

Development and Standardization of Moringa Oleifera Flower Powder Incorporated Food Products

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Abstract: Nutritional problems like PEM, anaemia and vitamin A deficiency continue to plague a large proportion of Indian children. Moringa oleifera flower contains adequate amount of calcium, iron, vitamin C and fiber for the women, children and old age people. Moringa oleifera is widely used in India, since the Ayurveda and Yunani medicinal systems, use it for the treatment of several ailments. The flowers have many therapeutic values for human beings. But it was less utilized by the people. Hence, the present study was undertaken to use the M. oleifera flowers for the development food products. The M. oleifera flowers powder was prepared by dehydration method and the food products such as vermicelli, chappathi and idli powder were prepared by the incorporation of M. oleifera flowers powder at various concentrations (5%, 10% and 15 %). The sensory evaluation results revealed that, 15 % of M. oleifera flowers powder incorporated Idly powder, 10 % incorporated Chappathi and 5 % incorporated Vermicelli were accepted by most of the people. The nutrient content of 100 gm of Moringa oleifera flower powder was analysed and was reported as 3.2% of ash, 5.18% of moisture, 12 g of protein, 3% of fiber, 44.8 mg of vitamin C, 48 mg of calcium, 11 mg of iron, 32 mg of phosphorus and 160 µg of β carotene. The biochemical analysis of Moringa oleifera flower incorporated idli powder was carried out and it was reported as 5% of ash, 9.20% of moisture, 42 g of protein, 3.50 of fiber, 24 mg of calcium, 46 mg . Moringa oleifera flower powder incorporated products were stored upto 30 days without undergoing any deteriorative change under both room and refrigeration condition. The present findings provide a new strategy to utilize the M. oleifera flower powder as nutritional as well as functional ingredient for eradicating many of the diseases.

Introduction

Vegetable flowers are more perishable and hence the flowers remain underutilized. Moringa oleifera flowers are highly nutritious and possess medicinal properties but it was rarely used by the people. Plant foods play an important role in the diet as they provide essentials micronutrients and minerals. Vegetable flowers are in particular season of the year. When compared to other parts of Moringa, flowers are having more therapeutic value. Moringa oleifera flowers are rich in carotene, protein, vitamin C and potassium and act as a good source of natural antioxidants. Among the various types of processing techniques dehydration is considered to be an inexpensive method and imparts properties that are unmatched by any other preservation technique. The nutrient loss can be minimized through the dehydration technique and helps to retain the nutrient content.

Over three billion people are currently micronutrient (i.e. micronutrient elements and vitamins) malnourished. This global crisis in nutritional health is the result of dysfunctional food systems that do not consistently supply enough of these essential nutrients to meet the nutritional requirements of high-risk groups. The utilization of Moringa oleifera flowers as vegetable is very less and is mostly discarded or goes waste. The flowers are abundantly available. Due to the high content of iron and calcium, it is particularly valuable for women, children and old (Savitha, 2014).

Objectives

- To study the usage pattern of various parts of Moringa oleifera tree.
- To prepare the dehydrated the Moringa oleifera flowers powder, to develop the products of Moringa oleifera flowers powder incorporated products and to find out the acceptability of Moringa oleifera flower powder incorporated products by sensory evaluation.
- To analyze the nutrients and microbial load of the of Moringa oleifera flower powder and Moringa oleifera flower powder incorporated product and analyze anti nutritional factors of Moringa oleifera flower powder.
- To market the developed Moringa oleifera flower powder incorporated product.

Materials and Methods

The Moringa oleifera flowers were collected from the farms nearby Virudhunagar. Other ingredients needed for the study were collected from the local market, Srivilliputtur, Virudhunagar district.

3.1. Study the consumption pattern of various parts of Moringa oleifera

A Questionnaire was prepared to know the usage of the various parts of the Moringa oleifera tree among the women in Virudhunagar.

3.2. Dehydration of Moringa oleifera flower

Cabinet drier was used for dehydrating Moringa oleifera flowers. Dehydration is the best technique in the food industries for regaining nutrient content. Flowers are separated from the stem ends and edible portions were taken from Moringa. The samples were dried by the cabinet dryer at 65°C until they were fully dried or crisp and samples were turned frequently to ensure uniform drying.

