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Nutritional analysis and sensory evaluation of food products enriched with *Moringa oleifera* leaves

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Abstract

The present study was primarily undertaken on *Moringa oleifera* Leaves which are commonly referred to as drumstick. These are important food commodity which has enormous attention as the natural nutrition of the tropics. The leaves, seeds and flower of *Moringa oleifera* all have great nutritional and therapeutic value. Moreover consumption is very less due to lack of knowledge and awareness. Therefore, the effort was made to develop food products. Two commonly consumed food products namely Laddu and Mathri were developed which was incorporated at 5gm, 10gm and 15gm levels of *Moringa oleifera* leaves powder. All the samples of the *Moringa* powder enriched Food products were evaluated for its sensory attributes by using 9-point hedonic scale and nutritional analysis of the product was carried out by using ICMR table of Indian food. The products incorporating with 5gm of *Moringa oleifera* was found most acceptable by the panel members and the result of the Nutritive value indicated that *Moringa oleifera* leaves had appreciable amount of Protein, Energy and calcium. Therefore, it can be concluded that products developed from enrichment of *Moringa oleifera* has acceptable sensory attributes and improved nutritional content.

Keywords: *Moringa oleifera*, therapeutic, knowledge, awareness, incorporated

Introduction

The rising number of the urban population has increased the demand for products and services associated with fast-paced city living, particularly products which are convenient and time-saving. Laddu & Mathri are one of the most widely accepted processed convenience food. These products are cooked food that is small, circle, flat and sweet. It usually contains flour, sugar and some type of oil or fat. Laddu & Mathri are important sources of carbohydrates, vegetable proteins and some vitamins and minerals. The nutritive value of Laddu & Mathri can be enhanced by enrichment with a wide variety of proteins, vitamins and minerals sources. They offer a valuable vehicle of enrichment with nutrients because of their popularity, relatively low cost, varied taste and ease of availability, high nutrient density, and long shelf-life ^[1].

Moringa oleifera commonly referred to as the drumstick or Ben oil is known for its resistance to drought and diseases and is a tree native to India, but has been planted and naturalized in many other parts of the world, including Nigeria in Africa. It contains 13 species from tropical and subtropical climate that ranges in size from tiny herbs to massive trees. *Moringa oleifera* is the best known of the 13(thirteen) species of the genus *moringacea* ^[2]. *Moringa oleifera* is also known by many other common names. In Philippines, where the leaves are cooked and fed to babies, it is called 'mother's best friend' or 'mallungay'. Other names include benzolive tree in Haiti, horse radish tree in Florida and 'nebeday', which means "never die" in Senegal ^[3]. In Nigeria, it is known as 'Zogale' in Hausa, 'Okwe Oyibo' in Igbo, 'Ewe Ile' in Yoruba and 'Jeghel-agede' in Tiv.

It is an important food commodity which has had enormous attention as the 'natural nutrition of the tropics'. The leaves, seeds and flowers of *Moringa oleifera* all have great nutritional and therapeutic value ^[4]. The seeds are eaten like peas or roasted like nuts when still green; the dry seeds are apparently not used for human consumption, perhaps because the bitter coating becomes hardened while the flowers are eaten when cooked and taste like mushrooms. The leaves are outstanding as a source of vitamins A, B group and C when raw and are among the best sources of minerals. They are also excellent sources of protein, but poor sources of carbohydrate and fat. *Moringa* leaves are one of the best plant foods available in nature.

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The leaves can be cooked and eaten as a vegetable –like spinach. More often, they are dried and ground into flour and used in soups and sauces. They are especially beneficial in the treatment of many ailments, due to their various medicinal properties and rich iron content.

In Africa, nursing mothers have been shown to produce much more milk when they add *Moringa* leaves to their diet. Severely malnourished children were reported to have made significant weight gains when care givers add the leaves to their diet to increase its nutritional content [2,7].

