Determination of Quality Characteristics of 'Nimba Arishta': A Comparative Analysis of Sri Lankan Brands

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Abstract

Ayurveda is an ancient system of medicine that has been used for thousands of years. It comprises a variety of medicines, including fermented forms such as Arishta (fermented decoctions). The therapeutic use of Arishta is determined by the properties of its ingredients and the method of preparation. Because of the differences in the ingredients used and the manufacturing process applied by different manufacturers, the physicochemical characteristics are susceptible to various changes. In the present study, different brands of Nimba Arishta, mainly made from Azadirachta indica (A, B, C, D, E and F) available in the market were thoroughly evaluated for their physicochemical parameters to establish an accepted procedure for standardisation of these Ayurvedic formulations. The physicochemical parameters such as pH, brix, refractive index, specific gravity, total dissolved solids, total ash content, acid insoluble ash and water soluble ash contents were evaluated. The results of the study were found within these ranges; pH 3.01(D) - 3.64(A), refractive index 1.3725 (A) - 1.4019(C), specific gravity 1.0684(A)- 1.0864(F), brix 25.06(A) - 41.00(C), total dissolved solids (g/mL) 0.1993(A) - 0.4107(C), total ash content (w/w%) 0.0971(D) – 0.1070(A), water soluble ash content (w/w%)(0.004(B) - 0.0899(F), acid insoluble ash content (w/w%) 0.0131(D) - F-0.0571(F). The results showed that the formulation of different brands of Nimba Arishta varies, highlighting the need for standardisation of Arishta.

Keywords: Arishta, Standardization, Nimba arishta, Physicochemical

I. INTRODUCTION

With the known negative impacts of synthetic products, there is a rising shift toward using herbal treatments for disease management. (Luqman et al., 2014). Ayurveda has a rich and ancient tradition of utilizing polyherbal drugs and formulations to address various health conditions. (Nandre et al., 2012). Ayurvedic practitioners have been utilizing fermentation techniques for centuries to enhance the effectiveness of medicines. Arishta are self-fermented ayurvedic medicines prepared by blending a decoction of various parts of different plants with sugar and bee honey. In most Arishta preparations, dried flowers of *Woodfordia fruticosa* L. Kurz (Lythraceae) known as 'malitha mal' in Sinhala are added as the fermentation initiator, in combined with dried plant parts collectively referred to as the 'Kalka'. Differences in preparation methods and ingredients for the same Arishtas result in variations in the quality parameters of the final product. Due to the differing production processes employed by various manufacturers, the organoleptic and physicochemical characteristics can show inconsistencies in quality parameters. Since plant materials are used, the content of the extracted ingredients may be varied depending on the identity, purity, quality and maturity level of the plant materials, their source of origin and on the fermentation process. If commercially available Nimba Arishtas differ considerably with regard to their physical and chemical composition, there's a problem with these products about their quality, safety and efficacy in providing expected outcomes. In Sri Lanka, all commercially available Arishtas are marketed under the traditional names listed in the Ayurvedic Pharmacopoeia. The presence of identical names for preparations from different manufacturing companies might lead to the assumption of uniformity among the products.

To enhance the therapeutic effectiveness of Ayurvedic herbs, it is crucial to ensure they comply with modern standards for identity, purity, safety, drug content, and both physical and biological properties. This can be accomplished through the use of scientific methods to evaluate

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and improve the quality of these herbs. (Patwardhan, 2005; Kulkarni et al., 2012a). In the absence of a well-established system for standardization and monitoring in the country, questions often arise regarding the quality, safety, and efficacy of these medicines.

In Ayurveda pharmacopoeia in Sri Lanka (1976), 32 Arishtas are described. Nimba Arishta is one such Arishta utilized in Sri Lanka to treat rashes and gout, purify the blood, and act as an anthelmintic. To investigate those variations, same type of Arishta, 'Nimba Arishta' produced from different manufacturers in Sri Lanka are analysed and compared by this study.

II. METHODOLOGY

Collection of samples - Sealed bottles of Nimba Arishta were randomly collected from six different manufacturers from the districts of Colombo and Kandy and they were kept at room temperature. Those samples were identified as A, B, C, D, E and F. Following analyses on the physicochemical properties of the samples were performed.

