IJ International Journal of Home Science Extension And Communication Management
Volume 2 | Issue 1 | Jan., 2015 | 8-12
● DOI : 10.15740/HAS/IJHSECM/2.1/8-12
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RESEARCH ARTICLE

Effects of different drying methods and value addition of versatile food mix with moringa dry leaves

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ABSTRACT : *Moringa oleifera* leaves have been reported to be a rich sources of vitamins especially, vitamin A and minerals. They are also an excellent source of nutrients such as vitamin C, zinc, calcium, iron and potassium and phytochemicals which have been shown to have positive health effects. The leaves can be eaten as a vegetable. The leaves cannot be stored more than a week without refrigeration due to its perishable nature. Hence, the leaves can be dried and converted into powder. The powder or dry leaves can be used to enhance the nutritional value of the foods. The present paper thus attempts to develop and standardize new innovative value added product using dried moringa leaves. Among the different drying methods studied blanched and shade dried leaves had better nutrient content. Hence the shade dried leaves were used for standardizing moringa leaf versatile food mix. It was standardized by using grains along with pulses in different variations of moringa leaves. Nutritional properties were analyzed. The standardized moringa leaf versatile food mix contains 6.5 per cent of protein, 6358µg of beta carotene and 4.2 g of iron and hence it will meet the average nutritional requirement of 20 per cent of all age groups. The versatile food mix can be stored in Metalized Poly Propylene (MPP) packages upto 6 months with significant changes in their nutritional properties.

KEY WORDS : Moringa leaves, Drying methods, Versatile food mix, Nutrients, Storage

View Point Article : Parvathi, S., Nithya, M., Devi priya, J. and Yogeshwari, R. (2015). Effects of different drying methods and value addition of versatile food mix with moringa dry leaves. *Internat. J. Home Sci. Extn. & Comm. Manage.*, **2** (1): 8-12.

Article History : Received : 05.11.2014**; Revised :** 17.11.2014**; Accepted :** 03.12.2014

INTRODUCTION

India is the major contributor of agricultural produce to the world. Though the country has attained food security at the national level, hunger and malnutrition continue to haunt, despite of green, white and IT revolution and economic reforms. The main reason behind is lack of food security, lack of awareness on healthy foods and not fully utilizing the natural resources etc. Among the plant foods, green leafy vegetables are rich in micronutrients and could be used to prepare healthy and nutritious foods to enhance the nutrient content and to attain food security (Bhaskarachary *et al.*, 2011). Among the Green Leafy Vegetables (GLV), *Moringa oleifera* is one of the best examples, which contains all essential nutrients, enzymes, omega oils, minerals, antioxidants and phytochemical compounds, all found in one leaf hence, it is called as "Green Gold"(Dexxebbicher *et al.*, 1991). Scientific evidences confirm that moringa leaf is the wonderful crop that can alleviate malnutrition among children and women. The plant provides a rich and rare combination of antioxidants namely, zeatin, quercetin, β-sitosterol, caffeoyl quinic acid and kaempferol (Kasolo, 2010). Moringa has gained much importance in the recent days due to its multiple uses and benefits to agriculture and industry. Over the past two decades many reports are describing its nutritional and medicinal properties. Nowadays people are so health conscious and they

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are willing to buy healthy and natural foods. Moringa leaves are available abundant in India. It is easily accessible to everybody at a very affordable price.

The leaves can be eaten as a vegetable. The leaves cannot be stored more than a week without refrigeration due to its perishable nature. Hence, the leaves can be dried and converted into powder.

Moringa leaf powder is easy to make, store and use. It finds suitable applications in all the South Indian recipes. It has projected great demand in the Indian market and aboard and in many countries. Promotion of moringa leaf incorporated functional foods help to cure several chronic degenerative disorders. The present investigation was concentrated to develop and standardize new innovative value added product using dried moringa leaves.

METHODOLOGY

Good quality of moringa leaves was purchased from the local market at Madurai district. The purchased leaves were cleaned properly by removing the insect damaged leaves, deteriorated leaves, stems and the good quality leaves were selected for drying and the dried leaves were used for the development of moringa leaves based value added products.

Dehydration of moringa leaves :

The cleaned moringa leaves were dried in different drying methods namely shade, cabinet and fluidized bed drying. The cleaned leaves were blanched by steam for 3 minutes. For the selected drying methods both blanched and unblanched method were used. For all the selected drying methods, 500 g of leaves were taken. After drying, the dried leaves and powder were used for standardization of versatile food mix. The processing of dried moringa leaves is given in Fig. A.