Moringa oleifera is esteemed as a versatile plant due to its multiple uses. Its leaves are good source of protein, vitamins A, B and C and minerals such as calcium and iron. *Moringa* leaves are more potent in nutritional values. Its vitamin C content is seven times more than that of oranges, it has thirteen times more vitamin than spinach and is on a lead on its own when it comes to amino acid, 2,000 times more than green tea and 242 times more than apples. The leaves are sources of the sulphur containing amino acid such as methionine and cysteine which are often in short supply in most legumes. It is also a good source of good cholesterol, high density lipoprotein which in high levels is known to protect against cardiovascular disease. Breast feeding mothers can also greatly benefit from fresh *Moringa* leaves as they are known to increase the volume of milk. *Moringa* leaves are completely safe for consumption because they have no known negative side effect, nor toxic elements. For centuries, people in many countries have used *Moringa* leaves as traditional medicine for common ailments. They are traditionally used for the cure of asthma, catarrh, chest congestion, cholera, conjunctivitis, cough, diarrhea, eye and ear infections, fever, headaches, abnormal blood pressure, scurvy, semen deficiency, sore throat, tuberculosis etc. *Moringa* is said to cure about 300 diseases and almost have all the vitamins found in fruits and vegetables. *Moringa* is considered to be the most nutritious, rich plant on earth. *Moringa* leaves have been consumed by Asian people for millennia as healthy food products. Containing more than 90 nutrients and 46 anti-oxidants, these vivid green leaves are natural super -power food. *Moringa* was highly valued and Egyptians extracted edible perfume and skin lotion. In the 19th century, plantation of *Moringa* in the West Indies

exported the oil to Europe for perfumes and lubricants for machinery [6].

Keeping all these report in view, an attempt was made to develop nutrient-rich *Moringa* leaves Laddu & Mathri and determine its nutritional content and sensory attributes.

Methods and Materials

The present study was carried out to analyze Nutritional and Sensory Attributes of Laddu and Mathri Enriched with *Moringa oleifera* Leaves powder. The fresh *Moringa* leaves were separated from the stalks of the ties; it was then removed from the leaf petal by hand and then the leaves were placed on a bag spread on a laboratory table for drying. Then the *Moringa* leaves were dried under a room temperature for 16 days. The leaves were turned over several times with hand to improve uniform drying at room temperature. After that milling the dried leaves were milled using a stainless steel harmer's mill. After milling, it was sieved to get the *Moringa* flour or powder and then nutritive food products were made and sensory evaluation was done by panel members in the laboratory of department of Home Science, Pushp Institute of Science & Higher Studies Pilibhit.

The whole methodology was divided into five phase;

- **Phase I:** Collection of raw material
- **Phase II:** Formulation of food products
- **Phase III:** Sensory evaluation by using 9 point hedonic scale
- **Phase IV:** Nutritional analysis of most accepted products and comparison with the standard food products
- **Phase V:** Statistical Analysis and report writing

Collection of raw material

The study was done on the *Moringa* leaves to popularize their health benefits. The different raw material was collected from the local market, Pilibhit (U.P.) District. After that the *Moringa* leaves were processed for further investigations and other raw material required for the study was purchase from local market and then analysis was done in the Food Laboratory of Department of Home Science, Pushp Institute of Sciences & Higher Studies Pilibhit.



Plate 1: Collection of raw material

Formulation of food products

Processing of Leaves

The fresh *Moringa* leaves were separated from the stalks of the ties; it was then removed from the leaf petal by hand. The leaves were placed on a bag spread on a laboratory table for drying. Then the *Moringa* leaves were dried under a room temperature for 16 days. The leaves were turned

over several times with hand to improve uniform drying at room temperature. After that milling the dried leaves were milled using a stainless steel harmer's mill. After milling, it was sieved to get the *Moringa* flour or powder and then three blends of *Moringa* powder used in different ratios such as in variant-1(5gm), variant-2(10gm), variant-3(15gm) for Laddu & Mathri preparations.

Development of supplementary food products

Supplementary food products were developed by incorporating *Moringa* leaves powder in primary ingredient at 5gm, 10gm and 15gm level for Laddu & Mathri in the Food Laboratory of Food and Nutrition, Department of Home Science, Pushp Institute of Sciences & Higher Studies, Pilibhit.

Laddu

Semolina flour (180gm) was roasted with ghee (120gm) on

a low flame for 10 minutes. Roast Cashew (120gm) and almonds (120gm) separately. Now jaggery (120gm) was crushed and made into syrup with addition of water by heating and jaggery syrup was added in roasted semolina flour after cooling it at room temperature. Add nuts in the mixture. The mixture was divided into 6 equal portions by weight. Then add *Moringa* leaves powder in different ratio such as 5gm, 10gm and 15gm in 3 equal portions and turned it into small balls with the help of palm (Pant, 2011).



