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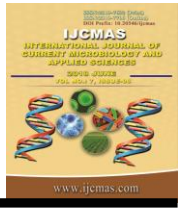

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Formulation and Evaluation of Dehydrated Greens Incorporated Value Added Products

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A B S T R A C T

The present investigation was aimed to increase consumption of green leafy vegetables in the daily diet thus combating the micronutrient deficiencies, especially iron and calcium. A series of laboratory experiments were carried out to study nutritional constituents of some selected green leafy vegetables and after comparing the iron and calcium content of the dehydrated green leafy vegetables, *Amaranthus spinosus, Talinum triangulare* and *Chenopodium album* were found to be higher in both iron and calcium content. So, these three green leafy vegetables were selected for incorporation in various products. These greens were mixed in three different proportions and these formulations were computed for nutritional and tested for rehydration and Formulation- 1 was judged nutritionally superior and showed good physical properties after rehydration. Hence, Formulation 1 was incorporated in preparation of various recipes at 10%, 15% and 20% level and these were found acceptable upto 15% level of incorporation.

Introduction

Green Leafy Vegetables (GLV) are treasure house of nutrients, specially micronutrients in particular, are available at low cost during the seasons in Assam. Owing to high moisture content, green leafy vegetables are highly perishable and are sold at throwaway prices in the peak season resulting in heavy losses to the growers due to non-availability of sufficient storage, transport and proper processing facilities at the production point (Pande *et al.,* 2000). Augmenting utilization and avoiding wastage calls for employing suitable preservation techniques that are user-friendly and sustainable at the household level. Dehydration is one of the traditional methods of preservation, which converts the food in to light weight, easily transportable and storable product. Advantage of this method, if employed for vegetables, is that it can be easily converted in to fresh-like form by rehydrating and can be used throughout the year. It facilitates the utilization of the dried leaves in other parts of the country or world where this vegetable is unavailable in plenty. In addition to increasing variety in the menu, reducing wastage, labour and storage space, dehydrated vegetables are simple to use and have longer shelf life than fresh vegetables (Chauhan and Sharma, 1993). In order to place the GLVs in to the routine diets and to

break monotony of the meals, it becomes essential to convert the traditional products in to attractive, value added acceptable products. The present investigation is an attempt to dehydrate the commonly consumed GLVs and to extend the utility of dehydrated vegetables in traditional recipes for micronutrient security.

Materials and Methods

On the basis of the preliminary screening of 20 locally available green leafy vegetables for micronutrients, three greens were selected on the basis of higher iron and calcium content. The raw material required for the study were procured from local market, sorted with tender stem along with healthy leaves and were washed under tap water then with distilled water. The procedure was repeated till the vegetables are devoid of dirt and soil. The GLVs were dried by cabinet dryer at 60°C. Drying was continued till the GLVs became crisp. The dehydrated GLVs were packed in polyethylene and HDPE pouches and stored for evaluation of shelf life. Moisture, ash, crude fibre, calcium and potassium were estimated following AOAC standard methods (2000, 1984). Iron content was determined using Wong's method and phosphorous was estimated by method described by Fiske and Row (Ranganna, 1986). Vitamin C content was determined by volumetric method (Freed, 1966). The rehydration ratio of dehydrated leaves was estimated using the method suggested by Patil *et al.,* (1978). The microbial analysis of the stored products was done at the end of storage period of 60 days in terms of aerobic plate count (AOAC, 1995).

Results and Discussion

Formulation of greens mixture

After comparing the iron and calcium content of the dehydrated green leafy vegetables, *Amaranthus spinosus, Talinum triangulare* and *Chenopodium album* were found to be higher in both iron and calcium content as compared to other selected green leafy vegetables. These greens also contains a good amount of phosphorous and potassium. The retention of ascorbic acid content of these green leafy vegetables is also quite satisfactory (Fig. 1).

These dried greens also show good rehydration when hydrated. Thus observing all the aspects, three green leafy vegetables *Amaranthus spinosus, Talinum triangulare* and *Chenopodium album* were selected for further purposes.

