

Utilization of Moringa Oleifera Powder for Combating Micronutrient Malnutrition

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Abstract: Malnutrition is world health crisis. Nutrient deficiencies are highly common among adolescent girls as their diets contain low levels of nutrients. Four hundred and sixty two million people across the world are suffering from malnutrition. Nutritional anemia is one of the causes for malnutrition among adolescent girls. Replacing the missing nutrients through value addition or supplementation can help preventing micronutrient malnutrition. Green leafy vegetables are good sources of micronutrients. Dehydration is a value addition process. The major nutrient deficiencies can be taken care of by value addition of *moringa* powders by incorporating them into commonly consumed and most accepted food products. Value addition can increase the palatability and nutritive value of foods. In the present study, an attempt was made to develop and evaluate the products by incorporating *moringa* leaf powders at 5 per cent level. The prepared recipes were subjected to Organoleptic evaluation by using 9 point hedonic scale. The mean scores of the recipes for all the sensory properties such as appearance, color, texture, taste and overall acceptability ranged between 7.0 to 9.0. The results related to nutritive value of recipes incorporated with *moringa* powder at 5 per cent level (per 100 g) were having high protein content ranging between 7.0 to 20 g/100 g. The energy, carbohydrate, fat, fiber, total carotenoids, calcium, iron and zinc contents were in the ranges of 255 to 436 kcal/100 g, 20 to 56.2 g/100 g, 5.5 to 18.7 g/100 g, 2 to 15.5 g/100 g, 482 to 9146 µg/100 g, 122 to 183 mg/100 g, 4.2 to 6.1 mg/100 g and 1.1 to 3.2 mg/100 g. Therefore, incorporating *moringa* leaf powder in recipes can help in combating malnutrition.

Keywords-Malnutrition, Moringa leaf powder, Micronutrients, Adolescent girls

1. INTRODUCTION

Malnutrition is world health crisis [1]. Nutrient deficiencies are highly common among adolescent girls as their diets contain low levels of nutrients. According to World Health Organization (WHO), 462 million people across the world are suffering from malnutrition [2]. Nutritional anemia is one of the causes for malnutrition among adolescent girls. Malnutrition occurs due to inadequate supply of nutrients and poor absorption in the body. It is agreed that Food Security does not imply just ensuring adequate energy intake, but also compels that there is adequate consumption of essential micronutrients [3]. The diets of developing countries are lacking in vitamin A, iron, and zinc [4]. Majority of the population are suffering from micronutrient malnutrition. Low consumption of GLV could be a reason for vitamin A and iron deficiency [5]. *Moringa* leaves are store house of nutrients rich in minerals like copper, potassium, iron, magnesium, zinc and calcium [6]. It works as an effective source of natural antioxidants. *Moringa oleifera* (fresh) has been used in treating malnutrition. In spite of considerable losses in vitamins, green leafy vegetable powders retained good amounts of proteins, fibre, minerals, fair amounts of ascorbic acid and β-carotene [7]. The best choice for preserving green leafy vegetables is dehydration. Dehydration is a value addition process [8]. In addition to nutrient concentration, they have more life span than fresh green leafy vegetables. Dehydrated green leafy vegetables are rich in proteins, total phenolics, natural antioxidants, vitamins, minerals and fiber. The major nutrient deficiencies can be taken care of by value addition of GLV powders into commonly consumed and most accepted food products. Incorporation of this *moringa* leaf in the form of powders can play vital role in prevention of malnutrition and anemia in adolescent girls. Therefore, in the present investigation, an attempt was made to develop *moringa* leaf powder and standardize few recipes (*Pesarattu*, Green rice, Bread rolls, muffins and pakodi) by incorporating *Moringa* leaf powder at 5, 10 and 20 per cent levels.

2. EXPERIMENTAL METHODS OR METHODOLOGY

2.1 Development of *Moringa* leaf powder

Bulk quantities of *moringa* leaves were bought and were cleaned with cold water to remove the dirt. The roots were trimmed off and the leaves were washed. They were subjected to blanching, a combination of chemicals (0.5 % potassium metabisulphite + 0.1 % magnesium oxide + 0.1% sodium bicarbonate) used for blanching is known to have better retention of ascorbic acid when compared to individual chemicals used for blanching [9] at temperatures ranging from 95 to 100°C for 5 minutes [10]. The blanched leaves were spread evenly on black tarpaulin sheet and dried in a solar drier at $25 \pm 5^\circ \text{C}$ for 24 hours. The dried leaves were finely ground by using pulverizer, sieved, weighed and packed in polyethylene pouches and sealed until further analysis. *Moringa* leaf powder was presented in Fig. 7.