Plate 2: Development of *Moringa* leaves flour Laddu

Mathri

Mathri is a Rajasthan snack. It is a kind of flaky biscuit from north-west region of India. It is made of refined flour, water, ghee, salt and cumin seeds. Take refined flour (180gm), salt, cumin seeds (optional) in a bowl, mix well, and then add ghee (120gm), mix it by rubbing between thumb and fingers till everything is incorporated well. This mixture was divided into 6 equal portions by weight. Add *Moringa* leaves powder in different ratio such as 5gm, 10gm and 15gm in 3 equal portions. Make tight and stiff dough by

adding very little water at a time. Cover the dough and let it rest for 15 minutes. Take a medium size ball from the dough and flatten out using your palm. Start rolling it into a big circle using the rolling pin. Now using any circle cap and cut the small Mathri. You can use the knife to put the liner holes on Mathri. Heat 500 ml oil in the kadhai and drop the Mathri. Fry on the low medium flame from both sides till it becomes golden brown and crispy. Take out in the absorbent paper to remove excess oil from the Mathri.



Plate 3: Development of *Moringa* leaves flour Mathri

Standardization of products

The selected preparations viz. Laddu and Mathri were standardized in the laboratory for their portion size, cooking characteristics and organoleptic characteristics. Leaf powder was incorporated at 5gm, 10gm and 15gm level. Ingredients used in the preparations were carefully balanced along with a procedure by repeated trial to obtain standard product.

Sensory evaluation by using 9 point hedonic scale

Moringa oleifera leaves flour products were served to the selected group of 30 panel members for evaluation of their sensory attributes. Organoleptic evaluation of *Moringa oleifera* leaves flour enriched products was done using 9 point hedonic scale (table 1).

Table 1: Hedonic scale for organoleptic evaluation

Quality description	Score
Liked extremely	9
Liked very much	8
Liked moderately	7
Liked slightly	6
Neither liked nor disliked	5
Dislike slightly	4
Dislike moderately	3
Dislike very much	2
Dislike extremely	1

Nutritional analysis of food products

Nutritional analysis was done by using food value Table of ICMR.

Statistical analysis of food products

The data was collected and presented in results Average nutritional and sensory scores values of the enriched Laddu and Mathri were statistically analyzed by using mean and standard deviation.

Result and discussion

The food products (*Moringa* leaves powder based nutritious Laddu and Mathri) were subjected to sensory evaluation to check their acceptability. The results of the study have been discussed under the following heads;

Sensory evaluation of products developed incorporating with *Moringa* leaves Powder

Nutritive value of accepted food products

Comparison of food products with standard food products

Sensory evaluation of products developed incorporating with *Moringa* leaves flour

Laddu

The perusal of the data (Table No. 2) showed that best score was obtained by variant-I (5gm) for all organoleptic attributes. A decrease trend was observed in scores of appearance, colour, taste, flavour and texture in laddu with the increase in *Moringa* flour. Variant-I (5gm) laddu was more liked by the panelists than other variants. Variant-I achieved the highest scores for appearance (6.96 ± 0.65), colour (7.4 ± 0.48), taste (7.26 ± 0.62), flavour (7.4 ± 0.66) and texture (6.8 ± 0.66) while Variant-III was given the least scores. The mean scores for overall acceptability were found to be highest (7.16 ± 0.61) for variant-I followed by variant-II (5.75 ± 0.66) and variant-III (4.28 ± 0.40).

Table 2: Sensory acceptability scores of *Moringa* leaves flour Laddu

Attributes <i>Moringa</i> powder (Laddu)	Variant-I (5gm)	Variant-II (10gm)	Variant-III (15gm)
Colour	7.4 ± 0.48	6.13 ± 0.88	4.5 ± 0.5
Taste	7.26 ± 0.62	6.1 ± 0.94	4.2 ± 0.07
Texture	6.8 ± 0.66	5.3 ± 0.73	4.5 ± 0.5
Appearance	6.96 ± 0.65	6.06 ± 6.06	4.03 ± 0.70
Flavour	7.4 ± 0.66	5.2 ± 0.73	4.2 ± 0.7
Over all	7.16 ± 0.61	5.75 ± 0.66	4.28 ± 0.40