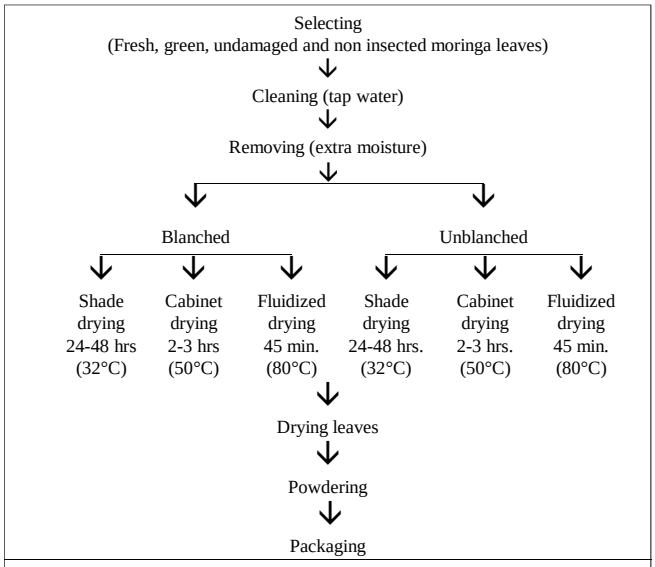

Fig. A : Processing of dried moringa leaves

Standardization of moringa leaf versatile food mix :

Among the different drying methods studied blanched and shade dried leaves had better nutrient content. Hence, the shade dried leaves were used for standardizing moringa leaf versatile food mix. The details of the standardization of the mix were given in Table A.

Table A : Standardization of moringa leaf versatile food mix

Ingredients	C*	T_1	T_2	T_3
Little millet (g)	10	10	10	10
Kodo millet (g)	10	10	10	10
Barnyard millet (g)	10	10	10	10
Foxtail millet (g)	10	10	10	10
Finger millet (g)	10	10	10	10
Jowar (g)	10	10	10	10
Pearl millet (g)	10	10	10	10
Green gram (g)	10	10	10	10
Red gram (g)	10	10	10	10
Red rice (g)	10	10	10	10
Horse gram (g)	10	10	10	10
Soya (g)	10	10	10	10
Dried moringa leaves (g)	-	5	10	15

C*- Control

Processing of moringa leaf versatile food mix :

The moringa leaf versatile food mix was standardized by using grains along with pulses in different variations. The details of standardization of moringa leaf versatile food mix is given below in Fig. B.

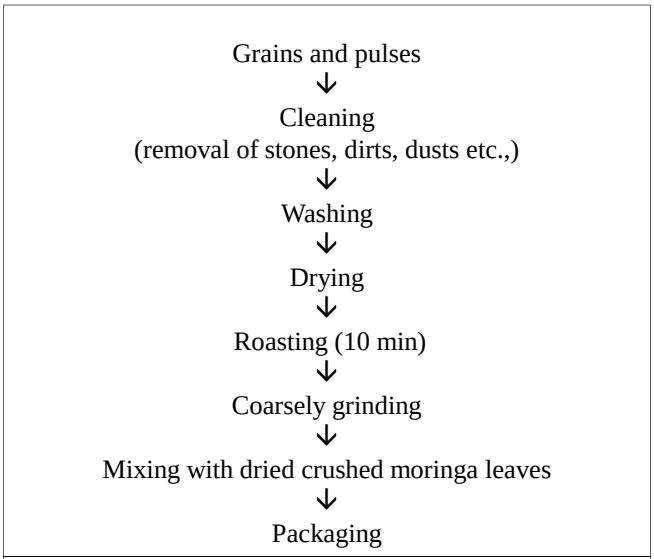

Fig. B : Processing of moringa leaf versatile food mix

Sensory evaluation of moringa leaf versatile food porridge :

The standardized moringa leaf versatile food mix was used to prepare porridge. The prepared porridge was tested

for their acceptability by the panel of 15 members and was evaluated for their appearance, colour, taste, texture and flavour. The evaluation was carried out using 9 point hedonic scale (Swaminathan, 1980).

Nutrient analysis of moringa leaf versatile food mix :

Based on the acceptability score, the standardized nutri rich versatile food mix was analysed for its proximate composition and mineral contents using AOAC (1995) method. The mineral content was analysed as suggested by Sadasivam and Manickam (1996).

Shelf life study of versatile food mix :

Based on the sensory evaluation, the best variation (T_2) was selected for shelf life study. The selected versatile food mix was kept for storage study using different packages namely, Low Density Poly Ethylene (LDPE) and Metalized Polypropylene (MPP) under ambient conditions (32°C). Changes in the nutrient content of the mix were studied at 30 days of interval.

Statistical analysis :

The data obtained during storage period were subjected to statistical analysis to find out the impact of different packaging materials and storage period using Dunnets test.

