

Development of Ragi-Wheat Composite Value-Added Product Enriched with *Moringa olifera* for Reproductive Age Women

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Abstract

Underutilized plants and cereals can be utilized for the development of the food products enriched with the nutrients which facilitates the availability of nutrition for reproductive age women. By keeping above point into consideration, the major objective of the study was to develop Ragi-Wheat Composite laddoo enriched with *Moringa Olifera* Leaves and to determine the sensory acceptability, nutritional composition and cost of the developed food product. Different treatment of the value added food products were developed by combining different percentage of malted Ragi-Wheat Mix flour and *Moringa Olifera* Leaves Powder like T₁ (95% Malted Flour Mix and 5% Leaves Powder), T₂ (90% Malted Flour Mix and 10% Leaves Powder) and T₃ (85% Malted Flour Mix and 15% Leaves Powder). The Product formulations were subjected to organoleptic analysis for testing various sensory attributes via nine point hedonic scale. ANOVA was used for the statistical analysis. The nutritional composition and cost of the different formulations was evaluated. There were significant ($P < 0.05$) differences between overall acceptability of all the blends. T₁ was liked very much while T₂, T₃ were moderately liked by the panel of judges. Energy, protein, fat, carbohydrate calcium and iron were higher T₃. The cost of Ragi Wheat composite laddoo enriched with *Moringa Olifera* Leaves Powder (Rs/ 100g) ranged from Rs 36.12 -36.85. The study is part of the effort to provide home-based value added supplementary foods that can be more nutritious and cost effective to the reproductive age women of low income families. The developed product is a dietary supplement which can be served as Ready-to-eat snack for the healthy life.

Keywords- *Moringa Olifera*, Ragi, Wheat, Malted Flour Mix, Value Added Product

Introduction

Women of reproductive age constitute 22% of total population and are considered vulnerable or special risk group for nutritional health problems. The nutrition and health status of women are important for the quality of their lives, survival and healthy development of their children (Bryce *et al.*, 2008). The physiological condition of women influence the nutritional status, because

Indian mothers are pregnant too frequently, malnourished, anaemic and dying of causes which could have been easily prevented. In addition in our society, health and nutritional status of women are adversely affected by social, cultural and economic system (**King, 2003**). Adequate nutrition is a 'human right' for all and the nutritional benefits to women's social and economic capabilities need to be viewed as goals. So underutilized plants and cereals can be utilized for the development of the food products enriched with the nutrients which facilitates the availability of nutrition for reproductive age women.

Moringa oliefera is underutilized plant species constituting various medicinal and nutritional properties and Because of its high protein and calcium content it is good for pregnant, post-partum and lactating mothers (**Seshadri and Nambiar, 2003**). The protein content of the dried MOLP is similar to that of moth beans, soybeans and kidney beans which have (22 - 24%) protein. Pulses being expensive are difficult to purchase by the poor people of the developing countries therefore dried MOLP can be used in food products to serve the role of pulses (**Joshi and Mehta, 2010**). Along with nutritional properties, the leaves are loaded with medicinal benefits as they possess flavonol and phenolic acid which have the ability to inhibit prostate and breast cancer (**Joshi and Mehta, 2010**), many infectious disease along with cardiovascular disease (**Anwar et al, 2007**) and *Moringa olifera* leaves also perform various pharmacological activities in our system, such as analgesic, antihypertensive, antitumor activity, and anti-inflammatory (**Prabhu et al., 2011**)

Wheat is an essential cereal for reproductive age women as it contains good amount of calories and protein while Ragi is one of the important cereals which is superior to rice and wheat with respect to mineral and micronutrient contents (**Gopalan, 2016**). Now days, importance of finger millet has been increased due to its dietary fibre, starch pattern and high calcium-iron contents. In addition, it is nutritionally superior to Wheat and Rice because of its high Calcium (380 mg), Dietary fibre (18 g) and Phenolic compounds (0.03 g-3 g) per 100 g. The health benefits from ragi consumption are attributed to its polyphenol and dietary fibre contents (**Thapliyal and Singh, 2015**). The process of malting improves digestibility, sensory and nutritional quality of finger millet and lowers anti-nutritional factors from it (**Devi et al., 2014**)

So the development of the value added food products based on these underutilized plant and cereals is the best possible way to enrich the nutritional value of the daily diet of the reproductive age women and also beneficial for their good health and wellbeing.

