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Standardization and organoleptic evaluation of Nutri-dense Poshan mix

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Abstract
Malnutrition is a burning issue in developing countries. Food plays is the major in deciding nutritional status of the population. This study was conducted with an objective to standardize nutria-dense food mix. Pulses are consumed worldwide and are desired for their high protein quality and quantity. They represent an affordable alternative to animal protein by complementing cereal proteins, thus providing a balanced amino acid profile in vegetarian diets. So Cereal and pulse ingredients were used in product development. Wheat, green gram and horse gram constituted main ingredients, additionally skim milk and drumstick leave powder were also added. Organoleptic evaluation was carried out using 9 point hedonic scale. Best accepted combination of ingredients was selected to be final product. Twenty percent skim milk powder and 10 per cent dehydrated drumstick leaves powder incorporation was accepted.

Keywords: Composite mix, product development, organoleptic evaluation, germination

Introduction
Development of nutritious and organoleptically acceptable recipes with locally available foods is a challenge for the food scientist. However, the benefits of such food- based strategies to prevent micronutrient malnutrition are manifold. They: (a) are preventive, (b) are cost-effective, (c) are sustainable, (d) are income- generating, (e) are culturally acceptable and feasible to implement, (f) promote self- reliance and community participation, and (g) foster the development of environmentally sound food production systems [1].

A variety of factors reduce the nutritional value of cereals and pulses, such as enzyme inhibitors and other anti-nutritional components which limit protein digestibility and quality, and metal chelating agents which reduce the bioavailability of micronutrients such as iron and zinc [2]. However, a number of processing methods may be employed to eliminate or reduce the level or activity of these factors, including germination, fermentation, soaking, dehulling and thermal treatments (e.g., infrared heating, canning or boiling). Germination (sprouting) is a traditional, non-thermal process which improves the nutritional quality of cereals and pulses by increasing nutrient digestibility, reducing the levels or activities of anti-nutritional compounds, boosting the contents of free amino acids and available carbohydrate, and improving functionality [3]. Germination involves chemical changes such as the hydrolysis of starch, protein and fat by amylolytic, proteolytic and lipolytic enzymes, respectively. When grains and seeds are hydrated (soaked) and then held (sprouted) under ambient conditions, both endogenous and newly synthesized enzymes begin to modify seed constituents. Thus, complex macromolecules are broken down into lower molecular weight molecules which are more digestible and more readily absorbed by the body [4].

Germination or malting result in some biochemical modification like increase in free amino acids and total sugars and decrease in dry weight and starch content, as well as improved protein quality. Processing's like germination, soaking, debraning and dry heating reduce antinutrients like phytic acid, tannins, and polyphenols that usually interact with proteins to form complexes.

Germination is an inexpensive and effective method for improving the overall nutritional quality of food grains by enhancing their digestibility and reducing the contents of anti nutritional factors.

Germination of grains increases the protein, ash, iron, calcium and phosphorus level of malted mixes developed. The use of locally available low-cost ingredients available in developing countries has great potential for producing highly nutritious, acceptable and dense foods. The addition of malt to foods improved their functional and nutritional qualities.

People in developing countries often consume inadequate amounts of micro- nutrients because of their limited intake of animal products, fruits, vegetables, and fortified foods. Intakes of micro-nutrients less than the recommended.

Use of green leafy vegetables to eradicate underlying micronutrient deficiencies has been advocated for a long time. The leaves of the drumstick tree (Moringa oleifera) have one the highest known contents of total carotene (~40,000 µg/100 g FW) and β- carotene (~19,000 µg/100 g FW). They are also an excellent source of a variety of other nutrients and phytochemicals (phytonutrients), which have been shown to have positive health effects [3-6]. Drumstick leaves may have an unacceptably bitter taste to some people, due to the presence of polyphenols [5]. However, these polyphenols have also been reported to have multiple beneficial biological effects, including antioxidant activity, anti- inflammatory action, inhibition of platelet aggregation, antimicrobial activities and anti- tumor activities [7-10]. Promotion, development, and even engineering of plant foods with enhanced concentrations of chemopreventive phytonutrients are promising new strategies for promoting health. However, any meaningful inclusion of phytonutrients must also consider the taste of these substances. Consumer and marketing studies invariably show that taste, as opposed to perceived nutrition or health value, is the key influence on food selection. Thus, organoleptically acceptable recipes with drumstick leaves would be a most suitable protocol for dietary diversification or improvement, as these leaves are storehouses of both the classic nutrients (carbohydrate, protein, oil, vitamins and minerals) as well as beneficial non- nutrients (typically referred to as phytochemicals or phytonutrients).