The three dehydrated green leafy vegetables *Amaranthus spinosus, Talinum triangulare* and *Chenopodium album* were mixed in various proportions and acceptability tests were carried out. The greens mixture was tried to formulate in such a way so that maximum benefit of nutrients with special reference to calcium and iron can be obtained within the accepted level. The three greens were mixed in following ratios –

Formulation 1: 60g (*A. spinosus*): 20g (*T. triangulare*): 20g (*C. album*)

Formulation 2: 50g (*A. spinosus*): 30g (*T. triangulare*): 20g (*C. album*)

Formulation 3: 40g (*A. spinosus*): 30g (*T. triangulare*): 30g (*C. album*)

Nutritional value of these formulations were computed and tested for physical parameters after rehydration.

The nutritive value of the formulations and rehydration ratio are given in Table 1 and Figure 2 and it was found that Formulation 1 was nutritionally superior as well as having good physical properties after rehydration.

Development of greens mixture incorporated recipes

Dehydrated greens can be utilized in multiple ways by incorporating into existing products and formulation of nutrient rich value added products. It is essential to look for sustainable, culturally acceptable, cost effective strategy by which consumption of greens can be increased and thereby combating micronutrient deficiencies. The selection of recipes was done by keeping in mind the consumption pattern and changes in life-style of modern households. The recipes were selected with the purpose to combat micronutrient deficiencies as well as to increase consumption of green leafy vegetables. In addition, it is also aimed to break monotony, provide satisfaction and add variety to the diet. The selected formulation of the greens mixture (60g *A. spinosus*, 20g *T. triangulare* and 20g *C. album* per 100g) was used in preparation of various recipes. Table 2 enlists the developed products by incorporating Formulation 1 greens mixture.

Formulated greens mixture (Formulation 1) was incorporated into the above products with an aim of facilitating the consumption of green leafy vegetables as well as to help combat micronutrient deficiency. The selected recipes were consumed by almost all of the age groups of Indian population and can be prepared with fewer ingredients and in less time. Though children and adolescents are at risk for micronutrient deficiency, they mostly prefer snacks and fast food items. Therefore, by enriching the snack items such as *pakoda* with dehydrated green leafy vegetables, micronutrient content of the diet can be ensured. Greens incorporated *roti* can be provided as a breakfast item, tiffin item as well as can be consumed as meal. The *biscuits, pakoda*and *nimkee* are the products which are commonly consumed as snack items between the meals. *nimkee* (baked and fried) and salty biscuit can also be prepared for commercial purpose as these products have good market demand. Hence, fortification of these common foods with dehydrated green leafy vegetables can be a way to incorporate micronutrients in the diet without much effort. This food based strategy is much safer than medicated supplementation (Table 3).

In the present study, the greens incorporated products were found with high amount of micronutrients specially calcium and iron. Highest calcium content was found in greens incorporated *pakoda* (391.83 mg/100g) followed by*roti* (382.60 mg/100g), baked *nimkee* (243.10 mg/100g), salty biscuit (232.50 mg/100g) and fried *nimkee* (225.80 mg/100g). The iron content of the products was in the range of 7.67-12.56 mg/100g. Per 10 g of Formulation 1 greens mixture provides 221.02 mg calcium and 6.28 mg iron, so by incorporating greens mixture in various proportion to common recipes, the calcium and iron content can be increased.

Verma and Jain (2012) assessed the nutritional quality of *mathri* fortified with fresh and dehydrated vegetables (spinach 1.50 g, mint 1.50 g, carrot 1g and lotus stem 6g) in 7% incorporation in *mathri*. Iron content was high in dried vegetables *mathri* was 5.37 mg in comparison to *mathri* prepared with fresh greens (1.30 mg). The ash content was 2.10% and 1.40% for dried and fresh respectively. In the present study, the iron content of fried and baked nimkee was increased to 7.67 and 8.10 mg/100g at 15% level of incorporation. Wani *et al.,* (2011) estimated the chemical constituents (moisture, protein, fat, ash and fibre) of noodles by adding cauliflower leaf powder to the noodle formulation at the level of 0, 10, 15, and 20% flour weight basis and indicated that noodles with cauliflower leaf powder for all addition levels contained more protein, fibre and ash in comparison to control sample.

