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Sensory Attributes and Shelf Life Evaluation of an Instant Soup Powder Fortified with Moringa (*Moringa oleifera* Lam.) Leaves

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ABSTRACT

Micronutrient deficiencies cause severe health problems in Sri Lanka as well as in the global context. *Moringa oleifera* Lam. (Moringa) is a rich source of micro and macro nutrients. Present consumers seek convenience in food preparation. Therefore, a study was conducted to develop an instant vegetarian soup powder containing moringa dried leaf powder. Four moringa soup powder formulae with different moringa leaf powder contents (w/w) *viz.*, 12%, 16%, 20% and 22% were produced. A sensory evaluation was carried out to assess the consumer acceptance for colour, texture, taste, aroma, viscosity, overall acceptability and purchasing intention using a Nine Point Hedonic scale. The sensory attributes of the best treatment were compared with two locally available commercial instant vegetarian soup powders, M1 and M2. The formula with 12% moringa dried leaf powder showed the highest mean scores for all the sensory attributes and was significantly different from other treatments. It also recorded no significant differences in terms of sensory attributes, except for colour and aroma, when compared to M1 and M2. Further, the new soup formula scored higher mean scores, *albeit* non-significant, than M2 for texture, taste, aroma, overall acceptability and purchasing intention. The shelf life studies during a 12-month storage at ambient conditions (32±2°C, 56±2% RH) in polypropylene primary packages, with Kraft paper bags lined with polypropylene used as secondary package, showed no significant changes in pH (5.30 to 5.48) and moisture content (7.9 – 8.6%) while the microbial contamination was considerably lower (4.7×10^2 CFU g^{-1}) than the permitted limit.

Keywords: Dry leaf, *Moringa oleifera*, Sensory attributes, Soup powder, Vegetarian

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INTRODUCTION

Micronutrient deficiencies affect over 2 billion people around the world mainly due to poor access to healthy foods. It is also a major public health problem in Sri Lanka. Foods fortified with micronutrients can be used as a solution to meet the recommended daily intake of micro-nutrients as suggested by WHO (2007). Moringa (Drumstick; *Moringa oleifera* Lam.; Family Moringaceae) has been identified as one of the most assuring species in ameliorating

micronutrient malnutrition (Chadha *et al.*, 2011). It is also known as the miracle tree or the tree of life due to its uses, particularly with respect to nutrition and pharmacology. Moringa leaves have antibiotic, antitrypanosomal, hypotensive, anti-inflammatory, antiulcer, antispasmodic, hypoglycemic, analgesic and hypocholesterolemic properties owing to the presence of various phytochemicals. Its leaves stored in the dried powder form is suitable for consumption for up to 6 to 12 months absent of nutritional value deprivations and devoid of refrigeration (Fahey, 2005).

Moringa leaves are an inexpensive, sustainable source of protein and micronutrients which is amply available year round in Sri Lanka. Gram for gram comparison of moringa dried leaves have 10 times the vitamin A of carrots, 0.5 times the vitamin C of oranges, 17 times the calcium of milk, 15 times the potassium of bananas, 25 times the iron of spinach, and 9 times the protein in yoghurt (Fuglie, 2001). Present consumers seek convenience in food preparation and as a result the demand for instant food is rising. The popularity of dry soup mixes is increasing due to their ease in preparation, unique sensory attributes, flavour stability and prevention from oxidative and enzymatic spoilages, long shelf life, low transportation cost because of light weight, quick reconstitution ability, and year around availability (Krejčová *et al.*, 2007). Fresh as well as dried leaves of moringa could be used in the making of soups and porridges (Lockett *et al.*, 2000).

Vegetables are good sources of antioxidants, phytonutrients and fibres whereas red rice is a rich source of iron (Fe), zinc (Zn) and other minerals. Greengram is a relatively cheap source of minerals such as potassium (K), magnesium (Mg), calcium (Ca), phosphorus (P), and iron (Fe) which can fulfil significant dietary requirements in plant based diets of developing countries (Kavya *et al.*, 2014). Considering their nutritional value and local availability, red rice, greengram, carrot, pumpkin and oyster mushroom could be appropriate supplementary ingredients for a moringa-based soup powder in Sri Lanka.