The adverse effects of deficiencies in vitamin A, iron, and folic acid, including night- blindness in pregnant and lactating women and iron- deficiency anemia, are well known. Low intakes of these and other nutrients, including zinc, calcium, riboflavin, vitamin B6, and vitamin B12, also have consequences for women’s health, pregnancy outcome, and the health and nutritional status of breastfed children. Multiple deficiencies coexist, so the benefit of multiple micronutrient supplements is becoming increasingly apparent. These issues need to be discussed, and guidance be provided on the selection of appropriate food for women of reproductive age in developing countries. The main effect of vitamin A is to maintain adequate levels of iron in plasma to supply the different body tissues including the bone marrow with proper amounts of this essential mineral which may be the mechanism by which the hemopoeitic tissue becomes flavored with more available iron. A significant association of serum retinol with hematocrit, serum iron and serum ferritin has been reported by Bloem *et al.* (1989) in a cross sectional study of children in north east Thailand [2]. Several studies using dehydrated drumstick leaves (DDL) in traditional Indian recipes have been carried out in recent years, evaluating the recipes for their acceptability among children. However, the threshold for acceptability may vary since drumstick leaves have a slightly bitter taste to many people. This distinctive taste is compounded by innate taste preferences, sex and age, thus adding an extra layer of complexity to the acceptance of bitter plant foods by the consumer.

Hence keeping these issues in mind study was conducted with an objective to develop and evaluate protein and micronutrient dense poshan mix.

Methods

Fresh drumstick leaves (Moringa oleifera) were obtained from trees around the city of Dharwad, Karnataka. Commonly used Cereal (wheat) and pulse (green gram and horse gram) were procured from local market.

Malted wheat, green gram, horse gram, dehydrated drumstick leaves powder, skim milk powder were the ingredients used. The optimization for quantity of various ingredients used in the development of the product for sensory attributes was done. Standardization of poshan mix is shown in figure 1.

Organoleptic evaluation of Poshan mix

The developed mix was further made into drink for organoleptic evaluation. Nine point hedonic scale was used to assess its acceptability. The organoleptic characters like appearance, colour, texture, taste, flavor and overall acceptability was tested for the developed composite mix. Sensory evaluation was carried out by the 15 semi-trained panel members using nine-point hedonic scale in the department of Food Science and Nutrition, UAS, Dharwad. The participants were randomly invited to participate in the study.