Table.1 Nutrient composition of the formulated greens mixtures (per 100g)

Green leafy vegetables	Moisture (g)	Ash (g)	Crude fibre (g)	Calcium (mg)	Iron (mg)	Phosphorous (mg)	Potassium (mg)	Vit. C (mg)
Formulation 1	4.63	14.45	9.85	2212.05	62.78	310.20	2289.10	10.34
Formulation 2	4.68	13.78	8.32	2050.70	56.92	345.20	2752.40	10.70
Formulation 3	4.67	13.25	8.11	1872.91	50.77	352.30	2659.50	11.54

Table.2 Development of greens incorporated recipes for calcium and iron security

Name of the products	Ingredients used	% Level of incorporation of greens mixture
Roti	Whole wheat flour, refine oil, salt and water for kneading	10, 15 and 20
Pakoda	Bengal gram flour, onion, green chilli, ginger, baking soda, salt, oil (for frying)	10, 15 and 20
Fried *nimkee*	Refined wheat flour, dalda, sugar, salt, black cumin, oil (for frying)	10, 15 and 20
Baked *nimkee*	Refined wheat flour, dalda, sugar, salt, black cumin	10, 15 and 20
Salty biscuit	Refined wheat flour, dalda, sugar, salt, egg, baking powder, black cumin	10, 15 and 20

Table.3 Nutrient composition of greens incorporated products (per 100g)

Products	Moisture (g)	Ash (g)	Crude fiber (g)	Calcium (mg)	Iron (mg)	Phosphorous (mg)	Potassium (mg)	Vit C (mg)
Roti	23.48	4.12	3.89	382.60	12.10	278.34	374.83	1.12
Pakoda	15.53	2.04	2.21	391.83	12.56	262.13	353.56	0.93
Fried *nimkee*	4.03	2.21	1.52	225.80	7.67	103.60	211.40	0.73
Baked *nimkee*	3.54	2.42	1.73	243.10	8.10	112.40	236.10	0.78
Salty biscuit	3.87	1.65	1.02	232.50	7.76	106.70	228.90	0.67

Table.4 Effect of packaging material on moisture content

Product	Storage days	Moisture content (g/100g)		
		Plastic bottle (TARSON)	HDPE (200 gauge)	PP (100 gauge)
Greens mixture (reduced to pieces)	0	3.76 ± 0.24	3.76 ± 0.18	3.76 ± 0.28
	30	3.91 ± 0.17	3.84 ± 0.26	3.97 ± 0.24
	60	4.12 ± 0.18	3.98 ± 0.17	4.18 ± 0.22
Greens mixture (powder)	0	3.70 ± 0.26	3.70 ± 0.19	3.70 ± 0.26
	30	3.88 ± 0.19	3.81 ± 0.24	3.94 ± 0.14
	60	4.03 ± 0.17	3.90 ± 0.26	4.11 ± 0.18
Nimkee (fried)	0	4.14 ± 0.18	4.14 ± 0.21	4.14 ± 0.19
	30	4.28 ± 0.24	4.22 ± 0.26	4.37 ± 0.28
	60	4.52 ± 0.17	4.41 ± 0.18	4.63 ± 0.21
Nimke (baked)	0	3.95 ± 0.26	3.95 ± 0.28	3.95 ± 0.22
	30	4.21 ±0.21	4.10 ± 0.24	4.26 ± 0.18
	60	4.32 ± 0.19	4.23 ± 0.22	4.43 ± 0.14
Salty Biscuit	0	4.35 ± 0.24	4.35 ± 0.17	4.35 ± 0.21
	30	4.49 ± 0.18	4.42 ± 0.19	4.58 ± 0.17
	60`	4.65 ± 0.28	4.58 ± 0.26	4.86 ± 0.24