A. Determination of pH

pH was measured using the method described in The Ayurvedic Pharmacopoeia of India -2.4.24. A digital pH meter was calibrated using standard buffer solutions. The Arishta sample was thoroughly mixed to ensure homogeneity, and the pH value was measured with the calibrated pH meter (bench 700 series). The determination was performed at a temperature of 23°C.

B. Determination of Brix

The brix value (total soluble solids) of samples were measured using digital Abbe refractometer (Biobase BK-R2S).

C. Determination of refractive index

The Abbe refractometer (Biobase BK-R2S) was used to measure the refractive index at 23 ◦C according to the method outlined in Indian Pharmacopoeia-2018: 2.4.27.

D. Determination of specific gravity

Specific gravity was measured using the method described in Ayurvedic Pharmacopoeia of India - 2018 : 3.8. A thoroughly cleaned and dried calibrated pycnometer was selected. The temperature of the substance to be examined was adjusted to about 20◦C and the pycnometer was filled with it. The temperature of the filled pycnometer was adjusted to 25◦C. Any excess of the substance was removed and weighed. The tare weight of the pycnometer was subtracted from the filled weight of the pycnometer. The specific gravity was determined by dividing weight of the liquid contained in the pycnometer by the weight of water contained, both determined at 25◦C.

E. Determination of Total Dissolved Solids (TDS)

The method is given in the Indian Pharmacopoeia-2018 : 2.6.5

Method:

Empty weights of cleaned tared dishes were weighed and an accurate quantity of the arishta sample was measured, placed in a tared dish, evaporated at a low temperature as possible until the solvent is removed and heated on a water-bath until the residue is apparently dry. The dishes were transferred to an oven and dried to constant weight at 105°C. Again, the weight after drying (W2) was recorded and the percentage of solid content was calculated based on the following formula:

Total dissolved solids (w/v %) = (W3 – W1) / V x 100%

W1- weight of empty dish, W3- weight of residue, V – volume of the sample

F. Determination of total ash content

Ash contents of the Arishta samples were determined by wet ashing method - gravimetric principal, specified in Ayurvedic Pharmacopoeia of India – 2.2.3.

Method: Arishta sample (10.000 g. n=3) was accurately weighed into a previously cleaned and dried porcelain crucible, then heated over a water bath until all liquid had evaporated. The crucible was subsequently transferred to the muffle furnace set at 450 °C and incinerated until it was free of Black carbon particles, resulting in light grey ash. Afterward, the crucible was taken out of the furnace and allowed to cool in a desiccator. The weight of the crucible was recorded soon after it reached room temperature. The ashing, cooling and weighing processes were repeated until no further weight loss was observed. Ash content of the Arishta sample was calculated using the following equation.

Calculation:

Ash content (%) = $(W_1-W_2) / W_o$ x 100%

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Where, W_1- Weight of the crucible with residue after drying, W_2- Weight of the empty crucible, W_o- Weight of the sample.

G. Determination of Acid-Insoluble Ash

The method described in Ayurvedic Pharmacopoeia of India – 2.2.4 was followed.
The ash obtained was boiled for 5 minutes with 25.00 mL of dilute hydrochloric acid; the insoluble matter was collected on ashless filter paper, washed with hot water and ignited to a constant weight. The crucibles were then cooled in a desiccator and weighed. The percentage of acid insoluble ash was calculated.

H. Determination of Water-Soluble Ash

The method described in Ayurvedic Pharmacopoeia of India – 2.2.5 was followed. The ash obtained in Section 3.4.2.6 was boiled with 25.00 mL of water for 5 minutes. The resulting insoluble matter was filtered using an ashless filter paper, thoroughly washed with hot water, and then ignited for 15 minutes at a temperature not exceeding 450°C. The weight of the insoluble residue was subtracted from the total weight of the ash to determine the water-soluble ash. The percentage of water-soluble ash was then calculated accordingly.

III. RESULTS AND DISCUSSION

A. *Statistical analysis:*

The results are expressed as the mean ± standard deviation (SD) from three independent experiments. Statistical analysis was performed using one-way analysis of variance (ANOVA), followed by Tukey's test, with a significance level of $p < 0.05$. All analyses were conducted using Minitab software. (version- Minitab® 19.2020.1).

B. *Physicochemical properties of Nimba Arishta samples*

Results of all the physicochemical properties were statistically analyzed using one way ANOVA with 95% confidence level (α=0.05).

Two hypotheses were used for each parameter.

H_0 – All means are equal.