Therefore, the present study was conducted to develop an instant vegetarian soup powder with added moringa dried leaf powder and evaluate its acceptability by the consumers. The product's sensory properties were also compared with those of locally available instant soup powders and the shelf life was assessed.

MATERIALS AND METHODS

Location

The study was carried out at the Faculty of Agriculture and Plantation Management, Wayamba University of Sri Lanka, Makandura and at HJS Condiments Limited, Biyagama, Sri Lanka from May to September 2017.

Raw Materials and Processing

Moringa leaves were collected from thefarmers in the Northern Province over inspection and testing. Red raw rice,

greengram, carrot, pumpkin, oyster mushroom, iodized salt, corn flour, cumin, coriander, pepper, and cinnamon were procured from the local market. Processed garlic powder was obtained from Ruhunu Foods (Pvt) Ltd., Kundasale, Sri Lanka. Two brands of locally available vegetarian instant soup powders (coded as M1 and M2) were taken for comparison of sensory attributes.

Moringa leaves were processed following the steps of: destalking, washing, drying of leaves in poly-tunnels for 4 days, grinding, UV treatment and sieving of leaf powder. Red raw rice and greengram were soaked in water (1:2 w/v) for 2 h and 4 h and steamed for 15 min and 30 min, respectively. Carrots were washed, peeled, sliced into 3 mm slices and blanched by immersing in boiling water (100°C) for 3 min and were immediately dipped in ice water for 2 min followed by draining. Pumpkins were washed, peeled, sliced, seeds removed and cut uniformly into 2.5 cm x 0.5 cm size slices. Then, the pieces were blanched for 1 min by immersing in boiling water followed by cooling under running water for 1 min and draining. Oyster mushrooms were cleaned, washed, dipped in potassium metabisulphite (KMS) solution (0.6 g KMS and 10 g citric acid/kg fresh mushroom, diluted in 1 L of potable water) for 15 min, drained and cut into small pieces. Then, the processed rice, greengram and vegetables were dehydrated in an industrial food dehydrator (Model ST-60MA, Leader Food Dryer, Kuroda Industry Co., Ltd, Japan) at 55°C for 6 - 8 h and ground into powders separately in a mixer grinder (Phillips HL 3294/C). Coriander and cumin seeds were washed, sun dried and ground into powder while cinnamon too was powdered. The powdered ingredients were immediately packed and sealed in Kraft paper bags lined with polypropylene.

Formulation of Soup Powder Mixtures

Four soup formulae (T1, T2, T3 and T4) were developed by analytically measuring and homogenously mixing ingredients where ratios between moringa leaf powder (MLP) and red rice powder were changed while keeping other ingredients constant (Table 1). The produced mixtures were packed in polypropylene bags where Kraft paper bags lined with polypropylene were used as secondary packaging.

For reconstitution, 10 g of soup powder was dissolved in 150 mL of potable water and boiled on a stove for 5 - 6 min while stirring that resulted in one cup (approximately 140 mL) of soup.

Sensory Evaluation

A sensory evaluation was carried out to find out the best treatment out of the 4 soup formulae using 30 panellists. The colour, texture, taste, aroma, viscosity, overall acceptability and purchasing intention were assessed using a nine-point Hedonic scale: 9-excellent, 7-slight defects, 5-neither like nor dislike, 3-more defects, 1-not acceptable.