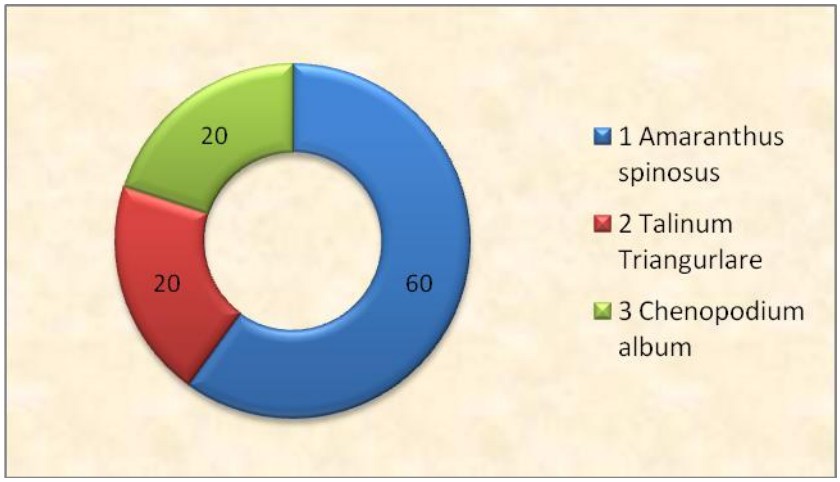
Mean ± Standard deviation

Table.5 Effect of packaging material on rehydration ratio of dehydrated greens mixture

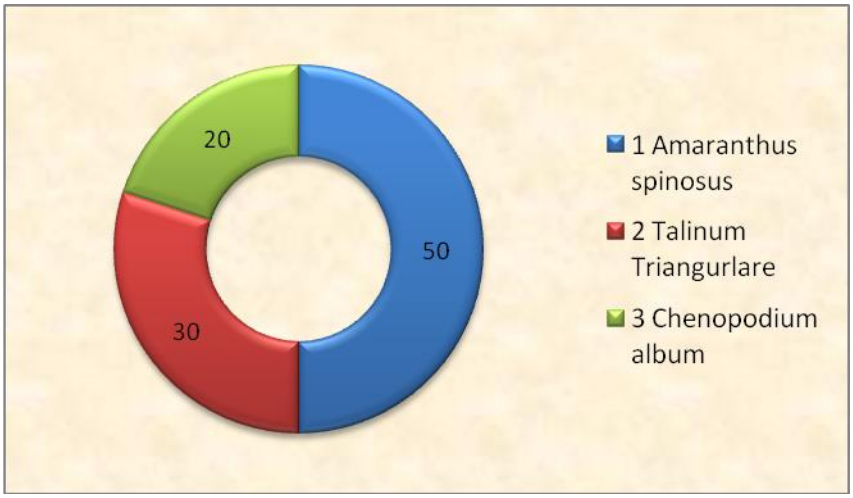
Product	Storage days	Rehydration ratio		
		Plastic bottle (TARSON)	HDPE (200 gauge)	PP (100 gauge)
Greens mixture (coarse)	0	5.70 ± 0.26	5.70 ± 0.24	5.70 ± 0.19
	30	5.41 ± 0.21	5.54 ± 0.14	5.37 ± 0.22
	60	5.12 ± 0.19	5.36 ± 0.28	5.08 ± 0.26
Greens mixture (powder)	0	5.78 ± 0.24	5.78 ± 0.17	5.78 ± 0.28
	30	5.48 ± 0.22	5.57 ± 0.26	5.44 ± 0.24
	60	5.17 ± 0.28	5.40 ± 0.19	5.10 ± 0.21

Mean ± Standard deviation

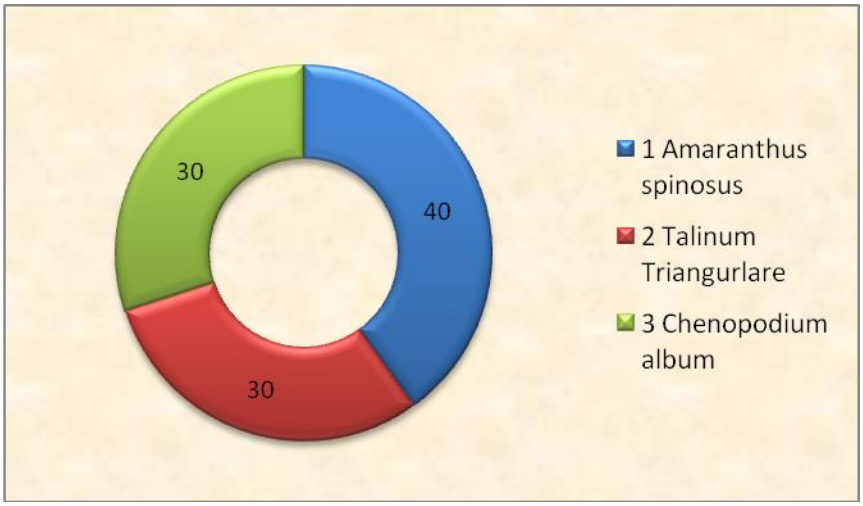
Fig.1 Formulation of dehydrated greens mixture