2.2 Standardization of recipes

In the present study, to the recipes of *pesarattu*, green rice, bread rolls, muffins and pakodi rehydrated *moringa* leaf powder was added at three different levels, namely 5, 10, 20 percentages and the recipe was standardized.

2.2.1 *Pesarattu*

Pesarattu is a breakfast item made with green gram and rice by soaking for six hours and then grinding coarsely into a batter. Ginger, onions, chillies and rehydrated *moringa* leaf powder are added to the batter and the batter is spread into pan cakes on a hot shallow frying pan. Fig. 8 shows the standardized *pesarattu*.

2.2.2 Green rice

Green rice is a fragrant, spicy recipe made with mint leaves and some spices-herbs. The green rice was prepared by cooking raw rice in a pressure cooker along with spices, rehydrated *moringa* leaf powder, coriander and mint paste. The standardized green rice is presented in Fig. 9.

2.2.3 Bread rolls

A bread roll is a snack item. Soft-cooked and mashed potatoes, carrots and beans were stir fried along with chopped onions, spices, rehydrated *moringa* leaf powder and the mixture is stuffed into bread slices which were previously dipped in water and squeezed. The stuffed bread slices were made into balls and deep fried. The standardized bread rolls are presented in Fig. 10.

2.2.4 Muffins

Muffin is a bakery product baked in a pan with cup-sized indentations. Muffins were prepared using sugar, butter, refined wheat flour, rehydrated *moringa* leaf powder, baking powder and baking soda. The standardized chocolate muffins are presented in Fig. 11.

2.2.5 Pakodi

Pakodi is a spiced fritter snack consumed during snack time along with any hot beverage. They were prepared by mixing Bengal gram flour, rice flour, salt, baking powder, chopped onions, ginger and rehydrated *moringa* leaf powder. Small quantities of the mixture were dropped in hot oil and deep fried till golden brown. The standardized pakodi is presented in Fig. 12.

3. RESULTS AND DISCUSSION:

3.1 Standardization and preparation of value-added products with incorporation of different proportions of green leafy vegetable powders

The green leafy vegetable powders were incorporated at different levels in a few commonly consumed recipes. In all the recipes the rehydrated *moringa* leaf powder was incorporated at 5, 10 and 20 percent levels and the recipes were standardized.

3.2 Organoleptic evaluation

The standardized recipes incorporated with *moringa* leaf powder at 5, 10 and 20 per cent levels were subjected to organoleptic evaluation. The mean scores obtained for appearance, texture, flavor, taste and overall acceptability of all the recipes ranged from 7.0 to 9.0. The average acceptance scores for taste decreased markedly at 15 to 20 per cent of leaf mixture incorporation. It is evident that the level of incorporation of powders increased the acceptability had decreased in few recipes. The aroma and mouth feel of the products secured higher scores at the level of 5 per cent but the scores gradually decreased at higher level of incorporation [11].

3.3 Nutritive value of the recipes

The nutritive value of recipes incorporated with *Moringa* leaf powder at 5 per cent level (per 100 g) was calculated and it is found that pakodi and *pesarattu* found to have rich iron with 6.1 and 5.1 mg/100 g. A study also showed an increase in the nutritional value of the products prepared by value addition with drumstick leaves [12]. The *moringa* muffin depicted an increase in iron (3.55 mg/100 g) [13].

Table.1. Standardized pesarattu formulations incorporated with moringa leaf powder

S. No	Ingredients	Formulations			
		Control	Formula 1	Formula 2	Formula 3
1	Green gram dal (g)	100	100	100	100
2	Onions big (g)	15	15	15	15
3	Green chillies (g)	10	10	10	10
4	Ginger (g)	5	5	5	5
5	<i>Moringa</i> leaf powder (g)	0	5	10	20
6	Salt	To taste	To taste	To taste	To taste
7	Oil (g)	5	5	5	5
Cooked weight (g)		130			
No of servings		2			
Per serving (g)		65			

Table.2. Standardized green rice formulations incorporated with moringa leaf powder

S. No	Ingredients	Formulations			
		Control	Formula 1	Formula 2	Formula 3
1	Rice (g)	100	100	100	100
2	<i>Moringa</i> leaf powder (g)	0	5	10	20
3	Mustard (tsp)	1	1	1	1
4	Cumin seeds (tsp)	1	1	1	1
5	Green chillies (g)	15	15	15	15
6	Salt	To taste	To taste	To taste	To taste
7	Onions chopped (g)	30	30	30	30
8	Dried red chillies (g)	5	5	5	5
9	Mint leaves (g)	50	50	50	50
10	Coriander (g)	50	50	50	50
11	Oil (ml)	15	15	15	15
Cooked weight (g)		240			
No of servings		2			
Per serving (g)		120			