Table 1. Composition of ingredients in different soup formulae

Ingredient	% Composition			
	T1	T2	T3	T4
Moringa	12.00	16.00	20.00	22.00
Red rice	19.44	15.44	11.44	9.44
Greengram	13.36	13.36	13.36	13.36
Carrot	16.56	16.56	16.56	16.56
Pumpkin	12.48	12.48	12.48	12.48
Mushroom	10.00	10.00	10.00	10.00
Garlic	4.00	4.00	4.00	4.00
Corn flour	2.00	2.00	2.00	2.00
Pepper	1.60	1.60	1.60	1.60
Salt	6.00	6.00	6.00	6.00
Coriander	1.04	1.04	1.04	1.04
Cumin	1.04	1.04	1.04	1.04
Cinnamon	0.48	0.48	0.48	0.48

Note: *T_1- Soup powder with 12% moringa leaf powder (MLP), T_2- Soup powder with 16% MLP, T_3- Soup powder with 20% MLP, T_4- Soup powder with 22% MLP.*

Sensory Evaluation of Newly Developed Soup Powder with 2 Commercial Soup Powders

A Hedonic test on a nine-point scale was conducted to determine the consumers' preference with respect to sensory attributes of colour, texture, taste, aroma, viscosity, overall acceptability and purchasing intention for the newly developed soup powder and 2 commercially available soup powders (M1 and M2) using 25 panellists.

Shelf Life Evaluation

Samples of the best treatment were stored under ambient temperature (32±2°C) and 56±2% RH for further analyses. The pH and moisture content were measured at 30-days intervals for a period of 12 months. The microbial count was measured in fresh samples and thereafter at monthly intervals for 12 months, using the Total Plate Count Technique, Dilution Pour Plate technique, and Enumeration of *Escherichia coli* and Coliform Bacteria methods as described in the Bacteriological Analytical Manual (1998).

Data Analysis

Data from sensory evaluations were analysed by non-parametric Wilcoxon Rank Sum test and Kruskal-Wallis test using SAS (Version 9.4).

RESULTS AND DISCUSSION

Sensory Evaluation of Soup Formulae Containing Varying Levels of Moringa Leaf Powder

There were significant differences (p<0.05) in colour, texture, taste, aroma, viscosity, overall acceptability and purchasing intention among the four soup powder formulae (Figure 1). All four formulae obtained mean scores of 5.0 or above for all the sensory attributes. The highest mean scores for all sensory attributes were recorded by T1 which had 12% dried MLP. The second highest mean scores were recorded by T2 which contained 16% MLP. There were significant differences (p<0.05) in texture, taste, aroma, overall acceptability and purchasing intention between T1 and T2. The soup powder made with 22% MLP (T4) recorded the lowest mean scores for all the sensory attributes.

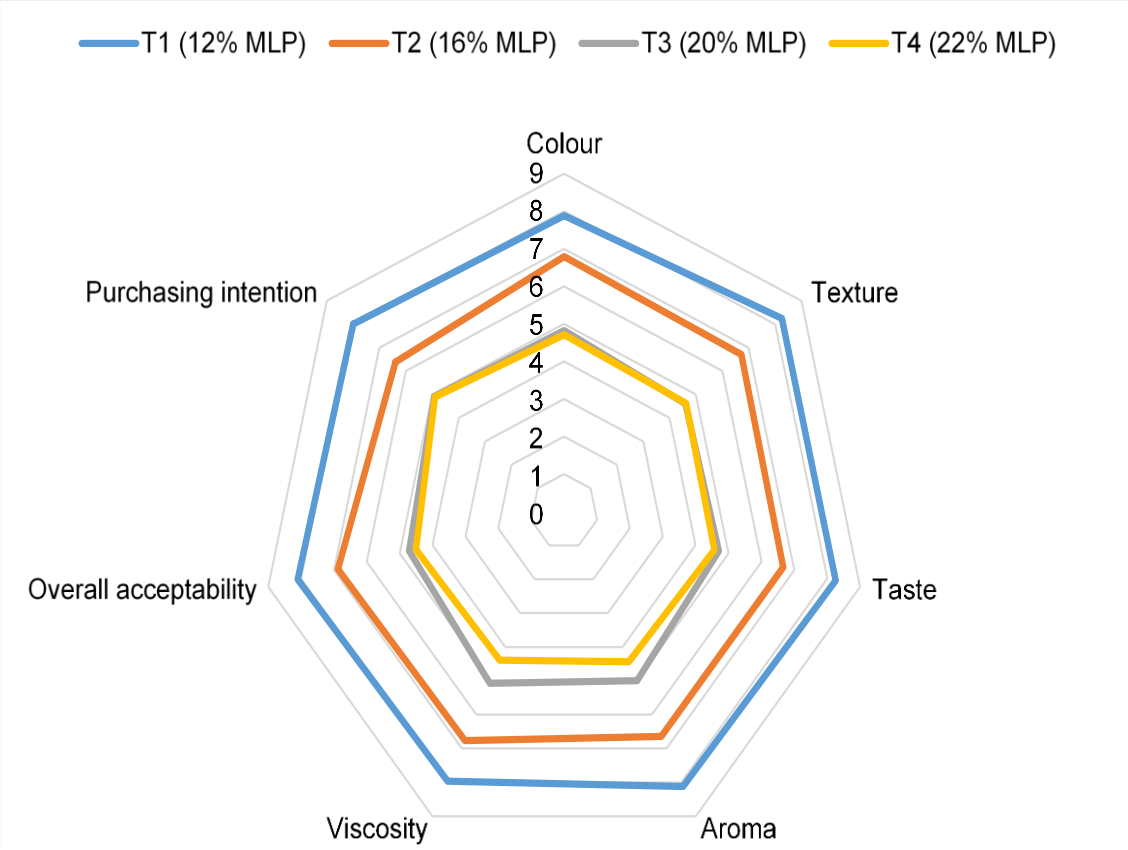
These variations in preferences could be a result of astringency caused by the tannins in *M. oleifera* leaves (Dahiru *et al*., 2006).

