulary and Pharmacopoeia describe preparation methods and analytical tests, acceptable analytical ranges for many physicochemical parameters remain undefined. This absence of defined limits complicates quality evaluation and inter-laboratory comparison.

Conventional wet-chemistry techniques such as loss on drying, ash values, extractive values, titrimetric analysis, and gravimetric procedures remain highly relevant because of their simplicity, reproducibility, and cost-effectiveness. These methods are particularly suitable for routine evaluation of Ayurvedic drugs, which share analytical similarities with food and nutraceutical products.

The present study compiles and systematically analyzes long-term laboratory data obtained from routine testing of Ayurvedic *Lehyams* and gel formulations. By examining trends and variability across a large dataset, this work aims to propose approximate analytical ranges for commonly evaluated parameters, thereby contributing to future efforts in

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standardization and quality assurance of Ayurvedic medicines.

MATERIALS AND METHODS

Ayurvedic medicines are designed for both short- and long-term use. Semi-solid preparations such as *Avaleha/Lehyam* are preserved for extended periods. These formulations are prepared by combining jaggery, sugar, or sugar candy with the expressed juice or decoction of prescribed drugs, and may additionally contain ghee, oil, or honey.

Properly prepared *Avaleha/Lehyam* should:

- Be sufficiently thick to be lifted with a spoon.
- Exhibit thread formation when stretched between fingers.
- Sink in water without dissolving readily.
- Retain finger impressions upon gentle pressure.

These preparations are typically stored in inert glass, porcelain, or suitable metallic containers and are generally recommended for use within one year.

The formulations were evaluated for appearance, colour, odour, taste, and consistency, followed by physicochemical testing including loss on drying (105°C), total ash, acid-insoluble ash, pH, specific gravity (25°C), total solids, fat content, reducing sugars, total sugars, and chromatographic profiling (TLC/HPTLC) for active constituents.

RESULTS & DISCUSSION

Twelve *Lehyam* samples (Table 1) and fourteen gel samples (Table 2) were analysed; however, therapeutic categories were not uniformly stated on label claims.

***Lehyams*:** Loss on drying values ranged from 2.21 to 62.54%, reflecting differences in sugar, honey content, moisture retention, and thermal endpoint determination during manufacturing. Total solids showed moderate clustering between 5 to 35%, while fat content was generally low (<1 %), except in specific formulations intentionally containing lipid carriers.

Outlier values were observed in some cases and are likely attributable to formulation-specific choices rather than analytical error. Higher fat and sugar levels in *Lehyams* are expected due to the use of oils, jaggery, and sweetening agents.

Gel formulations: Including pain-relief gels, cosmetic gels, and aloe-based gels- exhibited substantial physicochemical variability.

- pH ranged from 3.08 to 8.28, with most samples clustering between 4.5 and 6.5, consistent with dermal compatibility. Face and cosmetic gels predominantly fall within the mildly acidic range. Aloe vera-based gels show wider variation, reflecting differences in buffering agents, preservatives, and processing conditions.
- Ash values were typically below 1%, except for one aloe-based gel displaying an exceptionally high ash content, possibly indicative of higher inorganic residue. Low ash values are characteristic of well-filtered, clear gel formulations and elevated ash values may indicate poorer raw-material processing or higher inorganic residue.
- Water-soluble matter ranged from trace levels to approximately 36%, while alcohol-soluble matter varied from 4 to 20%, highlighting heterogeneity in formulation practices and variable concentrations of alcohol-soluble phytoconstituents.
- Acid-insoluble ash was below detection limits in all samples, suggesting minimal contamination with siliceous matter and good raw-material hygiene.

Overall, the absence of uniform analytical behaviour among products with similar therapeutic intent underscores the need for indicative reference ranges rather than strict limits.

Ayurvedic formulations are generally considered safe when prepared and administered according to traditional guidelines; however, routine analytical monitoring is essential to ensure consistent quality and safety. The active ingredients in many of the above-mentioned formulations are also tested, as and when required, using standard methods.

Table 1: *Lehyams*- trends in analytical test parameters in Ayurvedic formulations

S.No	Name of the Formulations	LOD	T. Solids	Fat content
1	*Amrutha Lehyam*	13.13	17.50	0.35
2	*Tiryaq-e-Nazla*	14.34	9.20	0.60
3	*Gnanavardhini Lehyam*	12.20	10.50	0.22
4	*Turangh Lehyam*	16.29	35.00	3.60
5	*Jouhar-e-Khaas*	11.28	14.18	0.35
6	*Jouhar-e-Dimagh*	13.39	12.21	0.30
7	PCA Bolli Special *Lehyam*	5.46	16.00	7.84
8	Grovel *Saraswathi Lehyam*	2.21	12.90	0.40
9	Ayush Forte	62.54	29.00	15.07

10	*Vajrapursha*	9.91	4.96	1.90
11	*Amrita Bindadi Lehyam*	9.66	10.48	3.95
12	*Ramasanjeewi*	9.12	7.00	1.80