3.3. Incorporation of Moringa oleifera flower powder into recipes and sensory evaluation

The dehydrated powder was incorporated into the common preparations namely chappathi, vermicelli and idly powders at five, 10 and 15 per cent levels and acceptability tests were carried out by 10 panel members. Sensory evaluation is a scientific tool that uses the human senses to examine the properties which influence the quality of the product.

A) Dehydrated Moringa oleifera flower powder incorporated vermicelli

The ingredients used for preparing vermicelli incorporated with Moringa oleifera flower powder are given in the Table 1.

Table 1 Ingredients used for the preparation of vermicelli

Control		Experimental			
Ingredients	Amount (g)	Ingredients	Amount (g)		
			Sample A	Sample B	Sample C
Malted wheat flour	60	Malted wheat flour	55	50	45
Green gram dhal	30	Green gram dhal	30	30	30
Sago	10	Sago	10	10	10
-	-	<i>Moringa oleifera</i> flower powder	5	10	15

The malted wheat flour was prepared by the germination of wheat and dried. After drying the sprouts were removed and roasted. All the ingredients were mixed thoroughly and fed into idiappam extruder. After extrusions the products were dried in a cabinet drier at 60°C for 30 minutes and packed in polyethylene pouches and used for the further analysis.

B) Dehydrated Moringa oleifera flower powder incorporated chappathi

The ingredients used for preparing chappathi which was incorporated with 5%, 10% and 15% of Moringa oleifera flower powder are given in the Table 2.

Table 2 Ingredients used for the preparation of Chappathi

Control		Experimental			
Ingredients	Amount (g)	Ingredients	Amount (g)		
			Sample A	Sample B	Sample C
Whole wheat flour	100	Whole wheat flour	95	90	85
		<i>Moringa oleifera</i> flowers powder	5	10	15

Wheat flour was mixed with three various proportions of dehydrated Moringa oleifera flower powder and made into dough by adding salt and water. Then it was divided into separate balls, thin it in roll board. Heat the tawa and cook till it was done.

C) Dehydrated *Moringa oleifera* flower powder incorporated idli powder

Table 3 Ingredients used for the preparation of idli powder

Control		Experimental			
Ingredients	Amount (g)	Ingredients	Amount (g)		
			Sample A	Sample B	Sample C
Ground nut	150	Ground nut	150	150	150
Black gram dhal	150	Black gram dhal	150	150	150
Chilli	10	Chilli	10	10	10
Asafoetida	3	Asafoetida	3	3	3
Garlic	10	Garlic	10	10	10
		<i>Moringa oleifera</i> flowers powder	5	10	15

The above all ingredients are roasted well and made into coarse for the preparation of idli powder and *Moringa oleifera* flower powder was incorporated with three various proportions of 5g, 10g and 15g.

3.4. Sensory Evaluation

According to Srilakshmi (2003), when the quality of the food product is assessed by means of human sensory organs, the evaluation is said to be sensory or subjective or organoleptic. For evaluating the sensory characteristics, the three different formulation of *Moringa oleifera* flower powder incorporated products Vermicelli, Idli powder and Chapati were prepared by standardized procedure. They were assessed by 10 panel members. The panelists were asked to determine the sensory attributes and they scored on basis of sensory qualities such as appearance, colour, texture, flavor and taste. The overall acceptability was evaluated by the mean score of all attributes.

3.5. Nutrient analysis of *Moringa oleifera* flower powder and *Moringa oleifera* flowers powder incorporated product

The biochemical composition of *M. oleifera* flower powder and accepted *M. oleifera* flowers powder incorporated sample and control sample were analysed. Moisture content of the sample was determined by following the standard hot air oven method (AOAC, 2005). The ash content was measured by the method of AOAC (2005) using Muffle furnace. Crude protein (NX6.25) was determined by Micro – Kjeldhal method of AOAC (2005) using Kjeltex instrument (Tecator nitrogen analysis system). Phosphorus and iron content of the samples were determined spectrometrically and calcium content in the sample was estimated titrimetrically by the method of AOAC (2005). Carotene content of the sample was determined spectrometrically by the method of AOAC (2005).

