Preparation of Value Added Products from Dehydrated Drumstick Leaves

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Abstract

The purpose of this paper is to evaluate the acceptability of value added products prepared from dehydrated drumstick leaves (moringa oleifira) powder. Drumstick leaves have enormous potential for benefiting humanity. India's ancient tradition of ayurveda says the leaves of moringa tree prevent 300 diseases. The leaves are inexpensive, abundantly available still are under exploited and are mostly discarded or go waste.

The leaves of moringa oleifira were shadow dried and were turned into a homogeneous powder referred to as moringa leaf powder (MLP). The leaf powder was (analyzed for proximate, mineral (Ca, P, Fe), Vitamin (beta carotene and vitamin C) composition and anti nutritional factors (oxalate and phenol). In total 10 different recipes with different levels (0%, 5%, 10%, 15%,20%) of the leaf powder incorporation were prepared and assessed for quality on the basis of sensory attributes.

The leaf powder contained 23.66% of protein, 28.47% carbohydrate, 7.03% fat, 12.1% fiber 24 mg/ 100g iron, 3405 mg /100g calcium and 218mg /100g phosphorus, 39600 microgram/100g beta carotene and 140 mg/ 100g vitamin c. The products prepared by incorporating the leaf powders were well accepted to the level of 10%. The protein, iron, calcium and beta carotene content was significantly higher in the value added recipes.

The abundantly available inexpensive leaves of moringa are exceptionally nutritious but one of the most underutilized tropical crops. The moringa leaves could be used to improve the nutritional quality of food as well as to combat malnutrition. Dehydration of the leaves will make it a concentrated source of nutrients which could be used in the value addition of various products.

KEYWORDS: moringa oleifira, dehydration, sensory evaluation, acceptability, value addition

Introduction

The plants have always been vital to mankind irrespective of the era and area all over the globe since the beginning of life. Moringa oleifira is the most nutrient rich plant yet discovered. This humble plant has been making strides in less developed societies for thousands of years, and significant nutritional research has been conducted since the 1970s.

It is the most widely cultivated species of a monogeneric family, the moringacea that is native to the sub Himalayan tracts of India, Pakistan, Bangladesh and Afghanistan. This rapidly growing tree is widely cultivated in many locations in the tropics (Fahey, 2005). It is a perennial soft wood tree with timber of low quality, but which for centuries has been advocated for traditional medicinal and industrial uses (Fahey, 2005).

Moringa provides rich and rare combination of nutrients, amino acids, anti oxidants, anti aging and anti inflammatory properties used for nutrition and healing. Moringa is sometimes called " Mothers' Best Friend" and " Miracle Tree". Since 1998, the WHO has promoted moringa as an alternative to imported food supplies to treat malnutrition (Manzoor et al, 2007; Sreelatha and Padma, 2005). Regarding human micronutrient and macronutrient needs moringa oleifira quantitatively provides more nutrients per gram of plant material than many other plant species. It provides more than seven times the vitamin C found in oranges, 10 times the vitamin A found in carrots, 17 times the calcium found in milk, nine times the protein found in yoghurt, 15 times the potassium found in bananas and 25 times the iron found in spinach (Fahey 2005; Fuglie, 2000; Gopalan et al 1998; Rockwood et al 2003).

Moringa is a nature's gift to mankind. It is especially promising as a food source in the tropics because the tree is in full leaf at the end of the dry season when other foods are typically scarce.

It is already an important crop in tropical countries. All parts of moringa are edible but unfortunately its utilization is limited either due to ignorance or due to inability to use them in different products.

Thus the present study was undertaken to explore possibilities of using the dehydrated moringa leaf powder (MLP) to enrich the various conventional food items.

Materials and Methods

Collection

The leaves of moringa oleifira were collected at the same time from the same tree to avoid effect of soil variation on the micronutrient content of the leaves.

Sorting

Fresh green undamaged leaves were selected for drying to produce the best quality dehydrated powder.

Washing

The stalk of the leaves was cut from the main branches and the leaves were washed three to four times with plenty of water to remove all the adhering dust, dirt particles. The leaves of moringa are 20- 70 cm long with 8-10 pairs of pinnae each bearing two opposite, elliptic or obovate leaflets and one at the apex, all 1-2 cm long (Morton, 1991). The petioles of the leaves were kept intact for the easy handling of the leaves. After washing, the petiole of the leaves were tied together in small bunches and were hung in airy spaces to drain away extra water and to air dry the leaves. The residual moisture was evaporated at room temperature before the actual drying process, on a clean paper with constant turning to avoid fungal growth. After that the petioles were removed and only the leaves were taken for drying.