H_1 – Not all means are equal.

Decision rule: if p value < α, reject H_0

Data represented as mean values ± S.D. (n=3) Means that do not share a letter are significantly different.
According to the results of one-way ANOVA (Table 01), it can be concluded that there are significant differences among different brands of Nimba Arishta in terms of the pH value except the brands B, C, E and F. The observed pH values are found within the range of 3.01 and 3.64 which are acidic values. The acidic pH can help create an environment conducive to the growth of desired microorganisms and inhibit the growth of undesirable ones, thus helping to extend the shelf life of the Arishta. According to Chinky et al., 2021 this acidic pH range is an indicative of low bacterial count, while neutral or alkaline pH levels may suggest a higher level of contamination in the herbal preparation. The pH of Nimba Arishtas in a previous study ranged from 3.2 to 3.6 (Kroes et al., 1989), which slightly changes to the pH range observed in the present results.
These statistical findings suggest that there are variations in the brix values among the different Arishta brands, indicating differences in their composition or manufacturing processes. Only brands D and F are statistically similar in terms of brix and refractive index, while all the other brands are significantly different from each other. However, one common component of Arishta is sugar, which contributes to sweetness and acts as a source of fermentable carbohydrates for the fermentation process. It's important to note that the specific composition and concentration of soluble solids in Arishta can differ based on the individual recipe and the desired therapeutic effects. The concentration of soluble solids, including sugars, in Arishta can vary depending on factors such as the amount of sweetener added and the duration of fermentation. Those samples with higher brix values were found to contain lesser ethanol content due to the incomplete fermentation.
The refractive index can be influenced by the composition and concentration of solutes present in the sample. Here, the refractive index value is found within a narrow range of 1.37 and 1.40. The Tukey pairwise comparisons further elucidate the specific differences between the brands. Sample C exhibits a significantly higher refractive index compared to all other brands, indicating that it likely contains a different concentration of solutes or unique chemical components affecting its optical properties. In certain cases, the refractive index can be used as an indicator of quality or adulteration in beverages. Deviations from

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expected refractive index values may indicate the presence of contaminants, dilution, or improper manufacturing processes. The refractive index can serve as a quality control parameter for consistency in the production of Arishtas. Establishing a reference range of refractive index values for a specific decoction formulation can help identify any deviations or variations in subsequent batches, indicating potential issues in the fermentation process or ingredient quality.

The analysis of specific gravity among different brands of Nimba Arishta revealed significant differences in the means of specific gravity values. This implies that the specific gravity, which is a measure of the density of the liquid, varies significantly across the different brands.

Higher specific gravity values may indicate a higher concentration of dissolved substances or herbal extracts in the fermented decoction.

Table 01: Results of analyzed tests

Sample	pH	Brix%	Refractive index	Specific gravity	Total Dissolved Solids (g/mL)	Total ash content (w/w%)	Acid insoluble ash content (w/w%)	Water soluble ash content (w/w%)
A	3.64 ± 0.04^{a}	25.06 ± 0.15^{d}	1.3725 ± 0.0005^{e}	1.0684 ± 0.0004^{f}	0.1993 ± 0.0012^{e}	0.1070 ± 0.0014 ^{d}	0.0399 ± 0.0013 ^{a}	0.0580 ± 0.0113 ^{a,b}
B	3.11 ± 0.01^{b}	29.23 ± 0.25^{b}	1.3798 ± 0.0002^{c}	1.0965 ± 0.0005^{c}	0.2522 ± 0.0050^{c}	0.3378 ± 0.0455 ^{c}	0.0135 ± 0.0050 ^{a}	0.0040 ± 0.0028 ^{c}
C	3.10 ± 0.03^{b}	41.00 ± 0.50^{a}	1.4019 ± 0.0001^{a}	1.1632 ± 0.0005^{a}	0.4107 ± 0.0023 ^{a}	0.2709 ± 0.0005 ^{c}	0.0481 ± 0.0099 ^{a}	0.0878 ± 0.0108 ^{a}
D	3.01 ± 0.01^{c}	27.40 ± 0.40^{c}	1.3769 ± 0.0003^{d}	1.0894 ± 0.0004^{d}	0.2534 ± 0.0030 ^{c}	0.0971 ± 0.0045 ^{d}	0.0131 ± 0.0041 ^{a}	0.0444 ± 0.0076 ^{b}
E	3.14 ± 0.04^{b}	30.10 ± 0.10^{b}	1.3814 ± 0.0004^{b}	1.1048 ± 0.0007^{b}	0.2806 ± 0.0013 ^{b}	1.5548 ± 0.0011 ^{a}	0.0406 ± 0.0288 ^{a}	0.0280 ± 0.0113 ^{b,c}
F	3.07 ± 0.03^{b,c}	27.5 ± 0.50^{c}	1.3767 ± 0.0003^{d}	1.0864 ± 0.0004e	0.2387 ± 0.0042 ^{d}	0.9607 ± 0.0010 ^{b}	0.0571 ± 0.0306 ^{a}	0.0899 ± 0.0127 ^{a}

