

Comparative Quality Evaluation of Marketed Ayurvedic Churnas

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ABSTRACT

Background: Quality and therapeutic reliability of Ayurvedic Churna formulations, the traditional powdered dosage forms, depends on identity and purity of raw materials, processing conditions and consistency of the finished product. **Objective:** To evaluate some selected marketed Ayurvedic Churna formulations, TriphalaChurna (Sample A and Sample B) on the basis of pharmacognostical, phytochemical, physicochemical, physical, microbiological and thin-layer chromatographic parameters in a comparative manner. **Methods:** The samples were evaluated for organoleptic properties, powder-microscopic diagnostic characters of powder, preliminary phytochemical constituents, ash and extractive values, pH, bulk and tapped density, Carr's index, Hausner ratio, bacterial count and TLC fingerprints using three solvent systems. **Results:** Sample A was a light-brown, astringent, fine powder while sample B was dark brown, with a strong pungent odor and pungent taste. Microscopy revealed diagnostic structures peculiar to the formulation. Both the samples showed alkaloid reactions in some selected tests, tannins and carbohydrates while the reactions of their glycoside and cardiac-glycoside were varied. The ash values reported were 7.2% and 5.2%, pH values were 3.5 and 3.2, bulk densities were 0.55 and 0.50 and tapped densities were 1.4 and 1.8 for Samples A and B respectively. TLC Rf values were different consistently in all three solvent systems. **Conclusion:** Multiparametric evaluation enabled to differentiate the two commercialized Churna formulations and produce practical quality profiles. The results support the use of combined microscopy, physicochemical testing, phytochemical screening and chromatographic fingerprinting for routine quality control purposes. The high reported ash values and incomplete loss-on-drying data suggest the need for confirmatory repeat testing prior to specification setting.

Keywords: Ayurveda, Churna, TriphalaChurna, standardization, phytochemical screening, TLC, quality control

1. INTRODUCTION

Ayurveda uses different dosage forms like Churna, decoctions, tablets, fermented preparations and medicated ghee. Churna is a fine powder of dried medicinal materials, which can be either a single drug or a mixture of several herbs. Its ease of manufacture, ease of administration and large surface area have made it a continued favorite in traditional practice. [5,6,21]

The spread of commercial herbal medicines has made reproducible quality control increasingly important. Botanical source, geography, climate, harvesting stage, post-harvest treatment, processing

and storage may lead to variation of herbal materials. Polyherbal products bring more variability as the identity, proportion and uniform distribution of each ingredient may affect the final product. Standardization therefore demands complementary methods to address identity, purity, chemical composition and physical characteristics. [7,13]

TriphalaChurna is a classical formulation of Haritaki (*Terminalia chebula*), Bibhitaki (*Terminalia bellirica*) and Amalaki (*Emblica officinalis*). [2,3,5,6]

The present study was aimed to compare the different samples of marketed TriphalaChurna samples by using a practical battery of pharmacognostical and quality-control tests and to generate comparative profiles which may provide support for routine assessment of identity, purity and consistency. [15,16,19,20]

2. MATERIALS AND METHODS

2.1 Study samples

Two powder preparations of Ayurvedic medicine in the market were studied. Codenamed Sample A and Sample B. The preparations were analyzed as such and coded for all analyses.

2.2 Organoleptic evaluation

Color, odor, flavor, texture, and appearance were evaluated by sensory analysis and documented in descriptive terms. [7,10,13]

2.3 Powder microscopy

Microscopic analysis was done on powdered samples. The analysis considered pieces of tissues and cell inclusions that help in identification of constituents present in the mixture as crude drugs, including stone cells, fibers, vessels, starch grains, calcium oxalate crystals, oil cells, and secretory structures among others. [10, 11, 12]

2.4 Preliminary phytochemical screening

Tests to detect major groups of phytochemicals were conducted through qualitative chemical tests. Tests for the detection of alkaloids included Mayer's test, Dragendorff's test, Wagner's test, and Hager's test; flavonoids by alkaline and Shinoda test; tannins by lead acetate, bromine water, and acetic acid test; terpenoids and steroids by Salkowski test and Liebermann-Burchard test; glycosides by Keller-Killiani and Borntrager's test; cardiac glycosides by Legal test and Baljet test; and carbohydrates by Molisch test, Fehling's test, Benedict's, Seliwanoff's and Barfoed's tests. [9,10,12]

2.5 Physicochemical and physical evaluation

Total Ash, Acid Insoluble Ash, Water Soluble Ash, Water Soluble Extractive, Alcohol Soluble Extractive and pH were measured in the study. Properties of the powders were evaluated through bulk density, tapped density, Carr's Index and Hausner Ratio. The results are presented as presented in the source study. There were no numeric values in the loss on drying column in the study data set and thus the column has not been presented. [5,7,8,13]