OBSERVATION AND ASSESSMENT

The results obtained from the present investigation are summarized below :

Preparation of moringa leaf versatile food porridge :

The standardized food mix was used to prepare porridge. The preparation of porridge was given below on Fig. 1. One hundred grams of mix was taken and added with 200 ml water. Pepper was roasted for 5 min and coarsely grinded. Pepper powder and salt was added with versatile food mix. Then it was allowed to cook for 20 min. The prepared porridge was organoleptically evaluated.

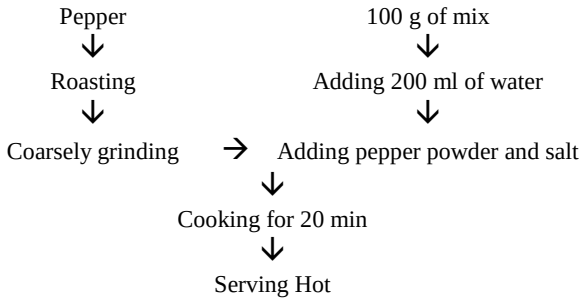

Fig. 1 : Preparation of versatile food porridge

Organoleptic evaluation of moringa leaf versatile food porridge :

The moringa leaf porridge was organoleptically evaluated with trained judges by using 9 point hedonic scale. The result of organoleptic evaluation is given in Table 1.

Based on the organoleptic evaluation ten per cent (T_2) incorporation of dried moringa leaves of versatile food porridge was highly accepted by the judges. Hence this treatment was selected for storage study. The mixes were prepared in bulk and stored in LDPE and MPP for six months to assess the shelf life of the mixes at ambient temperature.

Vanisha *et al.* (2008) standardized three recipes namely, *Mung* (*Phaseolus aureus*), *Kabuli chana* (*Cicer arietinum*) and *Desi chana* (*Cicer arietinum*) by incorporating 20 g freshly blanched moringa leaves. All three recipes were found to be acceptable by the panel of judges (18 to 21 year old women), with an overall composite score ranging from 3.06-3.53 (on a scale of 1 to 5).

Changes in the nutrient content of the moringa leaf versatile food mix during storage :

The changes observed in the nutrient content of the versatile food mix are presented in Table 2. The initial moisture content was 5.5 per cent in 100 g. The similar increasing trend in the moisture content was observed in 6.8 per cent and 6.5 per cent in P_1 and P_2 packaging materials at the end of the storage study. The carbohydrate content was initially in 58.3g/100g in P_1 and P_2.

The carbohydrate content was decreased to 52.6 g and 52.7g/100 g at the end of the storage period. The initial protein content was 6.5g/100 g in P_1 and P_2. The packed samples P_1 and P_2 decreased in 5.0g/100 g and 5.2g/100 g of protein content after storage days. The crude fibre content of the samples ranged from 3.5g/100 g initially, 2.2g/100 g (P_1) and 2.4g/100 g (P_2) after storage, respectively. The fat content was low in ranged from 2.3g/100 g (P_1 and P_2) initial and final content was 1.3g/100 g and 1.5g/100 g (P_1 and P_2), respectively. The highly beta carotene content was present in

Table 1 : Organoleptic evaluation of moringa leaf versatile food porridge

Particulars	C*	T_1	T_2	T_3
Colour	8.8	8.6	8.5	8.0
Texture	8.5	8.4	8.7	7.8
Flavour	8.5	8.5	8.7	7.5
Taste	8.8	8.5	9.0	7.8
Overall acceptability	9.0	8.5	9.0	7.5

C*- Control

versatile food mix. Initial beta carotene content was 6358µg/ 100 g, whereas the reducing trend of beta carotene was observed in 6339µg/100g and 6342µg/100 g in P_1 and P_2, after 180 days storage. The statistical analysis revealed that significant changes was noticed in packaging materials, storage period and also the combination of packaging materials and storage period. From the nutrient analysis, it was found that the mix contain 6.5 g of protein, 3.5 g of fibre and 6358 µg of ß-carotene.

Vanisha *et al*. (2008) reported that 20 g of freshly blanched moringa leaf incorporated recipes were rich in micronutrient and it provides 3955 µg β-carotene (665 retinol equivalents or RE) and 1.6 mg iron in 100 g of standardized products.

Jayabharathi *et al*. (2014) formulated a health mix with sprouted cereals, millets, pulses and drumstick leaf powder. The chemical characteristics was analysed and it was found that the health mix contains 372 kcal of energy, 16.19 g of protein, 2.81 g of fibre, 3359.56 µg of ß-carotene, 374.68 mg of calcium and 5.53 mg of iron in 100 g.

Janci Rani and Sarojini (2011) reported that cereals and legumes are important contributors of carbohydrates and proteins especially for the vegetarian population of the world. The author formulated fermented cereal foods by incorporating dried moringa leaf powder (DMLP). The developed food is wholesome diet and suitable for all age groups. Based on the nutrient content the benefits of formulated recipes were high and it needs to be popularized.