Sensory Evaluation of 12% Moringa Leaf Containing Soup Powder with Two Commercial Soup Powders

Sensory attributes of the new soup powder formulation was compared with two commercial vegetarian soup powder mixes in the market. The results revealed that there were no significant differences (p>0.05) among the newly produced 12% moringa leaf incorporated soup powder and the two commercial soup powders with respect to the sensory attributes of texture, taste, viscosity, overall acceptability and purchasing intention except for colour and aroma (Figure 2). Nevertheless, mean scores obtained by the newly formulated soup powder were higher than M2 with respect to texture, taste, aroma, overall acceptability and purchasing intention. The 12% moringa leaf incorporated soup powder also obtained mean scores of ≥ 5.0 for all the sensory attributes.

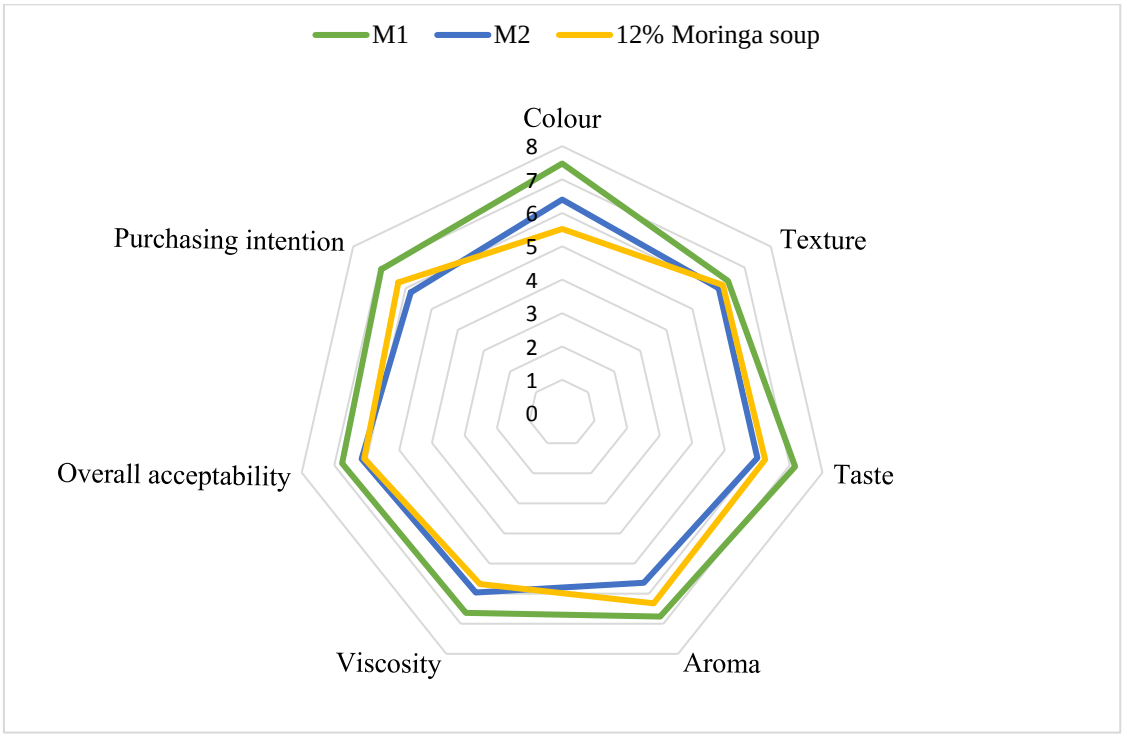
Shelf Life of 12% Moringa Incorporated Soup Powder