3.6. Analysis of antinutritional factor

The anti nutritional substances suspected to be present in *Moringa oleifera* flower namely tannin was analyzed. The tannin content was estimated by Folin-Deis Method.

3.7. Analysis of the microbial load

Microbial analysis was carried out to find out the shelf life of the dehydrated drumstick flowers and their incorporated idli powder. For the dehydrated *Moringa oleifera* incorporated idli powder the shelf life was tested at 15 days interval for one month using the total plate count method.

Results and Discussion

4.1 Consumption pattern of different parts of *M. oleifera* by the women in Virudhunagar

Table 4 shows the consumption pattern of various parts of the *M. oleifera* by the women in Virudunagar.

Table 4 Consumption pattern of different parts of *M. oleifera* by the women in Virudhunagar

S.No	Parts of <i>M. oleifera</i>	Usage by the women	
		Yes	No
1	Leaves	86%	14%
2	Flowers	6%	94%
3	Drumstick	92%	8%

It was found that 92 and 86 per cent of the respondents consume leaves and drumstick of the *M. oleifera* but a very few women prefer *M. oleifera* flower for cooking purpose. The unusage of *M. oleifera* flower in cooking was due to unavailability of flowers, lack of awareness, dislike and lack of time. But the flowers have more vitamins and minerals which are essential for the body regulation.

4.2 Sensory evaluation of the *M. oleifera* flower powder incorporated vermicelli

Table 5 Sensory evaluation of the *M. oleifera* flower powder incorporated vermicelli

Proportion of <i>M. oleifera</i> flower	Appearance	Colour	Texture	Flavour	Taste	Over all acceptability
Sample A (5%)	4.66±0.66	4.77±0.44	4.83±0.35	4.33±0.96	4.50±1.0	4.66±0.66
Sample B (10%)	4.25±0.59	4.65±0.41	4.50±0.40	4.40±0.45	4.58±0.45	4.63±0.39
Sample C (15%)	4.28±0.58	4.35±0.41	4.20±0.34	4.10±0.51	4.20±0.53	4.20±0.25

Out of the three various formulations 5%, 10% and 15% *M. oleifera* flower powder incorporated vermicelli, 5% *M. oleifera* flower powder incorporated vermicelli scored the best in quality attributes like appearance, colour texture and overall acceptability. But the 10% *M. oleifera* flower powder incorporated vermicelli scored the highest mean score for flavor and taste.

4.3 Sensory evaluation of *M. oleifera* flower incorporated chappathi

Table 6 shows the sensory evaluation mean score of the *M. oleifera* flower incorporated chappathi.

Table 6 Sensory evaluation of *M. oleifera* flower incorporated chappathi

Proportion of <i>M. oleifera</i> flower	Appearance	Colour	Texture	Flower	Taste	Over all acceptability
Sample A (5%)	4.57±0.78	4.28±0.75	4.57±0.78	4.35±0.47	4.0±0.47	4.41±0.49
Sample B (10%)	5.0±0	4.78±0.39	4.85±0.37	4.68±0.47	4.57±0.44	4.92±0.18
Sample C (15%)	4.57±0.44	4.54±0.42	4.20±0.44	4.50±0.40	4.35±0.47	4.50±0.40

Out of the three various formulations, 10% *M. oleifera* flower powder incorporated chappathi scored the best in quality attributes like appearance, colour, texture, flavor ,taste and for overall acceptability.

4.4 Sensory evaluation of *M. oleifera* flower incorporated Idli powder

Table 7 Sensory evaluation of *M. oleifera* flower incorporated Idli powder

Proportion of <i>M. oleifera</i> flower	Appearance	Colour	Texture	Flavour	Taste	Over all Acceptability
Sample A (5%)	5.0±0	4.37±0.58	4.56±0.72	4.37±0.58	4.50±0.72	4.20±0.56
Sample B (10%)	5.0±0	4.50±0.70	4.75±0.37	4.43±0.62	4.50±0.75	4.50±0.46
Sample C (15%)	5.0±0	4.75±0.46	4.75±0.70	4.43±0.72	4.50±0.92	4.75±0.46

Out of the three various formulations, 15% *M. oleifera* flower incorporated Idli powder scored excellent in color quality, appearance, texture, flavor,taste and for overall acceptability.