Trace mineral composition of moringa leaf versatile food mix :

The mineral composition of versatile food mix is given in Table 3. The initial value of trace mineral content was 141.5, 138.8, 4.2, 1.16, 113.5, 69.7, 42.5 and 12.8mg/100 g in P_1 and P_2, respectively. There was a decrease in mineral content was observed in 141.0, 138.0, 4.0, 1.12, 113.1, 69.2, 42.0 and 12.3mg/100 g P_1, respectively and 141.2, 138.2, 4.2, 1.15, 113.3, 69.4, 42.4 and 12.0 mg/100 g P_2 at the end of the storage period.

The statistical analysis revealed that there were significant changes noticed in storage period. But the combination of packaging materials and storage period indicated not significant. The mineral analysis indicated that the versatile food mix contain calcium 141.5 mg, phosphorus 138.8 mg and iron 4.2 mg.

The moringa leaf versatile food mix is suitable for all

Table 2 : Changes in the nutrient content of the moringa leaf versatile food mix during storage

Storage periods	Moisture (%)		Carbohydrate(g)		Protein (g)		Fat(g)		Fibre (g)		β-carotene (µg)	
	P_1	P_2	P_1	P_2	P_1	P_2	P_1	P_2	P_1	P_2	P_1	P_2
Initial	5.5	5.5	58.3	58.3	6.5	6.5	2.3	2.3	3.5	3.5	6358	6358
30 days	5.7	5.5	57.7	57.8	6.3	6.5	2.1	2.2	3.4	3.6	6355	6357
60 days	6.0	5.9	56.8	56.9	6.1	6.4	1.8	2.0	3.1	3.5	6351	6352
90 days	6.2	6.0	55.6	55.4	5.8	5.9	1.7	2.0	2.8	3.1	6348	6351
120 days	6.5	6.3	54.5	54.2	5.5	5.7	1.6	1.9	2.5	2.6	6345	6348
150 days	6.6	6.4	53.0	53.0	5.2	5.3	1.6	1.7	2.2	2.5	6341	6343
180 days	6.8	6.5	52.6	52.7	5.0	5.2	1.3	1.5	2.2	2.4	6339	6342
Factors	Moisture		Carbohydrate		Protein		Fat		Fibre		B- Carotene	
	SED	CD (0.05)	SED	CD (0.05)	SED	CD (0.05)	SED	CD (0.05)	SED	CD (0.05)	SED	CD (0.05)
S	0.05574	0.11459**	0.16670	0.34267**	0.04972	0.10221**	0.00891	0.01831**	0.03388	0.06964**	0.08909	0.18312**
P	0.02980	0.06125**	0.08911	0.18316**	0.02658	0.05463**	0.00476	0.00979**	0.01811	0.03722**	0.04762	0.09788**
SP	0.07883	0.16205**	0.23575	0.48460**	0.07032	0.14455**	0.01260	0.02590**	0.04791	0.09848**	0.12599	0.25897**

P_1 - LDPE - Low density polyethylene bags; P_2 - MPP – Metalized polypropylene bags; NS = Non–significant; ** indicates of significance of values at P=0.01, respectively

Table 3 : Trace mineral composition of moringa leaf versatile food mix

Parameters (mg)	Initial		Final	
	P_1	P_2	P_1	P_2
Calcium	141.5	141.5	141.0	141.2
Phosphorus	138.8	138.8	138.0	138.2
Iron	4.2	4.2	4.0	4.2
Copper	1.16	1.16	1.12	1.15
Magnesium	113.5	113.5	113.1	113.3
Potassium	69.7	69.7	69.2	69.4
Sulphur	42.5	42.5	42.0	42.4
Zinc	12.8	12.0	12.3	12.0

age groups. The standardized mix was compared with recommended daily allowance of different age groups. Since the 100 g of versatile food mix will provide 6.5 per cent of protein and 6358µg of beta carotene and hence it will meet the average nutritional requirement of 20 per cent of all age groups.

Conclusion :

This is a multipurpose food mix. It can be used as a dessert by adding milk. The mix can also be used for preparing mint rice, tomato rice by adding spices or it can be cooked as rice and used with any side dish. The moringa leaf versatile food mix was nutritious and healthy, since the versatile food mix was prepared with different types of millets, pulses and addition of dried moringa leaves. Hundred grams of fresh leaves is equal to 25 grams of dried leaves. The versatile food mix was standardized by adding 10 per cent of dried moringa leaves so it provides all essential nutrients, phytochemicals and antioxidants. It can be stored upto 6 months in Metalized Polypropylene (MPP) with minimum losses of nutrients. The mix can be used for all age groups and different disease conditions. Moringa leaf versatile food mix can be recommended to overcome the problem of malnutrition.

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