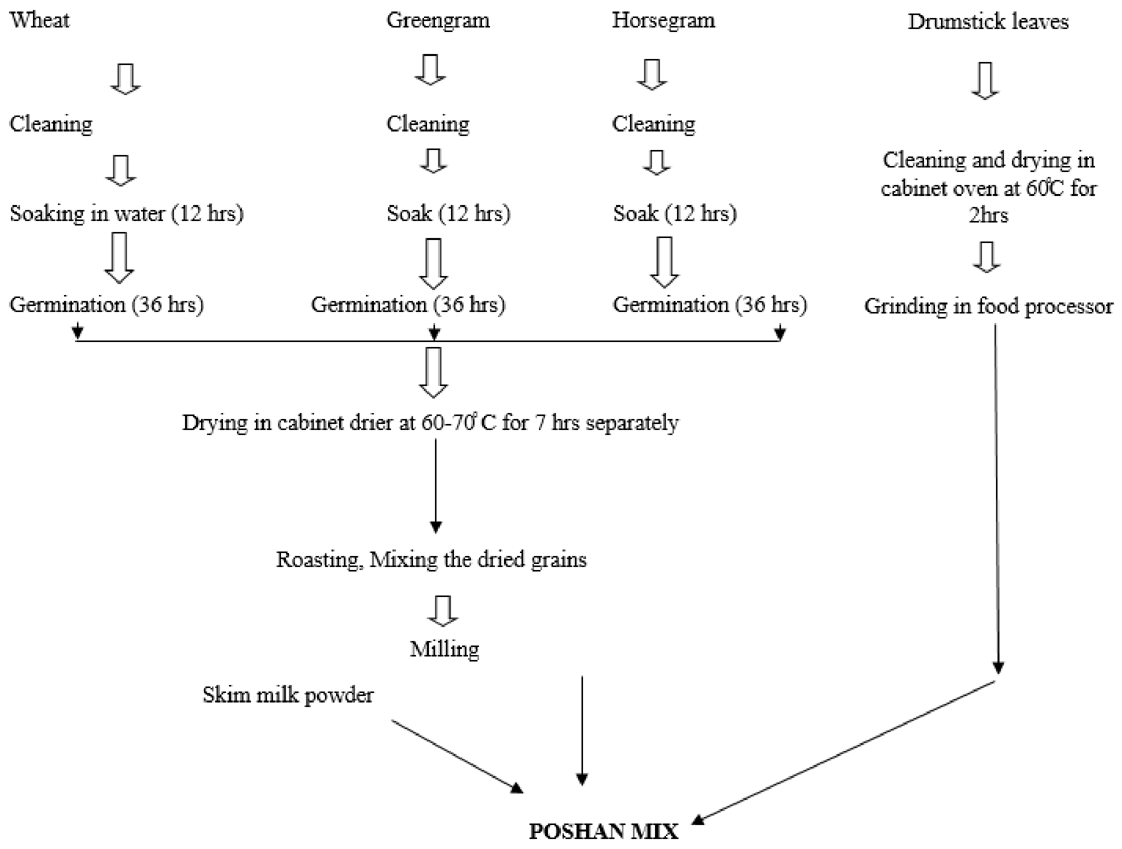

Fig 1: Process chart for Standardization of Poshan mix

Results and Discussion

Developed composite mix was made into drink by addition of jaggery and water. Drink was further evaluated. Optimization of pulse incorporation in poshan mix was standardized in 3 trials. Green gram and horse gram were taken on 25:75, 50:50 and 75:25 proportions, keeping wheat as constant (table 1). The best accepted trial i.e., green gram and horse gram in 50:50 proportion was further selected for optimization of other ingredients (table 2). Kadam *et al*., (2012) developed composite mix using wheat flour, chickpea, and soybean and methi leaves powder and it was acceptable.

Srivatsava *et al*., (2015) also developed weaning food using germinated cereals and pulses flour and assessed its organoleptic quality as well as nutritional composition. The flour (wheat, Bajra and whole moong flour) were mixed in different proportion to prepared Sweet Porridge and named as T1 (WF: BF: MF, 60: 20: 20), T2 (WF: BF: MF, 20: 70: 10) and T3 (WF: BF: MF, 20: 15: 65). The result shows that T3 scored best in overall acceptability among all the treatments.

Skim milk was incorporated at 3 different levels such as 10gm, 15gm and 20gm (table 3). Trial 3 was best accepted compared to other 2 trials (table 4). Tumwine *et al*., 2018 to develop a nutrient-enhanced millet-based composite flour incorporating skimmed milk powder and vegetables. The study demonstrated that the use of skimmed milk powder and vegetables was highly acceptable and greatly improved the protein quality and micronutrient profile of millet-based complementary foods.

Dehydrated drumstick leaves powder was incorporated at 10gm, 15gm and 20gm (table 5). Incorporation of 10gm of drumstick was acceptable (table 6). Nambiar and Parnami (2008) also conducted similar study where in drumstick leaves were incorporated to pulse recipes and was found acceptable.

Table 1: Optimization of pulse incorporation for preparation composite mix

Trials	Wheat (g)	Green gram (g)	Horse gram (g)
1	50 (50%)	12.50 (12.5%)	37.50 (37.5%)
2	50 (50%)	25 (25%)	25 (25%)
3	50 (50%)	37.50 (37.5%)	12.50 (12.5%)

Values in bracket indicates percentage

Table 2: Sensory profile of pulse variation trials

GG:HG ratio	Appearance	Colour	Texture	Flavour	Taste	Overall Acceptability	Acceptability index
25:75	6.67±0.62^{bc}	6.80±0.86^{bc}	6.73±0.88^{b}	6.67±0.72^{ab}	6.73±0.80^{ab}	6.67±0.72^{bc}	74.57±7.93^{bc}
50:50	7.13±0.64^{b}	7.20±0.56^{ab}	6.87±1.51^{ab}	7.00±1.00^{ab}	7.00±0.85^{ab}	7.00±0.85^{ab}	78.15±9.37^{ab}
75:25	6.20±1.32^{c}	6.40±1.18^{c}	6.20±1.32^{b}	6.27±1.39^{c}	6.27±1.39^{b}	6.20±1.08^{c}	69.51±14.01^{c}
Total Mean	6.97±1.06	7.03±0.97	6.87±1.24	6.80±1.15	6.87±1.10	6.83±0.98	76.61±11.40
F-value	9.82***	6.59***	4.15**	2.27^{NS}	3.55*	5.53*	5.39**
SEM±	0.23	0.22	0.30	-	0.27	0.23	2.66
CD at 5%	0.64	0.63	0.84	-	0.75	0.64	7.54

Values indicate mean ± SD of three replications. NS-Non Significant, *- significant at $p\leq 0.05$, ** - significant at $p\leq 0.01$ and *** - highly significant at $p\leq 0.001$.