Table 2: Gels - trends in analytical test parameters in Ayurvedic compositions

S.No	Name of the Formulations	pH	Ash	WSM	ASM
1	Aloe vera gel	8.28	36.40	36.40	20.20
2	Dr.Rao's keshovin hair gel	5.07	0.57	12.67	19.40
3	Pain relief gel	6.42	0.69	26.18	8.39
4	Under eye gel	5.63	0.10	1.60	7.14
5	Hibiscus gel	6.27	0.19	7.40	18.88
6	Soft natural aloe vera gel	5.64	0.39	0.54	10.34
7	Safed natural - fair complexation gel	5.75	0.22	1.62	6.50
8	Koneri's Ayur lip care	4.86	0.51	1.74	14.06
9	Koneri’s nova care	3.08	0.24	0.04	3.96
10	Aloe gel	3.81	BDL	1.24	3.24
11	Shabnam's aloe vera gel	4.65	0.50	2.76	4.16
12	Shanam's aloevera with saffron	4.44	0.36	4.25	3.70
13	Shabnam's aloe vera gel with cucumber	4.54	0.23	4.14	4.00
14	Glint aloe gel	4.21	0.88	4.08	6.40

**Acid insoluble ash (AIA) for all samples is reported as BDL - below detection limit.

Statistical Evaluation

Descriptive statistical analysis was performed to characterize central tendency, dispersion, and outliers. Values reported as below detection limit (BDL) were excluded from statistical computations. Analysis emphasized exploratory trends rather than inferential testing, consistent with the objective of proposing approximate analytical ranges.

The Boxplot 1 for loss on drying in *Lehyam* formulations reveals a narrow central tendency with a few pronounced high-value outliers. These outliers correspond to formulations with higher moisture or sugar content, suggesting variability in manufacturing endpoints and storage stability.

Box-plot 2 representation of pH values across Ayurvedic gel formulations demonstrates a broad interquartile range, indicating substantial formulation-to-formulation variability. Median pH values lie within the mildly acidic region, appropriate for topical applications, while extreme values identify outliers that deviate from common formulation practices.

Box-plots 3 for water-soluble and alcohol-soluble matter illustrate unequal distribution and skewness in extractive values. The presence of long whiskers and multiple outliers reflects heterogeneity in the nature and concentration of extracted phytoconstituents used by different manufacturers.

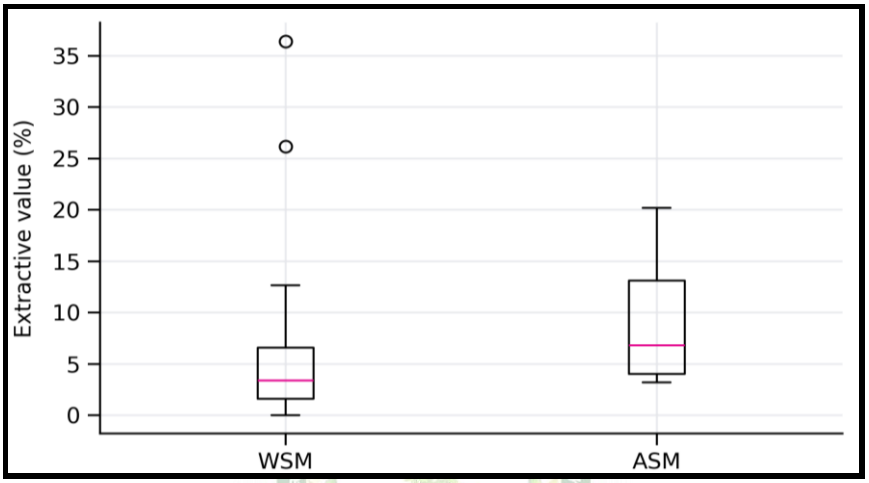
Continuous variables were summarized as sample size (n), minimum, first quartile (Q1), median, mean, third quartile (Q3), maximum, and standard deviation (SD).

Box-plots were generated to visualize the distribution of each parameter, including median, interquartile range (IQR), whiskers, and outliers, thereby supporting interpretation of heterogeneity and non-uniformity among products marketed under similar dosage forms. Values reported as below detection limit or missing entries (“-”) were treated as missing data and excluded from the computation of descriptive statistics and from box-plot calculations.

Boxplot 1 – Loss on drying distribution in *Lehyams*

Boxplot 2 - pH distribution in get formulations

Box-plot 3 - Extractive value distribution in gels



Formulation	Test Parameter	n	Min	Q1	Median	Mean	Q3	Max	SD
Lehyams	LOD	12	2.21	9.53	11.74	14.96	13.63	62.54	15.4728
Lehyams	TSolids	12	4.96	10.16	12.56	14.92	16.38	35.00	8.8170
Lehyams	Fat	12	0.22	0.35	1.20	3.03	3.69	15.07	4.4168
Gels	pH	14	3.08	4.47	4.97	5.19	5.72	8.28	1.2906
Gels	Ash	13	0.10	0.23	0.39	3.18	0.57	36.40	9.9852
Gels	WSM	14	0.04	1.61	3.42	7.48	6.61	36.40	10.7872
Gels	ASM	14	3.24	4.04	6.82	9.31	13.13	20.20	6.2585

Because the objective of this study was to propose approximate analytical ranges and to highlight inter-product variability rather than to test predefined hypotheses, the analysis emphasized descriptive statistics and exploratory visualization, rather than inferential statistical testing.

CONCLUSION

The analytical ranges reported in this study represent approximate reference windows derived from long-term routine laboratory testing of commercially marketed Ayurvedic *Lehyams* and gels. While these values cannot be interpreted as official standards, they may serve as a practical baseline for quality evaluation and for guiding future authenticated studies aimed at formal standardization.

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