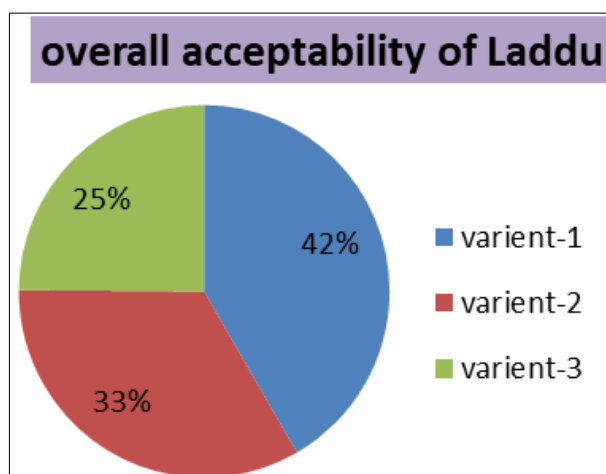


Fig 1: Overall acceptability of *Moringa* leaves flour Laddu

3.1.2 Mathri

The scores of organoleptic attributes decreased with increase in *Moringa* flour (Table No.3). The mean scores obtained from sensory evaluation showed that Variant-I was accepted by the judges. The data illustrated in the Table No.3 showed that average sensory scores of different

parameters in the product clearly indicates that variant-I has got the highest score for colour (8.03 ± 0.70), appearance (7.83 ± 0.63), flavour (8.03 ± 0.62), texture (7.73 ± 0.72) and taste (7.86 ± 0.66) and overall acceptability (7.89 ± 0.68) followed by variant-I and Variant-III. Variant-III was given the least scores. Hence it can be concluded that as variant-I

has got maximum score for all the parameters of sensory evaluation, thus it was selected for making nutritional

Mathri for the invention.

Table 3: Sensory acceptability scores of *Moringa* leaves flour Mathri

Attributes <i>Moringa</i> powder (Mathri)	Variant-I (5gm)	Variant-II (10gm)	Variant-III (15gm)
Colour	8.03 ± 0.70	6.4 ± 0.66	4.5 ± 0.5
Taste	7.86 ± 0.66	5.73 ± 0.62	4.03 ± 0.70
Texture	7.73 ± 0.72	5.93 ± 0.67	3.73 ± 0.67
Appearance	7.83 ± 0.63	5.93 ± 0.67	3.9 ± 0.7
Flavour	8.03±0.72	5.76±0.56	4.5±0.8
Over all	7.89±0.68	5.95±0.63	4.13±0.67

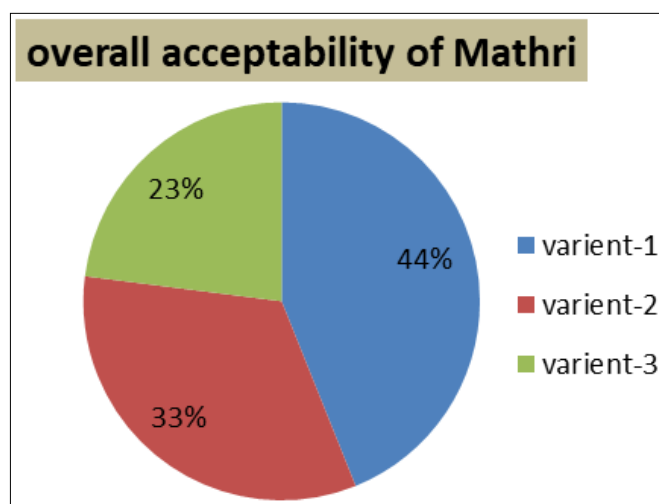


Fig 2: Overall acceptability of *Moringa* leaves flour Mathri

Nutritive value of accepted food products

The value of Nutritional Laddu and Mathri in show in Table No. 4 and Table No. 5

Nutritive value of accepted Laddu

Data shown in Table No. 4 showed that the calculative

Nutritive value of Energy, Protein, Fat, Iron and Calcium by using value from Food composition table of ICMR result revealed that calculative value in *Moringa* leaves flour accepted Laddu was Energy (603kcal), Protein (11.93gm), Fat (41.56gm), Iron (91.61mg) and Calcium (75.98mg).

Table 4: Nutritive value of accepted Laddu

Name of Product	Ingredients	Amount (gm)	Energy (kcal)	Protein (gm)	Fat (gm)	Iron (mg)	Calcium (mg)
<i>Moringa</i> powder laddu (Variant-I)	<i>Moringa</i> flour	5	4.6	0.33	0.08	0.04	3.5
	Jaggery	20	63.8	0.08	0.08	58.8	16
	Almond	20	131	4.16	11.78	1.01	46
	Cashew	20	119.2	4.24	9.38	1.16	10
	Semolina	30	104.4	3.12	0.24	30.6	0.48
	Ghee	20	180	-	20	-	-
	Total	115	603	11.93	41.56	91.61	75.98

Nutritive value of accepted Mathri

Data shown in Table No. 5 showed that the calculative Nutritive value of Energy, Protein, Fat, Iron and Calcium by using value from Food composition table of ICMR result

revealed that calculative value in *Moringa* leaves flour accepted Mathri (55gm) was Energy (323.8kcal), Protein (5.17gm), Fat (20.76gm), Iron (0.4mg) and Calcium (145.5mg).