2.6 Microbiological analysis

Total bacterial counts were determined as colony-forming units per mL (CFU/mL) for both commercially available preparations and incomparison to two standards/reference values from the study. [7,8]

2.7 Thin-layer chromatography

The comparative TLC profiling was performed with three mobile phases viz toluene:ethylacetate:formic acid (5:4:1), toluene:ethyl acetate (7:3) and ethyl acetate:formic acid:water (8:1:1). The retardation factor (R_f) values for Samples A and B were obtained.[14,17]

3. RESULTS

3.1 Organoleptic characteristics

The sensory characteristics easily differentiated the two formulations. Sample A was light brown in colour with characteristic odour and astringent taste while Sample B was dark brown with strong pungent odour and pungent taste. Both were fine, even powders.

Table 1. Organoleptic evaluation of marketed Churna samples

Parameter	Sample A	Sample B
Colour	Light brown	Dark brown
Odour	Characteristic	Strong, pungent
Taste	Astringent	Pungent
Texture	Fine powder	Fine powder
Appearance	Smooth	Smooth

3.2 Microscopic characteristics

Table 2. Powder-microscopic profile

Ingredients	Characters observed	Sample A	Sample B
Amalaki	Epidermal cells, parenchymatous cells, stone cells, sclereids, lignified fibres, vessels, calcium oxalate crystals, starch grains, tannin-containing cells	Lignified fibres, Calcium oxalate crystals, stone cells, starch grains, parenchymatous cells.	Stone cells, lignified fibres, vessels, calcium oxalate crystals, Starch grains.
Haritaki	Epidermal cells, stone cells, sclereids, fibres, fibre-sclereids, pitted vessels, reticulate vessels, parenchymatous cells, calcium oxalate crystals, tannin-containing cells	Fibres, Stone cells, reticulate vessels, Calcium oxalate crystals, parenchymatous cells, pitted vessels.	Fibres, pitted vessels, calcium oxalate crystals, stone cells.
Bibhitaki	Polygonal epidermal cells, stone cells, sclereids, lignified fibres, parenchymatous cells, pitted vessels, spiral vessels, reticulate vessels, calcium oxalate crystals, starch grains, tannin-containing cells	Lignified fibres, pitted vessels, starch grains, stone cells, calcium oxalate crystals, spiral vessels.	Stone cells, lignified fibres, pitted vessels, spiral vessels, calcium oxalate crystals, starch grains.

3.3 Phytochemical screening

The qualitative screening showed common and differentiating reactions. Both samples were positive in Mayer's and Hager's alkaloid tests and in lead acetate and bromine-water tests for tannins. Both were negative in the flavonoid tests and in the tested terpenoid/steroid reactions. Sample A showed a positive Keller–Killiani reaction, whereas Sample B showed positive Borntrager's, Legal and Baljet reactions. Carbohydrate reactions also varied between the samples.

Table 3. Preliminary phytochemical screening

Class	Test	Sample A	Sample B
Alkaloids	Mayer's	+	+
Alkaloids	Dragendorff's	–	+
Alkaloids	Wagner's	+	–
Alkaloids	Hager's	+	+
Flavonoids	Alkaline reagent	–	–
Flavonoids	Shinoda	–	–
Tannins	Lead acetate	+	+
Tannins	Bromine water	+	+
Tannins	Acetic acid	+	–
Terpenoids	Salkowski	–	–
Terpenoids	Liebermann–Burchard	–	–
Glycosides	Keller–Killiani	+	–
Glycosides	Borntrager's	–	+
Cardiac glycosides	Legal	–	+
Cardiac glycosides	Baljet	–	+
Carbohydrates	Molisch	+	+
Carbohydrates	Fehling's	+	–
Carbohydrates	Benedict's	–	+
Carbohydrates	Seliwanoff's	+	–
Carbohydrates	Barfoed's	–	–

