The Pharma Innovation Journal 2020; 9(7): 131-136

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.03
TPI 2020; 9(7): 131-136

www.thepharmajournal.com
Received: 18-05-2020
Accepted: 20-06-2020

Shekahara Naik R
Department of Food Science and Nutrition Yuavraja's College, (An Autonomous constituent College under University of Mysore), Mysuru, Karnataka, India

Akshay GM
Department of Food Science and Nutrition Yuavraja's College, (An Autonomous constituent College under University of Mysore), Mysuru, Karnataka, India

Prakruthi M
Department of Food Science and Nutrition Yuavraja's College, (An Autonomous constituent College under University of Mysore), Mysuru, Karnataka, India

Devaki CS
Department of Food Science and Nutrition Yuavraja's College, (An Autonomous constituent College under University of Mysore), Mysuru, Karnataka, India

Mahesh MS
Department of Food Science and Nutrition Yuavraja's College, (An Autonomous constituent College under University of Mysore), Mysuru, Karnataka, India

Corresponding Author:
Mahesh MS
Department of Food Science and Nutrition Yuavraja's College, (An Autonomous constituent College under University of Mysore), Mysuru, Karnataka, India

Development of noodles with composite flour containing malted barnyard millet composite flour and its evaluation

Shekahara Naik R, Akshay GM, Prakruthi M, Devaki CS and Mahesh MS

Abstract
More than 2 billion people i.e. over 30% of the world's population, suffer from deficiencies of micronutrients including iron, iodine, zinc, and vitamin A termed as hidden hunger. Noodles are consumed by a large number of the population and is a staple food in many parts of the world. Although >100000 million servings of noodles is consumed annually, it is energy dense, sodium rich, micro-nutrients deficient and high GI food with low fibre and thus not a healthy food. The sheer volume of noodle consumption makes it ideal vehicle for fortification and enrichment. Further, a large population are also gluten sensitive and develop mild to moderate symptoms of gluten intolerance after noodle consumption. Partial replacement of wheat flour with millet flour can reduce the gluten content and increase the micro-nutrient content of noodles. Barnyard millet is high fibre, no gluten, and low GI food with good source of several micro-nutrients. Thus in the present study wheat flour was partially replaced with malted barnyard millet flour (MBMF) in different proportion and noodles was developed. Wheat flour was replaced with 10-50% MBMF and noodles was developed. Sensory evaluation, nutrient composition analysis of the developed noodles was carried out. Partial replacement up to 20% with MBMF was better accepted. Incorporation of MBMF enhanced nutrient composition of noodles especially in terms of micro nutrient. Incorporation of millet flour into noodles preparation enhances its nutrition profile and makes it slightly healthier.

Keywords: Noodles, barnyard millet, nutrition, malting, fortification

1. Introduction

In many Asian countries, noodles are part of their staple diet. Instant noodles have become internationally recognized food, and consumption is on the rise in India. Ten of the top 15 consumers of instant noodles are Asian countries. The consumption of instant noodles in India has increased from 3260 million servings in 2015 to 6730 million servings in 2019 [1]. FSSAI (Food Safety and Standards Authority of India) defines noodles as, "Instant noodles (not applied to noodle seasoning) means product prepared from wheat flour and/or rice flour and/or flour of any other cereals, millets and legumes covered in sub-regulation 2.4 of the Food Safety and Standards (Food Products Standards and Food Additives) Regulations, 2011, and water as the main ingredient, with or without the addition of spices by kneading the dough and extending it [2]. The characteristic feature of instant noodles is the use of pre-gelatinization process and dehydration either by frying in any oil or fat covered under sub-regulation 2.2 of the Food Safety and Standards (Food Products Standards and Food Additives) Regulations, 2011, or by other methods. The product should be presented as fried noodles or non-fried noodles" (FSSAI). Although noodles can be prepared from noodles can be prepared from any cereals, millets or legume flour it is generally prepared in wheat flour or refined wheat flour (Maida).

The ill effects of nutrient deficiencies in Asia are particularly concerning since Asia is home to more than 3.8 billion people [3]. However, the region is also home to many cases of nutrition related diseases. The micronutrient intake in the daily diet is far from satisfactory and largely less than 50% of the RDA is consumed by 70% of the Indian population (National Nutrition Monitoring Bureau, 2002). To address these nutritional deficiency disorders and prevent their occurrence in the future, staple foods and condiments may be fortified based on the dietary practices and their nutritional requirements [4]. The high consumption of noodles across the world make it an ideal vehicle for fortification [5]. Global consumption of the noodles is second only to bread [6]. Noodles can also be prepared from composite flours, i.e. a mixture of different flours used in different proportion.

Millets are miraculous in their nutrition content. Millets are superior to rice in their protein content and are equal to wheat without gluten. Their fibre content is 3 to 5 times more than the widely promoted rice and wheat [7]. This increased fibre content is one of the reasons millets to have very low glycemic index compared to rice and wheat and thus beneficial in weight reduction, insulin resistance and diabetes mellitus. The high fibre content of millets acts as pre-biotics or gut fertilizers and thus helps to maintain healthy gut microbiome [8].