Formulation.1



Formulation.2



Formulation.3

Fig.2 Rehydration ratio of the developed formulations

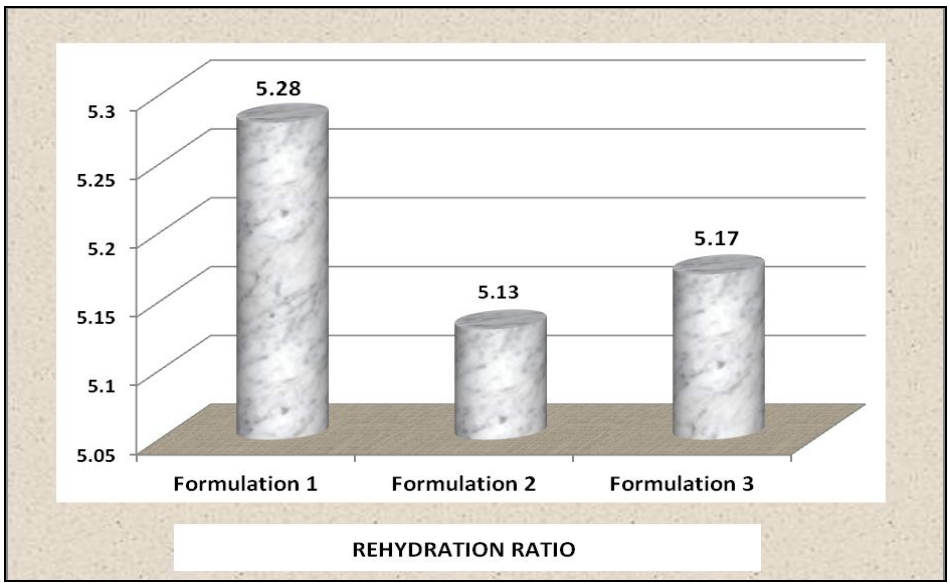
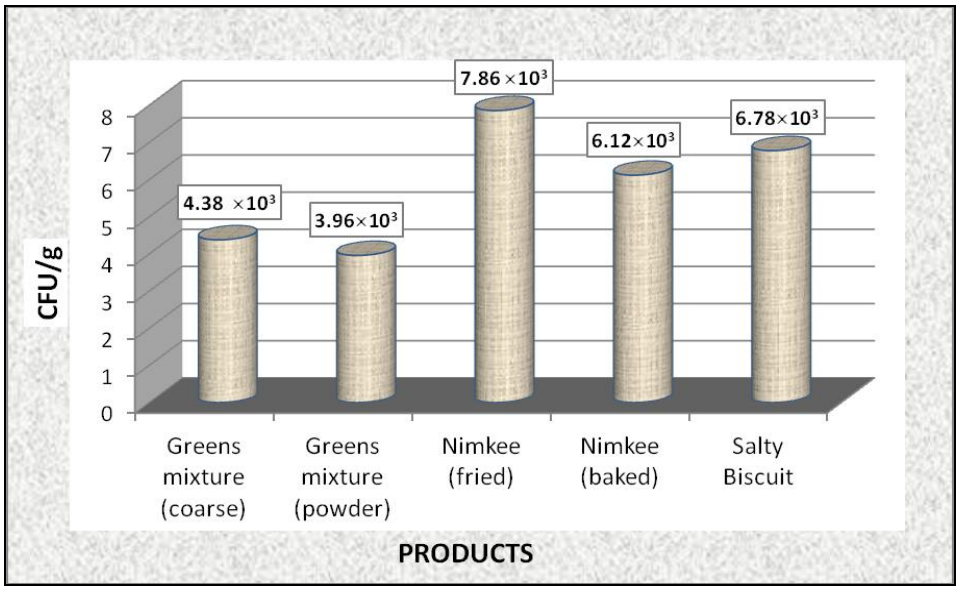


Fig.3 Aerobic plate count of dehydrated greens mixture and selected incorporated products



Storage study of the developed products

The formulated greens mixture and the developed products which can be stored for longer period, such as *nimkee* (baked and fried) and salty biscuit were studied for shelf life by evaluating moisture content and rehydration ratio of dehydrated greens in 30 days and 60 days of storage. The microbial analysis was done at the end of storage period of 60 days.