Table 5: Nutritive value of accepted Mathri

Name of Product	Ingredients	Amount (gm)	Energy (kcal)	Protein (gm)	Fat (gm)	Iron (mg)	Calcium (mg)
<i>Moringa</i> powder Mathri (Variant-I)	<i>Moringa</i> flour	5	4.6	0.33	0.08	0.04	3.5
	Refined flour	30	139.2	4.84	0.68	0.36	142
	Ghee	20	180	-	20	-	-
	Total	55	323.8	5.17	20.76	0.4	145.5

Comparison of food products with standard food products

Comparison of Laddu with standard Laddu

It can be seen from the **Table No.6** that the incorporation of *Moringa* leaves flour and standard in which *Moringa* Laddu has increased the nutritional value from the standard such as

Energy (348kcal to 603kcal), Protein (3.2gm to 11.93gm), Fat (20.32gm to 41.56gm), Iron (89.4mg to 91.61mg) and Calcium (16.48mg to 75.98mg). When comparison between Standard Laddu and *Moringa* Laddu is done then results depict that *Moringa* Laddu were more nutritious than standard laddu.

Table 6: Comparison of Laddu with standard Laddu

Name of Product	Ingredients	Amount (gm)	Energy (kcal)	Protein (gm)	Fat (gm)	Iron (mg)	Calcium (mg)
Standard laddu	Semolina	30	104.4	3.12	0.24	30.6	0.48
	Jaggery	30	63.8	0.08	0.08	58.8	16
	Ghee	20	180	-	20	-	-
	Total	80	348	3.2	20.32	89.4	16.48
<i>Moringa</i> powder Laddu (Variant-I)	<i>Moringa</i> flour	5	4.6	0.33	0.08	0.04	3.5
	Jaggery	20	63.8	0.08	0.08	58.8	16
	Almond	20	131	4.16	11.78	1.01	46
	Cashew	20	119.2	4.24	9.38	1.16	10
	Semolina	30	104.4	3.12	0.24	30.6	0.48
	Ghee	20	180	-	20	-	-
	Total	115	603	11.93	41.56	91.61	75.98

Comparison of Mathri with standard Mathri

It can be seen from the **Table No.7** that the incorporation of *Moringa* leaves flour and standard in which *Moringa* Mathri has increased the nutritional value from the standard such as Energy (319.2kcal to 323.8kcal), Protein (4.84 to 5.16gm),

Fat (20.68gm to 20.76gm), Iron (0.36 to 0.76mg) and Calcium (142mg to 145.5mg). When comparison between standard Mathri and *Moringa* Mathri is done then results depict that *Moringa* Mathri were more nutritious than standard

Table 7: Comparison of Mathri with standard Mathri

Name of Product	Ingredients	Amount (gm)	Energy (kcal)	Protein (gm)	Fat (gm)	Iron (mg)	Calcium (mg)
Standard Mathri	Refined flour	30	139.2	4.84	0.68	0.36	142
	Ghee	20	180	-	20	-	-
	Total	50	319.2	4.84	20.68	0.36	142
<i>Moringa</i> powder Mathri (Variant-I)	<i>Moringa</i> flour	5	4.6	0.33	0.08	0.4	3.5
	Refined flour	30	139.2	4.84	0.68	0.36	142
	Ghee	20	180	-	20	-	-
	Total	55	323.8	5.17	20.76	0.76	145.5

Conclusion

From the present study, it was concluded that Laddu and Mathri developed from the enrichment *Moringa oleifera* leaves powder had acceptable sensory attributes and also had improved nutritional profile in terms of macronutrients and micronutrients such as Energy, Proteins, Fats, Iron and Calcium when compared with standard recipe. On the other hand, in terms of the mean score of overall acceptability based on the sensory attributes, *Moringa* leaves scored the highest value comparison with standard products. This present study shows that there exists potential for *Moringa* flour incorporation into products.

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