Sample C exhibits a significantly higher specific gravity compared to all other brands. This suggests that the specific gravity of Arishtas is influenced by factors such as the selection and proportions of herbs used, the fermentation process, and the manufacturing techniques employed by different brands.

The variations in TDS content suggest differences in the composition and processing methods among the brands. Additionally, water-soluble components like herbal extracts or secondary metabolites derived from the herbs used in the formulation such as organic acids, amino acids, soluble pectins, etc. may also contribute to the overall dissolved solids content of Arishta. Only brands D and B are statistically similar in terms of TDS, while all the other brands are significantly different from each other. Elevated levels of TDS may suggest the presence of contaminants such as minerals, salts, heavy metals, organic compounds, or other dissolved substances. Controlling and maintaining appropriate TDS levels can help enhance the sensory qualities and consumer acceptance of beverages.

High TDS levels can impact the solubility and precipitation of certain components, leading to sedimentation or changes in appearance over time. Monitoring and controlling TDS levels help

maintain the desired product stability and extend the shelf life of the beverage.

The significance of the total ash (%) parameter in the analysis of Arishta, lies in its ability to provide information about the mineral content of the product. Total ash refers to the inorganic residue left behind after the complete combustion of organic matter. Thus, the ash content serves as a

criterion for assessing the identity and purity of crude drugs.

The brands do not vary in terms of their acid insoluble ash content. The presence of only a little amount of acid insoluble ash in these Arishta samples indicates the absence of impurities resembling silica in the drug. Low acid insoluble ash content in all samples indicates high purity of the drugs with lesser contaminations during the manufacturing process.

The water-soluble ash content of a herbal drug is an indicator of the amount of inorganic substances present in the drug that are soluble in water. It provides information about the level of mineral matter present in the herbal drug. Thus, the water-soluble ash content helps assess the quality of the herbal drug by measuring the amount of these water-soluble inorganic content.

In this study, the determination of the acid value in Nimba Arishta was challenging due to the lack of standardized methods specifically tailored for Arishta formulations. A titrimetric method was described in literature in determining the acid value of sevaral Arishta types, adopted from the Indian and Ayurvedic Pharmacopoeias for crude drugs, which use acetic acid in the calculation to quantify the acid value. However, the applicability of these methods to Nimba Arishta is questionable as the main primary acids present in this Arishta, which could be identified through HPLC analysis may differ from acetic acid.

IV. CONCLUSION

The present investigation evaluated six different brands of ayurvedic commercial preparations of Nimba Arishta. Comparative studies on samples of various brands were done based on their physicochemical parameters.

The investigation showed that organoleptic and various physicochemical parameters such as pH, brix, specific gravity, refractive index, total ash, water soluble ash, total dissolved solid, etc. were found to be different in leading brands of Nimba Arishta. The study revealed that it may be due to the variations in the formulation or in the production process. But from a similar field study, it has been found that the standard method described in the ayurvedic pharmacopoeia for the preparation of Arishta was generally used throughout the country and no alternative method was identified for use. (Menike, 1995).

It can be concluded that the observed variations in the standardization parameters for evaluating commercially available polyherbal formulations may be attributed to several factors, such as the different ingredients used, sources of herbs or plants used, and their quantities. This study was done with the aim to understand the variations of these ayurvedic formulations to standardize them. The data evolved in this study will be highly valuable for routine quality control of Nimba Arishta. By implementing and embracing standardization and quality control mechanisms, the effectiveness and acceptance of these medications can be further enhanced.

Additionally, ensuring the quality and safety measures of these medicines can contribute to their increased efficacy and popularity.

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ABBREVIATIONS

Total Dissolved Solids (TDS)