Drying

The air dried leaves were spread on cotton sheets and were kept in a well ventilated room for shadow drying. The room was insect, rodent and dust proof. Natural current of air was used for shadow drying the leaves.

The leaves were dried till they turned crisp, were brittle and their moisture level reduced to 6-7 Percent. Leaves were then ground to powder in a pestle mortar and were passed through a fine 1mm sieve.

Chemical analysis

The composition (moisture, dry matter, ash, acid insoluble ash, ether extract and crude fiber) of the dehydrated leaves was determined using the recommended methods of the Association of official analytical chemists (AOAC, 2000). Nitrogen free extract was determined by difference. Protein was determined using the micro kjeldhal method (N x 6.25). The Fe, Cu, Zn, Mn, Mg and Ca levels were determined by using a Shimedzu Atomic Absorption Spectrophotometer. Oxalate levels were determined titrimetrically using the standard AOAC (2000) procedures and phosphorus was determined colorimetrically using the Fiske and Subba Row method (1952). Beta carotene was separated by column chromatography and estimated colorimetrically (Ranganna, 1986). Ascorbic acid was estimated by visual titration method of reduction of 2,6- dicholorophenol- indophenols dye.

Preparation of Value added products

Six different recipes using different methods of cooking (deep frying, shallow frying, steaming, baking, sweet preparation and no cooking) commonly used by low and middle income group people were selected for value addition (Table I). Each recipe was standardized with total 100g weight of the ingredients and was served as the ‘control recipe’ for the purpose of comparison. Moringa leaf powder (MLP) was incorporated in the control recipe at different concentrations of 5, 10, 15 and 20 percent. The amount of MLP containing 6% moisture required to get these concentrations was 5.3, 10.6, 15.9 and 21.2 percent respectively.

Sensory Evaluation

Sensory evaluation of all the recipes containing different levels of MLP was done by a panel consisting of 10 judges. Stimulation threshold technique was used for the selection of the panel. The recipe was evaluated for their appearance, aroma, texture and mouth feel. Sensory attributes were scored on a 5- point hedonic scale (Excellent 5, Very good 4, Good 3, Average 2 and Poor 1). The judges were required to fill up the score card sheet, giving a maximum of 5 marks for each of the five factors listed above, thus making a total score of 25.

Statistical analysis

The data were analyzed using SPSS version 13.0. The significance of difference between means of groups was studied by applying the Duncans multiple range tests.

Result and Discussions

The nutritive value of MLP is depicted in Table II. The powder was a rich source of micronutrient providing 24 mg/100 g iron, 218mg/100g phosphorus, 3405mg per 100g calcium, 39600µg/ 100g β carotene and provided good amount of energy (271.83Kcal per 100g) and protein (23.66 g per 100 g) too and thus became a concentrated source of almost all the nutrients (Table II).

Effect of value addition on the acceptability of products

The MLP was light green in colour with a bland flavour. It gave green colour to the food which was light in colour at lower levels (5 and 10 percent) which increased to darker shades of green in most of the products at the 15 g and 20g level per serving. In all the products up to 15 g MLP per serving, the product was well accepted in terms of appearance, while a gradual decrease in acceptability was seen as the level of MLP incorporation increased. The average scores for appearance at 15 and 20 percent for all the savoury products were 'good to fair' while in the sweet product the acceptability scores were slightly low (Table III).

Moringa leaves had a mild odour; therefore, aroma and mouth feel was not a hindrance to the acceptability of the product. The products were acceptable at 10 % level of MLP incorporation, but beyond 10 percent level of incorporation the scores gradually decreased (Table III).

The average acceptability scores for texture decreased markedly at 10g level, it also became difficult to prepare the dough or the filling (Table III). The average acceptance scores for taste decreased markedly at 10 and 15 percent level of MLP incorporation (Table III). Study done by Nambiar and Parnami (2008) showed a 20% level of acceptance of the products prepared by the value addition with freshly blanched drum stick leaves. Recipes incorporated with brassica oleracea were acceptable at 5 to 10% of incorporation in various recipes (Buvaneswari and Ramy, 2014). Green gram dal and parantha incorporated with 5 to 7% of dehydrated bathua leaves (chinopodium album linn) were liked the most (Singh et al, 2007). Chapati and poori incorporated with bengal gram leaves were accepted to a level of 10% of incorporation. The acceptability decreased with increasing concentration of value addition (Singh and Grover, 2014). The present study was in agreement with the researches done on other leaves. At the higher levels of incorporation the leaves usually start giving a grassy flavour and a typical pungent odour, thus affecting the sensory attributes.