Values in a column followed by different letters are significantly different according to DMRT at 5% level.

Table 3: Optimization of skim milk powder incorporation for preparation composite mix

Trials	Wheat (g)	Green gram (g)	Horse gram (g)	SMP (g)
1	50	25	25	10
2	50	25	25	15
3	50	25	25	20

SMP-Skim Milk Powder

Table 4: Sensory profile of skim milk powder incorporation

Sample	Appearance	Colour	Texture	Flavour	Taste	Overall Acceptability	Acceptability index
10g	7.47±0.52[b]	7.07±0.70[c]	7.53±0.52[a]	7.53±0.52[b]	6.67±0.72[b]	7.47±0.52[ab]	80.99±4.62[b]
15g	7.53±0.52[b]	7.52±0.52[b]	6.80±0.68[b]	6.80±0.86[c]	6.67±0.90[b]	6.67±0.82[c]	77.78±4.14[c]
20g	8.47±0.52[a]	8.80±0.41[a]	7.27±0.59[a]	8.33±0.62[a]	8.47±0.52[a]	8.27±0.59[a]	91.85±2.60[a]
Total Mean	7.91±0.74	7.73±0.93	7.47±0.76	7.48±0.78	7.36±1.02	7.49±0.81	84.15±6.76
F-value	21.44***	34.30***	9.95***	12.14***	19.65***	13.71***	40.89***
SEM±	0.13	0.15	0.16	0.16	0.19	0.16	0.98
CD at 5%	0.37	0.42	0.45	0.45	0.53	0.45	2.77

Values indicate mean ± SD of three replications. NS-Non Significant, *- significant at $p \leq 0.05$, ** - significant at $p \leq 0.01$ and *** - highly significant at $p \leq 0.001$.
Values in a column followed by different letters are significantly different according to DMRT at 5% level.

Table 5: Optimization of dehydrated drumstick leaves powder incorporation for preparation composite mix

Trials	Wheat (g)	Green gram (g)	Horse gram (g)	SMP (g)	DDLP (g)
1	50	25	25	20	10
2	50	25	25	20	15
3	50	25	25	20	20

SMP-Skim Milk Powder
DDLP- Dehydrated Drumstick Leaves Powder

Table 6: Sensory profile of drumstick leaves powder incorporation

Sample	Appearance	Colour	Texture	Flavour	Taste	Overall Acceptability	Acceptability index
10g	8.47±0.52[a]	8.40±0.74[a]	8.33±0.62[a]	8.33±0.62[a]	8.40±0.51[a]	8.40±0.51[a]	93.21±5.54[a]
15g	7.47±0.52[b]	7.47±0.52[b]	7.40±0.51[b]	7.33±0.49[b]	7.33±0.49[b]	7.33±0.49[b]	82.10±4.41[b]
20g	6.80±1.21[c]	6.47±0.64[c]	6.87±1.13[bc]	6.53±1.06[c]	6.40±1.06[c]	6.60±1.12[c]	73.46±9.72[c]
Total Mean	7.33±1.07	7.35±0.97	7.30±0.99	7.17±1.03	7.13±1.07	7.22±1.04	80.56±10.43
F-value	16.77***	21.29***	15.23***	22.69***	29.14***	20.92***	29.80***
SEM±	0.21	0.18	0.20	0.18	0.18	0.19	1.72
CD at 5%	0.58	0.50	0.56	0.52	0.50	0.54	4.86

Values indicate mean ± SD of three replications. NS-Non Significant, *- significant at $p \leq 0.05$, ** - significant at $p \leq 0.01$ and *** - highly significant at $p \leq 0.001$.
Values in a column followed by different letters are significantly different according to DMRT at 5% level.

Conclusion

Malnutrition is defined as "the cellular imbalance between supply of nutrients and energy and the body's demand for them to ensure growth, maintenance, and specific functions". In developing countries due to lack of accessibility and knowledge the quality and quantity of food intake is very low. Hence it is important to incorporate more nutrients in regular means, this is possible only by formulation of nutri-dense products using locally available common food ingredients. Developed product in this study is rich in amino acid as the cereals and pulse complement each other with regard to essential amino acid. Hence the developed poshan mix can be used in everyday diet to ensure better nutrition.

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