Barnyard millet is a multi-purpose crop that is cultivated for fodder as well as for human consumption [9]. Barnyard millet is known to be a good source of protein which is highly digestible. It is also known to be an excellent source of dietary fibre (both soluble and insoluble). The carbohydrate content of Barnyard millet is low and is slowly digestible. The major fatty acid present in Barnyard millet is Linoleic acid [10]. In this study attempts were made to develop noodles using a composite flour of wheat flour and malted barnyard millet flour and to evaluate the sensory and nutritional characteristics.

2. Materials and methods

2.1 Procurement of materials

The barnyard millet was procured from a local organic farm. The wheat flour used for the preparation of noodles was procured from the regulated market and checked for the protein content (protein content for noodle preparation should be between 8-12%). The palm oil used to fry the noodles was procured in the packed form (Ruchi Gold) from a local shop. The additives used were procured locally from various shops across the city.

All the chemicals used in the analysis were of analytical grade.

2.2 Malting of barnyard millet

The millet was procured in the raw form and weighed. Malting was carried out as per the following procedure

The millet was cleaned to remove dirt, dust etc.

↓

The millet was steeped in water for 24 hours (Grain to water in the ration 1:3)

↓

The water was changed after every 4 hours

↓

The water was drained out and then the grains were spread on trays lined with muslin cloth

↓

Germination was carried out for 24 hours at room temperature

↓

The germinated grains were dried at 65^0C

↓

The husk and rootlets were removed

↓

The grains were then ground and sieved using a particle size 85 mesh (BSS)

↓

The finely powdered malt was used in the preparation of noodles.

2.3 Development of noodles with composite flour of malted barnyard millet flour and wheat flour

The noodles were developed according to the procedures given by Taneya et al. [11] and Kulkarni et al. [12].

Composite flour

Composite flour was prepared by mixing malted barnyard millet flour (MBMF) with wheat flour in different proportion viz., 90:10, 80:20, 70:30, 60:40, 50:50.

Procedure

All the ingredients except for the flour and oil were mixed in warm water

↓

The flour was mixed with oil and water containing all the ingredients

↓

The dough was kneaded for 10 minutes and rested for 40 minutes

↓

The dough was then extruded into noodle strands

↓

The noodles were steamed at atmospheric pressure for 3 minutes at 100 °C

↓

The noodles were fried at 145 °C for 90 seconds in palm oil

↓

The prepared noodles were then packed in polypropylene bags of 50 g each

Table 1: Ingredients used in the development of composite flour noodles

S. No.	Ingredients	Samples					
		C	S1	S2	S3	S4	S5
1	Wheat flour (g)	100	90	80	70	60	50
2	Malted barnyard millet flour (g)	0	10	20	30	40	50
3	Water (ml)	31	31	31	31	31	31
4	Oil (ml)	5	5	5	5	5	5
5	Starch (g)	2	2	2	2	2	2
6	Salt (g)	1	1	1	1	1	1
7	Sodium bicarbonate (g)	1	1	1	1	1	1
8	Citric acid (g)	0.1	0.1	0.1	0.1	0.1	0.1
9	GMS (g)	0	1	1	0	1	1
10	Xanthan Gum	0	2	2	0	2	2

2.4 Analysis of nutrient composition

Nutritional composition of noodles namely moisture, protein, fat, ash and fibre were analyzed by following standard analytical methods [13]. Carbohydrate was determined by difference method and energy value was computed. Micro nutrient such as iron, calcium, phosphorous, zinc *etc.*, were analyzed using standard AOAC methods.

2.4.1 Estimation of moisture [13]

Moisture was determined by taking 10 g of sample in moisture estimation cups and dried in an oven at 60˚C till the weight of moisture cups with its content was constant. Each time before weighing, the moisture estimation cup was cooled in desiccator. Moisture content of the sample was expressed in g/100g of sample.

$$Moisture\ content (\%) = \frac{intial\ weight - final\ weight}{weight\ of\ sample} X100$$

2.4.2 Estimation of protein [13]

The protein content of the dried samples was estimated as percent total nitrogen by the Micro-Kjeldahl procedure. Protein per cent was calculated by multiplying the percent nitrogen by the factor 6.25.

$$\textbf{Per cent protein (g/100g)} = \frac{titre\ value\ X\ normality\ of\ H2SO4X0.014}{Weight\ of\ the\ sample} X100$$

2.4.3 Estimation of fat [13]

Fat was estimated as crude ether extract using moisture free samples. The solvent was removed by evaporation and the residue of fat was weighed.

$$Fat\ content\ (\%) = \frac{100(B - C)}{A}$$

A= Sample weight
B= Weight of flask after extraction
C= Weight of flask before extraction

2.4.4 Estimation of Minerals [13]

Preparation of Samples for Mineral Content Analysis

The sample (5g) was weighed and taken in a crucible and subjected for ashing in a muffle furnace at a temperature of 550-600° C. The ash was taken in a digestion flask and digested with a mixture of concentrated nitric acid, sulphuric acid and per chloric acid. Then it was cooled to room temperature. The digested material made up to 100ml with distilled water.