Variation in pH and moisture content of the ambient-stored instant soup powder formulation was recorded for a period of



Scale: 9- Excellent, 1- Not acceptable. MLP-Moringa leaf powder

Figure 1. Mean scores obtained for the sensory attributes of four soup formulae



M1 and M2: two commercial instant vegetarian soup powders

Figure 2. Mean scores obtained for the sensory attributes of 12% moringa leaf incorporated soup powder and two commercial soup powders.

year and the results are depicted in Figure 3. Although there was a slight increase in pH and moisture with time, the moisture level recorded after a 12-month storage period was 8.63%. Moisture content less than 10% is considered as favourable for the keeping quality of soup powders (El Wakeel, 2007). Moreover, a majority of instant soup powder formulations in the market have a shelf life of 6 – 10 months (less than 1 year).

The microbial counts recorded in the fresh soup powder formulation was 2.0×10^2 CFU g^{-1} (Table 2). After 12 months of storage at ambient temperature, a count of 4.7×10^2 CFU g^{-1} was recorded. To comply with food industry standards, the maximum total plate count for dry soup powders at 35°C is 10^6 CFU g^{-1} and the observed counts were considerably lower than the maximum allowable limit. Yeast, mould and coliform were not detected during the 12 months storage period.

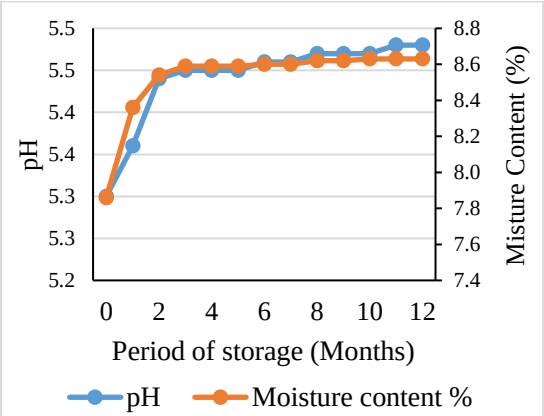


Figure 3. Change of moisture content and pH of 12% moringa leaf incorporated soup powder during storage period.

Table 2. Microbial growth (total plate count; TPC) in 12% moringa leaf incorporated soup powder mix during 12 months storage period under ambient conditions

Period of storage (Months)	Microbial growth (CFU g^{-1})
0 (Fresh sample)	2.0×10^2
1	2.4×10^2
2	3.2×10^2
3	4.0×10^2
4	4.0×10^2
5	4.2×10^2
6	4.3×10^2
7	4.5×10^2
8	4.5×10^2
9	4.6×10^2
10	4.6×10^2
11	4.6×10^2
12	4.7×10^2

CONCLUSION

The powdered soup formula with 12% moringa dried leaf powder was well accepted in terms of its sensory attributes including colour, texture, taste, aroma, viscosity, overall acceptability and purchasing intention. Moreover, the new formulation was equally preferred, except for colour when compared with two commercial products. Further, the product can be stored at ambient temperature (32±2°C) without significant quality deterioration up to 12 months.

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