As evident from Table 4, the moisture content gradually increased on storage. Maximum increment of moisture was seen in PP pouches whereas HDPE pouch showed less increment. This may be due to structural difference, composition and thickness of the two

materials. The water vapour transition rate of the two packaging material differs which resulted in variation of moisture content of the studied product.

From the Table 5, it is observed that rehydration ratio of dehydrated green leafy vegetables decreased on storage and was also observed variation in different packaging materials. Highest rehydration ratio was observed in HDPE packaged dehydrated greens and lowest in PP pouch packaged greens. As more moisture permeates through PP pouches than HDPE pouches, this leads to decrease in rehydration ratio of the dehydrated greens. Singh and Sagar (2010) and Seevaratnam *et al.,* (2012) reported similar results where HDPE packaged greens showed more rehydration ratio as compared to PP packaged leaves. Hence, HDPE was found to be more suitable for storage.

In the present study, the dehydrated greens mixture and selected greens incorporated products packaged in HDPE pouches were analyzed for aerobic plate count at the end of the storage period of 60 days.

As evident from Figure 3, the total colony forming unit (CFU) was highest in fried *nimkee* and lowest in powdered greens mixture. Total CFU was less in baked *nimkee* as compared to fried *nimkee.* This may be due to high moisture content of fried *nimkee* than baked *nimkee*. The microbial load of the dehydrated greens was low due to low moisture content which hampers the growth of microorganism. In case of baked products, the temperature employed during cooking is more (150-175^{o}C) which may decrease the initial microbial load of the product.

Thus from the microbial analysis, it was observed that these products can be stored upto 60 days without any marked growth of microorganisms.

Green leafy vegetables are the treasure trove of micronutrients and judicious combination of green leafy vegetables might serve as richer source of specific micronutrients. Dehydrated green leafy vegetables will serve as an instant food ingredient to be used without laborious pre-processing. Dehydration also increases shelf-life of the greens. Dehydrated green leafy vegetables can be efficiently utilized for processing of value added products. Consumption of dehydrated green leafy vegetables incorporated products in daily diet will ensure micronutrient security.

References

A.O.A.C. (1984). Official methods of Analysis of the Association of Official Analysis Chemists, Washington D.C., pp. 191-213.

A.O.A.C. (1995). Official methods of Analysis of the Association of Official Analysis Chemists, Washington D.C. 16th edition.

A.O.A.C. (2000). Official Methods of Analysis. Association of Official Analytical Chemists (17thed.) Washington, D.C.

Chauhan, S.K. and Sharma, C.R. (1993). Development of instant dehydrated saag. *Beverage and Food World* 20(4): 25-26.

Freed, M., 1966. Method of vitamin assay. Interscience Publication Inc., New York.

Pande, V.K., Sonune, A.V. and Philip, S.K. (2000). Solar drying of coriander and methi. *J. Fd. Sci. Technol.* 37(2): 110-113.

Patil, V.R., Kulkarni, D.N., Kulkarni, K. and Ingle, U.M. (1978). Effect of blanching factors on quality and durability of sundried and dehydrated fenugreek (*methi*). *Indian Food Packer* 32(1): 43-49.

Ranganna, S. (1986). In Handbook of analysis and quality control for fruit and vegetable products. 2nd Ed., Tata McGraw-Hill, New Delhi, India.

Seevaratnam, V., Banumathi, P., Premalatha, M.R., Sundaram, S.P. and Arumugam, T. (2012). Effect of Packaging Materials on Retention of Quality Characteristics of Selected Dehydrated Green Leafy Vegetables during Storage. *World J. Dairy Fd. Sci.* 7(2): 190-194.

Singh, U. and Sagar, V.R. (2010). Quality characteristics of dehydrated leafy vegetables influenced by packaging materials and storage temperature. *J. Sci. Indust. Res.* 69: 785-789.

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