Table.3. Standardized bread roll formulations incorporated with moringa leaf powder

S. No	Ingredients	Formulations			
		Control	Formula 1	Formula 2	Formula 3
1	Carrots (g)	100	100	100	100
2	Onions (g)	30	30	30	30
3	<i>Moringa</i> leaf powder (g)	0	5	10	20
4	Green chillies (g)	15	15	15	15
5	Garam masala (tsp)	½	1/2	1/2	1/2
6	Potatoes (g)	100	100	100	100
7	Salt	To taste	To taste	To taste	To taste
8	Bread (g)	50	50	50	50
9	Oil	For deep frying	For deep frying	For deep frying	For deep frying
Cooked weight (g)		120			
No of servings		2			
Per serving (g)		60			

Table.4. Standardized muffins formulations incorporated with *moringa* leaf powder

S. No	Ingredients	Formulations			
		Control	Formula 1	Formula 2	Formula 3
1	Refined Wheat flour(g)	60	60	60	60
2	Eggs (g)	1	1	1	1
3	<i>Moringa</i> leaf powder (g)	0	5	10	20
4	Sugar Powder	50	50	50	50
5	Butter (g)	20	20	20	20
6	Milk (ml)	30	30	30	30
7	Baking powder (tsp)	1	1	1	1
8	Baking soda (tsp)	1	1	1	1
9	Vanilla essence	5 - 6	5 - 6	5 - 6	5 - 6
10	Dried fruits (Tutti frutti, cashews, almonds, raisins)	Required for topping	Required for topping	Required for topping	Required for topping
Cooked weight (g)		120			
No of servings		4			
Per serving (g)		30			

Table.5. Standardized pakodi formulations incorporated with *moringa* leaf powder

S. No	Ingredients	Formulations			
		Control	Formula 1	Formula 2	Formula 3
1	Bengal gram flour (g)	100	100	100	100
2	Rice flour (g)	20	20	20	20
3	Water (ml)	60	60	60	60
4	<i>Moringa</i> leaf (g)	70	0	0	0
5	<i>Moringa</i> leaf powder (g)	0	5	10	20
6	Salt	To taste	To taste	To taste	To taste
7	Onions medium (g)	30	30	30	30
8	Ginger	Pinch	pinch	pinch	pinch
9	Oil	For frying	For frying	For frying	For frying
Cooked weight (g)		130			
No of servings		1			
Per serving (g)		130			

Table.6. Nutritive value of recipes incorporated with *Moringa* leaf powder at 5 per cent level (per 100 g)

Proximates	<i>Pesarattu</i>	Green rice	Breadrolls	Chocolate muffins	Pakodi
Protein (g)	18.4	6.7	11.3	12.5	19
Fat (g)	5.1	8.3	17	18.8	16.1
Fiber (g)	15	6.1	14.8	2.7	12
Carbohydrate (g)	37.6	37	55	45.4	48.5
Energy (kcal)	280	255	434	407	433
Total carotenoids (µg)	989	9116	8645	422	997
Calcium (mg)	160	154	161	159	126
Iron (mg)	5.1	4.7	4.6	3.4	6.1
Zinc (mg)	2.3	1.1	2.5	1.2	3.2



Fig 7. Moringa Leaf Powder

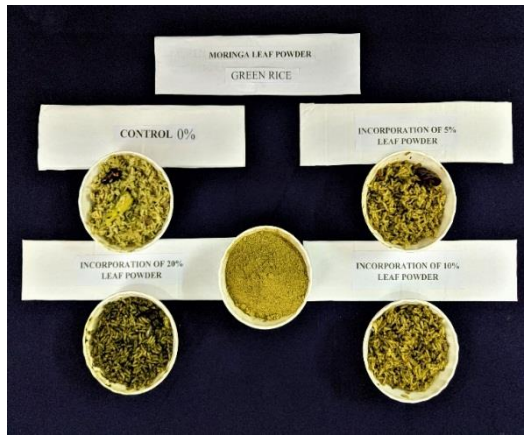


Fig 9. Greenrice



Fig 12. Pakodi



Fig 8. Pesarattu



Fig 10. Breadrolls



Fig 11. Muffins



4. CONCLUSION

The results of present study added to the knowledge on preparation of micronutrient rich recipes incorporated with *moringa* leaf powder at acceptable levels, along with information on nutritive values of moringa leaf powder incorporated recipes which can be supplemented to the diets of adolescents for preventing micronutrient malnutrition.

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