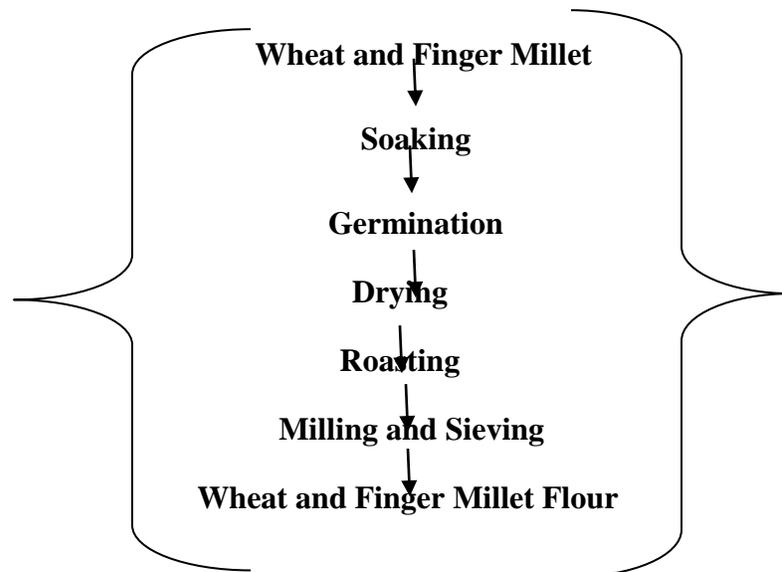
Objectives

- 1) To develop Ragi-Wheat composite laddoo for reproductive age women based on malted flours (Wheat + Ragi) and *Moringa olifera* leaves powder.
- 2) To analyze the sensory acceptability nutritional composition and cost of value added product developed with malted flour mix and *Moringa olifera* leaves powder.

Materials and Methods

Raw Materials- All the raw material required for the development of value added product like Wheat, Ragi, Ghee, Sugar were purchased from the local market of Jaipur. The leaves of the *Moringa olifera* were procured from the herbal garden of the university. In the ingredients, sugar was used as a Sweetening Agent while ghee was used as a Binding Agent.

Preliminary Treatment of Raw Materials- Malting of wheat and finger millet was done for the development of composite flour in which following steps were taken- (Srivastava and Kumar, 2009).



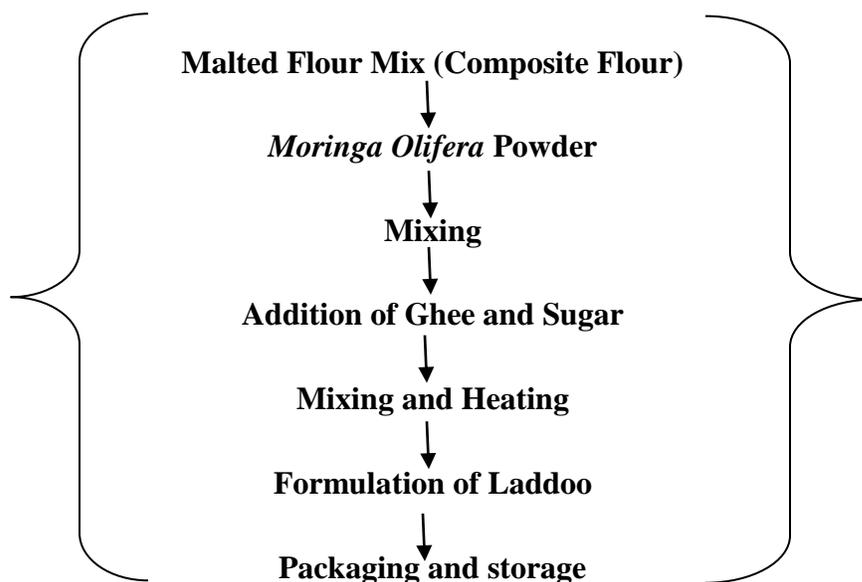
Development of Composite Flour- After the malting process, malted flour of wheat and Finger Millet were taken in equal amount and mixed together for the development of composite flour. All the raw materials required for preparation of Ragi-Wheat composite Laddoo were weighed as mentioned in experimental design.