Effect of product on acceptability

Steamed product (Khaman) was better accepted in comparison to shallow fried (Tikia, Mathari) and deep fried products. Shallow frying and deep frying imparted an unacceptable dark green colour to the products at higher levels of value addition with MLP (15 and 20 %). The products scored less in appearance but scored well in taste as the salt and spices masked the flavor of the MLP and gave them crispness which added to their acceptability levels. Green leaves contain chlorophyll, a pigment which gives green colour to leaves. This pigment is responsible for photosynthesis in leaves. Chlorophyll is a fat soluble pigment and thus may leach if it is cooked in a medium containing fat. As the food containing chlorophyll are heated, the pigment becomes deficient of air. This results in the appearance of a bright green colour. However, as cooking continues, acids in the cells of fruits and vegetables are released and cause a chain reaction resulting in the conversion of chlorophyll to pheophytin a (a grey green coloured pigment) or pheophytin b (an olive green coloured pigment). Over time the chlorophyll continues to degrade to an eventual yellowish colour.

Frying and shallow frying of food products with a fatty cooking medium, therefore had a detrimental effect on the concentration and intensity of the chlorophyll pigment present in the MLP and thus imparted an unacceptable green colour to the products at higher levels of value addition, while, at the lower levels the change in colour was camouflaged because of the presence of other ingredients. With very short steaming time, the chlorophyll content of the green leaves was preserved imparting an acceptable green colour to the products. The fermentation of the products made them more acceptable.

Sweet Product (Laddoo) scored less in all the sensory attributes in comparison to other products because the leafy taste and flavor of MLP imparted a typical taste to the laddoo which was unacceptable with sugar. Baked product (Biscuit) scored high in all the sensory attributes.

Coriander chutney was acceptable beyond 20 percent of MLP incorporation too. It could be because coriander itself is green in colour so the MLP blended well with green coriander. The use of green chillies and lemon further made the taste of MLP unidentifiable. The study is in agreement with the studies done by Joshi and Mathur, 2015 on the value addition of the products by different levels of less utilized green leafy vegetables. Joshi and Mehta, 2010 also revealed the same results in the products incorporated with drum stick leaf powders. Singh et al (2007) also showed the same results in the products prepared from dehydrated batua leaves. Similar findings were quoted by Gupta et al (2014) on the value added products prepared from Indian Sorrel leaves.

Effect of value addition on nutritive value of products

Dehydration turned MLP into a concentrated source of all the nutrients; thus, the increase in nutrients was directly proportional to the level of MLP incorporation. As the level of value addition increased the nutritive value of the product also increased significantly. A remarkable increase was found in the micronutrient level of the products after value addition. Study done by Nambiar and Parnami (2008), also showed an increase in the nutritional value of the products prepared by the value addition with drum stick leaves, The increase was significantly in β carotene. Study conducted by Wani and Sood, (2014) , revealed that incorporation of cauliflower leaf powders in biscuits up to 10% along with malted wheat flour not only improved the texture, taste and overall acceptability but also improved the nutritive value of these products significantly. Buvaneswari and Ramya, (2014), also advocated brassica oleracea leaf powder as an efficient means of improving the biological value of iron and vitamin C in the products through their study. The nutrient content of the recipes prepared by incorporating purlane (portulaca oleracea) especially with reference to dietary fiber, calcium and iron were higher than the control recipes (Tarkergari etal, 2013). Similar results were found by Singh etal, (2007) in dehydrated batua ((chenopodium album linn). Iron and carotene contents of dehydrated bathua leaves were 6-8 times higher than the fresh leaves, Iron and β carotene content of green gram dal and parantha incorporated with dehydrated bathua leaves was higher than their respective control. Similar findings were reported by Singh and Grover (2014) on recipes incorporated with bengal gram leaves. The iron content of the value added products was significantly higher than their respective control.