4.5 Preference of *M. oleifera* flower incorporated product by the consumers

Table 8 Preference of *M. oleifera* flower powder incorporated product by the consumers

Product	Consumer's first preference (%)
Chappathi	10%
Vermicelli	5%
Idly powder	85%

The prepared products were subjected to the hedonic rating test for finding the preference of *M. oleifera* flower incorporated product by the consumers. Then the most preferred product was used for biochemical analysis and marketing. Idli powder was preferred by 85% of the consumers.

4.6 Nutrient analysis of *M. oleifera* flower powder

The nutrient content of *M. oleifera* flower powder was analyzed and the results are given below in the table 9

Table 9 Nutrient content of *M. oleifera* flower powder

Nutrient	Amount
Ash	3.2%
Moisture	5.18%
Protein	12 g
Fiber	3%
Vitamin C	44.8 mg
Calcium	48 mg
Iron	11 mg
Phosphorus	32 mg
β carotene	160 μ g

The nutrient content of 100 gm of *Moringa oleifera* flower powder was analysed and was reported as 3.2% of ash, 5.18% of moisture, 12 g of protein, 3% of fiber, 44.8 mg of vitamin C, 48 mg of calcium, 11 mg of iron, 32 mg of phosphorus and 160 μ g of β carotene.

4.7 Nutrient analysis of *M. oleifera* flower powder incorporated idli powder

Table 10 Nutrient content of *M. oleifera* flower powder incorporated idli powder

Nutrient (per 100 g)	Control	Experimental
Ash	5%	5%
Moisture	9%	9.02%
Protein	40g	42g
Fiber	2.5%	3.5%
Vitamin C	40mg	41.60mg
Calcium	20mg	24mg
Iron	40mg	46mg
Phosphorus	34mg	38mg

The biochemical analysis *Moringa oleifera* flower incorporated product was carried out and it was reported as 5% of ash, 9.20% of moisture, 42 g of protein, 3.5% of fiber, 24 mg of calcium, 46 mg of iron and 38 mg of phosphorus.

4.8 Anti nutrient analysis of *M. oleifera* flower powder

Anti nutrient Tannin content of 100 gm of *M. oleifera* flower was analysed, it contains 2gm of tannin. According to Lakshmi and Radha (2005), the tannin content of dehydrated *M. oleifera* flower was 1.8 gm/100g.

4.9 Microbial analysis of *M. oleifera* flower powder and *M. oleifera* flower incorporated product

The storage study for the *M. oleifera* flower powder was carried out for a period of 1 month at 15 days interval and the results are interpreted below in Table 11.

Table 11 Storage studies of *M. oleifera* flower powder and products

S.No	Sample	Microbial load at room temperature			Microbial load at refrigeration		
		Initial	15 th day	30 th day	Initial	15 th day	30 th day
1	<i>M. oleifera</i> flower powder	-	2x10 ⁵	6x10 ⁵	-	-	2x10 ⁵
2	Control	-	4x10 ⁵	7x10 ⁵	-	-	1x10 ⁵
3	<i>M. oleifera</i> flower incorporated Idli powder	-	2x10 ⁵	2x10 ⁵	-	-	-

On storage of these products showed some changes in flavor occurred in fourth week of storage. Thus it can be concluded that the M. oleifera flower powder and M. oleifera flower incorporated product can be stored up to 30 days without undergoing any deteriorative changes.

4.10. Cost analysis and marketing of Moringa oleifera flower incorporated product

Marketing strategies are developed alongside the product development process and the cost was calculated for 100 gm M. oleifera flower incorporated Idly powder was Rs. 39.

Conclusion

The study concluded that the M. oleifera flower powder contains adequate amount of protein, calcium, iron, vitamin C and fiber. In addition to that it can be used effectively by incorporating the dehydrated M. oleifera flower powder into the recipes at household level in order to improve nutritional status of the people.

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