Preparation of Dried Moringa Olifera Leaves Powder- Drying of fresh *Moringa oleifera* leaves was carried out, with slight modifications, following the method reported by Joshi and Mehta. Fresh, undamaged leaves were sorted and washed with clean water thoroughly to remove all dirt. The water was drained and leaves were air dried for some time. The washed and air-dried leaves were then dried in a tray drier at 60°C for 4 hours. The dried leaves were ground, sieved (80 mesh size), packaged in zip lock bags and stored (-18°C).

Experimental Design- The development of Ragi-Wheat Composite Laddoo enriched with *Moringa Olifera* Leaves Powder was done in 4 different treatment combinations which are as follows-

S. No.	Treatments	Malted Flour Mix (%)	<i>Moringa</i> Powder (%)
1.	Control	100	0
2.	T ₁	95	5
3.	T ₂	90	10
4.	T ₃	85	15

Product Development- Following steps were followed- (Srivastava and Kumar, 2009).



Sensory Evaluation of Developed Product- Sensory acceptability such as appearance, colour, flavour (aroma), taste, texture and overall acceptability of the entire developed product was measured with the help of 9 point hedonic scale and were evaluated by a panel consisting 100 members. . The panel included the teachers, technical officers and students of Jayoti Vidyapeeth Women's University, Jaipur, Rajasthan.

Nutritional Composition Analysis- Nutritional composition of developed Ragi-Wheat composite laddoo enriched with *Moringa olifera* was done on the basis of nutritive value of raw ingredients used given by **Gopalan, 2016**. The nutritive value of dried *Moringa olifera* leaves powder was taken from

Cost Analysis- the cost of developed food product was calculated on the basis of market price of the raw materials used in the development of Ragi-Wheat composite laddoo enriched with *Moringa olifera*.

Statistical Analysis of the data- The data generated with triplicate readings were studied using one-way analysis of variance (ANOVA). All values in the text, table and figures indicates mean values \pm SD. Differences between control and different treatment samples were statistically examined by student's *t-test* and the level of significance was taken $P \leq 0.05$.

Result and Discussion-

Table-1 Sensory Evaluation of Ragi-Wheat Composite Laddoo Enriched with *Moringa olifera*

S. No.	Treatments	Colour	Flavor	Texture	After Taste	Overall Acceptability
1.	Control	8.25 \pm 0.134	7.85 \pm 0.258	7.8 \pm 0.260	8.21 \pm 0.148	8.03 \pm 0.117
2.	T ₁	7.85 \pm 0.298	8.2 \pm 0.238	7.95 \pm 0.116	8.5 \pm 0.188	8.13 \pm 0.145
3.	T ₂	7.25 \pm 0.327	7.7 \pm 0.249	7.65 \pm 0.236	7.93 \pm 0.316	7.63 \pm 0.141
4.	T ₃	6.7 \pm 0.290	6.4 \pm 0.305	6.45 \pm 0.320	7.14 \pm 0.404	6.67 \pm 0.169

The average sensory scores of various sensory attributes viz; Colour, Taste, Flavor, After Taste and Overall Acceptability of value added Laddoo were shown in Table- 1. Average sensory score of Laddoo in relation to Colour and Appearance had the highest in T₀ (8.25 \pm 0.134), followed by T₁ (7.85 \pm 0.298), T₂ (7.25 \pm 0.327) and T₃ (6.7 \pm 0.290) respectively. The calculated value of F (470.07) was higher than the tabulated F value (3.84) at 5% level of significance. This shows that there was a significant difference between the Colour and Appearance of control and treatments indicating that the addition of different proportions of *Moringa olifera* Leaves Powder affects the Colour and Appearance of the prepared product. The colour and appearance of the product becomes darker and acceptability level decreases as the amount of *Moringa olifera* Leaves Powder increases after a certain limit. The mean score for Texture was highest in T₁ (7.95 \pm 0.116), followed by T₀ (7.8 \pm 0.260), T₂ (7.65 \pm 0.236) and T₃ (6.45 \pm 0.320) respectively. The calculated value of F (393.81) was higher than the table value F (3.84) at 5% probability level. This shows that there is significant difference between the Texture of control and treatment