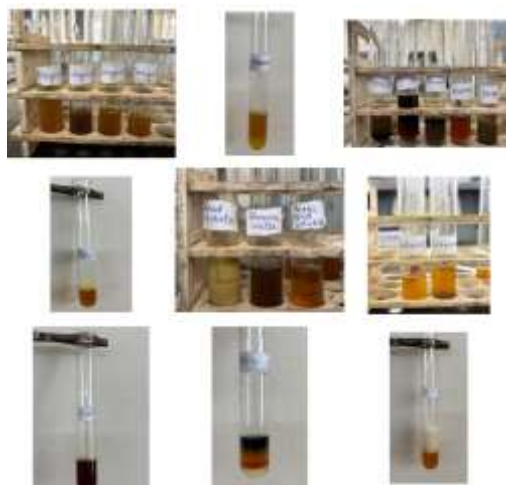


Figure no:1 phytochemical analysis of sample A

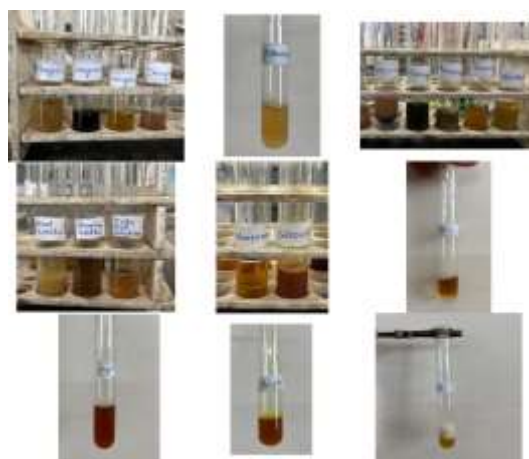


Figure no:2 phytochemical analysis of sample B

3.4 Physicochemical evaluation

The reported physicochemical values were significantly different among the formulations. Sample A had higher values for total ash, acid insoluble ash and water-soluble ash than Sample B. Sample B has more water-soluble extractive value and more alcohol soluble extractive value. The pH values reported were 3.5 for Sample A and 3.2 for Sample B.

Parameters	Standard	Sample A	Sample B
Total Ash	9.3%	7.2%	5.2%
Acid Insoluble ash	2.36%	3.16%	3.6%
Water Soluble ash	5.89%	4.14%	3.41%
Water Soluble Extractives	40.8%	35.1%	37.4%
Alcohol Soluble Extractive	19.2%	13.8%	16%
Loss on Drying	2.0%	2.25%	2.25%
Ph	3.40 ± 0.07	3.5	3.2

Table 4. Physicochemical evaluation

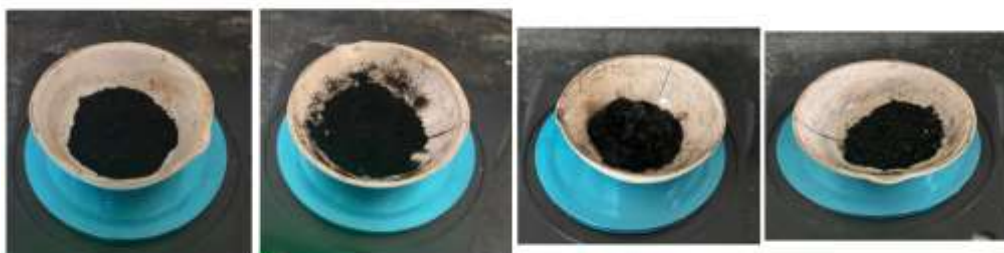


Figure no:3 total ash of sample A&B

Figure no:4 acid insoluble ash of sample A&B



Figure no:5 water soluble ash of sample A&B

Figure no:6 loss on drying of sample A&B

3.5 Powder-flow characteristics

Sample A and Sample B showed a bulk density of 0.55 and 0.50 respectively and tapped density of 1.4 and 1.8. The recorded Carr's indices and Hausner ratios were high for both formulations especially Sample B indicating marked compressibility / cohesiveness and poor flow under the conditions of the study.

Table 5. Physical evaluation of powder properties

Parameters	Standard	Sample A	Sample B
Bulk Density	0.434	0.55	0.5
Tapped Density	0.606	1.4	1.8
Carr's Index	27.88	60.7	72.2
Hausner Ratio	1.38	2.54	3.6


Figure no:7 bulk density of sample A&B
Figure no:8 tapped density of sample A&B

3.6 Microbiological findings

Total bacterial counts were 15 CFU/mL for Sample A and 250 CFU/mL for Sample B. Two standard/reference observations at 12 and 15 CFU/mL were also included in the study data set. As these entries were not specified as pharmacopeial acceptance limits in the source document, they are reported descriptively in this article and regulatory compliance is not inferred.

Table 6. Microbiological analysis

Analysis	Sample A	Sample B	Standard 1	Standard 2
Total bacterial count	15 CFU/mL	250 CFU/mL	12 CFU/mL	15 CFU/mL


Figure no:9 Microbial testing of sample A&B

3.7 TLC fingerprinting

The formulations were separated by TLC in all three solvent systems. Sample B had higher R_f values than Sample A in each mobile phase. The greatest absolute separation of the recorded R_f values was with toluene:ethyl acetate (7:3) where the values were 0.44 and 0.83 respectively.