Conclusion:

Water in food is reduced to a very low level during dehydration thus achieving better microbiological preservation and retarding many undesirable reactions during storage (Ibarz and Barbosa- Conovas, 2000), owing to the reduction in water activity GLV are rich source of micronutrient and the dehydration technology can make them a concentrated source of micronutrients. Utilizing these micronutrient rich GLV in a dehydrated form can be a food based approach to combat the micronutrient deficiencies, which is prevalent in our population, especially during season of non-availability. Dehydration of underutilized moringa leaves can enhance the nutritive value of the leaves remarkably and the value addition in various products will be helpful in tapping and exploiting the amazing nutritional potential of these leaves.

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Table I : Details of the selected food preparation

S.No.	Food Preparation	Method of cooking	Consumed as
1	Mathri (Salted crackers)	Deep frying	Snack
2	Aloo Tikki (Potato pattice)	Shallow frying	Snack
3	Khaman (Savoury cake made from bengal gram flour)	Steaming	Snack
4	Coriander chutney	No cooking	Side dish/ Relish
5	Biscuit	Baking	Snack
6	Suji laddoo (Ball shaped sweet made from semolina)	Roasting	Dessert

Table II: Nutritional composition of per 100 g of moringa leaf powder (MLP)

Nutrients	Amount	SD
Moisture	7 g	± 0.10
Dry matter	93 g	±0.10
Ash	19.20 g	± 0.12
Acid insoluble ash	302 g	±0.35
Ether extract	7.03 g	± 0.02
Crude protein	23.66 g	± 1.20
Crude fiber	12.1 g	±1. 36
Nitrogen free extract	28.48 g	± 5.20
Energy	271.83 Kcal	± 0.15
Calcium (Ca)	340 mg	±0.01
Phosphorus (P)	241 mg	±0.01
Magnesium (Mg)	0.50 mg	±0.01
Iron (Fe)	24 mg	±0.01
Zinc (Zn)	2.50 mg	±0.01
Copper (cu)	0.80 mg	±0.01
Mangnese (Mn)	0.49 mg	±0.01
Beta carotene	3960 µg	±0.12
Accobic acid (VC)	140 mg	±0.12
Oxalate	500 mg	±0.13

The data are mean value ± standard deviation (SD) of four replicates expressed on a dry weight basis

Table III: Effect of value addition by MLP on sensory attributes

Sensory attributes	0%	5%	10%	15%	20%	P value
Appearance	4.73^{e}	3.8^{d}	2.93^{c}	2.2^{b}	1.5^{a}	0.001
Aroma	4.76^{e}	3.96^{d}	3.2^{c}	2.36^{b}	1.86^{a}	0.001
Texture	4.53^{e}	3.56^{d}	2.8^{c}	2.33^{b}	1.53^{a}	0.001
Mouth feel	4.50^{e}	3.8^{d}	2.81^{c}	2.2^{b}	1.85^{a}	0.001
Taste	4.76^{e}	3.86^{d}	3.03^{c}	2.26^{b}	1.5^{a}	0.001
Total	23.28^{e}	18.98^{d}	14.77^{c}	11.35^{b}	8.24^{a}	0.001

Sensory attributes were scored on a five point hedonic scale by a panel of 10 judges (excellent 5, good 4, fair, 3 poor 2 very poor 1); values with different superscripts letters within a row differ significantly ($p< 0.05$) by the Duncans multiple range test

Table IV: Effect of product on the sensory attributes

Sensory attribute	Mathri (Salted crackers)	Aloo Tikki (Potato pattice)	Khaman (Savoury cake made from bengal gram flour)	Coriander chutney	Biscuit	Suji laddoo (Ball shaped sweet made from semolina	P value
Appearance	3.6^{d}	4.30^{ab}	4.62^{a}	4.65^{a}	4.17^{abc}	3^{e}	0.02
Aroma	4.13^{d}	4.21^{abc}	4.35^{ab}	4.50^{a}	4.2^{abc}	3.1^{e}	0.02
Texture	3.65^{cd}	3.88^{c}	4.03^{b}	4.61^{a}	3.85^{de}	3^{e}	0.73
Mouthfeel	2.8^{c}	2.7^{c}	3.2^{a}	3^{b}	2.7^{c}	2.3^{d}	0.02
Taste	3^{c}	3^{c}	3.70^{b}	4.12^{a}	3.7^{b}	2.4^{e}	0.02
Total	17.18d	18.09cd	19.9b	20.88a	18.62c	13.8e	0.02

Sensory attributes were scored on a five point hedonic scale by a panel of 10 judges (excellent 5, good 4, fair, 3 poor 2 very poor 1); values with different superscripts letters within a row differ significantly ($p< 0.05$) by the Duncans multiple range test