whereas the mean score for Flavor was highest in T₁ (**8.2±0.238**), followed T₀ (**7.85±0.258**), T₂ (**7.7±0.249**) and T₃ (**6.4±0.305**) respectively. The calculated value of F (432.03) was higher than the table value F (3.84) at 5% level of significance. Addition of *Moringa olifera* Leaves Powder increased the Taste and Flavor of the prepared Ragi-Wheat composite Laddoo in treatment T₁ but as proportions is increased Taste and Flavor decreased. The mean score for Overall acceptability was highest in T₁ (**8.13±0.145**), followed T₀ (**8.03±0.117**), T₂ (**7.63±0.141**) and T₃ (**6.67±0.169**) respectively. The calculated value of F (795.43) was higher than the table value F (3.84) at 5% level of significance. Addition of *Moringa olifera* Leaves in different percentage increased the overall acceptability of the prepared Ragi-Wheat Composite Laddoo up to a certain limits.

Table-2 Nutritional Composition of Ragi-Wheat Composite Laddoo Enriched with *Moringa olifera*

S. No.	Nutritional Composition	Treatments			
		Control	T ₁	T ₂	T ₃
1	Protein (g/100g)	9.75	10.42	11.08	11.75
2	Fat (g/100g)	50.1	50.33	50.55	50.78
3	Fibre (g/100g)	2.75	3.16	3.58	3.99
4	Carbohydrate (g/100g)	120.4	118.77	117.13	115.5
5	Energy (kcal/100g)	898	896.28	894.55	892.83
6	Calcium (mg/100g)	202	283.45	364.9	446.35
7	Iron (mg/100g)	4.48	5.85	7.22	8.59
	Cost (Per 100 gm)	36.85	36.6	36.37	36.12

The developed Ragi-Wheat Composite Laddoo enriched with *Moringa olifera* was accessed for Energy, Protein, Carbohydrate, Fat, Fibre, Calcium and Iron content according to the Nutritional Values of the raw materials used for the preparation of Value-Added product given by **Gopalan, 2016**. The cost of food was determined on raw basis. The nutritional composition and cost of the value added Laddoo prepared using different composition was shown in table 3. Result revealed that highest energy was found at T₀ (898 Kcal) followed by T₁, T₂ and T₃. Protein content was highest in T₃ (26.58 g) followed by T₂, T₁ and T₀. Carbohydrate content was decreased with the increase in amount of *Moringa olifera* Leaves powder i.e. T₀ (120.4g), T₁ (118.77 g), T₂ (117.13 g) and T₃ (115.5 g). Minerals (Calcium and Iron) are also highest in T₃ followed by T₂ and T₁. Therefore, it can be concluded that Ragi-Wheat Composite Laddoo prepared by using *Moringa olifera* leaves powder are highly nutritious.

Conclusion

Homemade Ragi-Wheat composite Laddoo enriched with *Moringa olifera* Leaves could be beneficial for the improvement in the nutritional status of the reproductive age women. This study suggest the use of indigenous food processing methods like malting and locally available raw material like Ragi, Wheat and *Moringa olifera* Leaves for the development of the value-added nutritious food product specially for the reproductive age women which facilitates the availability of micronutrients like calcium, iron and other nutrients. Homemade value-added products are significant for the good nutritional status of the women not only for the present but for the years to come. Cost-benefit ratio is a major advantage in case of homemade diet in comparison to commercially available nutritional supplement. Poor nutritional status of the reproductive age women can affect their lives as well as it will result in the continuous cycle of malnutrition. So a nutritious dietary supplement in the form of value-added food product is necessary for the reproductive age women.

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