Table 7. TLC analysis of marketed Churna samples

Mobile phase	Sample A R _f	Sample B R _f
Toluene:ethylacetate:formic	0.62	0.89

acid (5:4:1)		
Toluene:ethyl acetate (7:3)	0.44	0.83
Ethyl acetate:formic acid:water (8:1:1)	0.88	0.96



Figure no:10 Elution of Sample A&B by using Toluene: Ethyl acetate: Formic acid (5:4:1)



Figure no:11 Elution of sample A&B by using Toluene: Ethyl acetate (7:3)



Figure no:12 Elution of Sample A&B by using Ethyl acetate: Formic acid: Water (8:1:1)

4. DISCUSSION

The present comparison shows the advantage of using orthogonal quality control methods for polyherbal powders. Organoleptic examination allowed immediate differentiation between the two coded samples. You cannot authenticate by sensory examination alone, but it can be a useful first step in verifying identity and consistency. [1, 15, 16, 19, 20]

The structure was demonstrated by powder microscopy. Diagnostic microscopic features noted in the two coded samples provided useful comparative evidence for identity and consistency. Common features observed were fiber, vessels, starch and calcium oxalate crystals. This highlighted the significance of interpreting multiple diagnostic characters rather than a single feature. [10, 12]

The phytochemical results show similarities and differences between the formulations. Common reactions of tannins and selected alkaloids were observed. Glycoside and carbohydrate test patterns were different. Qualitative phytochemical reactions are screening tools not compound identification. Reagent specificity, extraction efficiency and matrix interference may affect results. Thus, the best use of these tests is as part of a wider fingerprint, not as definitive proof of chemical composition in isolation. [4, 9, 19]

Physicochemical analysis revealed significant variations in ash and extractive values. Ash parameters are informative indicators of inorganic residue and potential contamination or mineral contribution. The reported ash values, particularly 7.2% total ash for Sample A, are unusually high for a predominantly botanical powder and should be confirmed by replicate analysis, method review and comparison with applicable monographs prior to use as acceptance criteria. Comparison of the higher water-soluble extractive of Sample B and the higher alcohol-soluble extractive of Sample A provides indices of solvent-extractable constituents, but does not establish potency per se. [5, 7, 8, 13, 15, 16, 19, 20]

Physical evaluation reveals poor powder flow for both samples with the higher Carr's index and Hausner ratio for Sample B. Such behavior can influence handling, filling, packaging and dose uniformity. Further work should include investigation of particle size distribution, moisture content and electrostatic behavior as these factors have a strong influence on bulk and tapped density measurements. [13, 15]

The TLC data give a simple comparative chemical fingerprint. We would expect to see consistent differences in R_f values between Sample A and B because the formulations contain different ingredient sets. Toluene:ethyl acetate (7:3) gave the greatest numerical separation of the recorded principal spots of the systems tested and could be useful for rapid comparative profiling, although validation with reference markers, replicate plates and densitometric analysis would improve specificity and reproducibility. [14, 17]

Microbiological results should be interpreted cautiously. Sample B had a significantly higher bacterial count than Sample A in the study dataset. The document did not contain sufficient methodological detail or well defined pharmacopeial limits to arrive at a formal compliance conclusion. Future studies should report sampling mass, dilution scheme, medium, incubation conditions, replicate counts and validated acceptance criteria.[7,8]

5. LIMITATIONS

The study examined two formulations and thus does not establish trends in quality across the market. No numerical loss-on-drying results were included in the dataset. Quantitative measures were not reported with number of replicates, measures of dispersion and inferential statistics. The TLC analysis reported

Rf values without marker-compound co-chromatography or densitometric validation. The microbiological reference entries were not sufficiently defined to be interpreted for regulatory purposes.

6. CONCLUSION

A combination of organoleptic, microscopic, phytochemical, physicochemical, physical, microbiological and TLC approaches differentiated the two coded marketed Churna samples, yielding sample specific quality profiles. Powder microscopy and TLC were especially useful for identity-oriented comparison, while ash, extractive, pH and powder-flow parameters provided quantitative indices of product characteristics. The study suggests multiparametric standardization as a viable approach for routine quality control of Ayurvedic Churna formulations. Confirmatory replicate testing, validated chromatographic marker analysis, complete moisture determination and fully specified microbiological methods are recommended before formal product specifications or regulatory conclusions are drawn.[1, 7, 13, 15, 16, 19, 20]

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