a. Determination of Calcium

The calcium content present in the samples was determined by the method described by Raghuramulu *et al.*, [14]. The titrimetric estimation of calcium was performed by precipitating it as calcium oxalate. The precipitate was dissolved in the sulphuric acid and the amount of calcium dissolved in the acid was determined by titrating against a standard potassium permanganate solution. The end point was determined by appearance of pink colour and persists for few minutes. The calcium content was expressed as mg of calcium per 100 g of sample. The calcium content was calculated using the formula as:

% Calcium content = (x — b) x ^

Where,

x = ml of 0.01 N $KMnO_4$ required to titrate the sample b = ml of 0.01 N $KMnO_4$ required to titrate 1N TTSO4

b. Determination of Iron

The iron content present in the samples was determined by the method described by Raghuramulu *et al*., [14]. The samples (2 g) were subjected for ashing in a muffle furnace at a temperature of 550- 600° C for 2-3hrs. Then, the ash sample was digested using an acid mixture and reacted with potassium persulphate and potassium thiocyanate solutions. Red colour proportional to the iron content of the sample was developed in the solution. The O.D was measured using a spectrophotometer at 440 nm. A standard curve was prepared using ferrous ammonium sulphate as standard. The iron content was expressed as mg of iron per 100 g of sample. The iron content was calculated by using the formula as:

$$\%iron\ content = \frac{OD\ of\ the\ sample}{OD\ of\ the\ standard} X100$$

2.4.5 Determination of Carbohydrates

Carbohydrates were determined by using Difference method.

2.4.6 Determination of Energy

Energy was determined by using Calculation method.

2.5 Sensory evaluation

The noodles were served to semi trained panelists for organoleptic evaluation on a nine-point hedonic scale, with score 9 as excellent and score 1 as disliking. Sensory evaluation was carried by 25 semi trained panel members. The sensory properties such as appearance, colour, consistency, flavor, taste and overall acceptability of finished product were evaluated on the basis of 9-point hedonic scale [15]

2.6 Statistical analysis

The data obtained was analyzed using statistical tools like *t*-test and the standard deviation and mean were calculated wherever applicable.

3. Results and discussion

3.1 Nutritional profile of the developed product

Results of sensory evaluation are presented in Table 2. The noodles with 20% of malted barnyard millet flour was best accepted with overall acceptability of 8.13 out of 9. The sensory attributes of noodles with 10% MBMF was also on par with the control in almost all the attributes. Replacing wheat flour with MBMF beyond 20% was not acceptable with low scores in texture. Further as % MBMF increases, levels of gluten comes down resulting reduction of plasticity and springiness of noodles. Several studies have carried out partially replacing rice or wheat flour by barnyard millet flour in many of the traditional Indian dishes and bakery products [16, 17]. Veena et al., [18] reported that the incorporation of barnyard millet in differing amounts to traditional products like idli, dosa and chakli and reported that there were acceptable results in the organoleptic properties when the millet was incorporated to the dishes at 25% of the total flour weight. Supplementation of cereal based products with millets has become increasingly popular due to the nutritional and economic advantages. With proper processing technique a maximum of 30% of the cereal based flour can be substituted with millet flour advantageously [19]. Ugare, [20] reported the feasibility of preparation of noodles using composite flour of wheat flour and barnyard millet flour. The noodles prepared using the composite flour containing barnyard millet flour, wheat flour and refined flour had creamish brown colour, was easily extrudable and had long firm strands for the ratios of 10:85:5 and 20:75:5 for barnyard millet flour: wheat flour: refined flour. In our study it was observed that the maximum limit of partial replacement of malted barnyard millet flour was 20% beyond which noodles lose their texture and springiness due to reduced gluten.

Table 2: Sensory evaluation of the control and variations

Variation	Appearance	Colour	Flavour	Texture	Taste	Overall acceptability
Control	8.16 ± 0.58	7.88 ± 0.48	8.11 ±0.62	7.43 ±0.45	8.02 ±0.63	8.00 ± 0.44
S 1	8.01 ± 0.38	7.96 ±0.47	8.04 ±0.28	7.23 ±0.29	7.76 ±0.45	7.98 ± 0.32
S 2	8.04 ± 0.44	7.93 ±0.37	8.07 ±0.48	7.42 ±0.37	8.01 ±0.63	8.13 ± 0.60
S 3	7.71 ± 0.31*	7.56 ±0.41	7.34 ±0.23*	6.33 ±0.24*	7.26 ±0.45*	7.38 ± 0.36*
S 4	7.64 ± 0.32*	7.48 ±0.40	7.14 ±0.28*	6.23 ±0.26*	7.06 ±0.44*	6.98 ± 0.32*
S5	7.54 ± 0.49*	7.33 ±0.37	7.07 ±0.45*	5.42 ±0.33*	6.01 ±0.61*	5.13 ± 0.60*

S1 - WF: MBMB 90:10
S2 - WF: MBMB 80:20
S3 - WF: MBMB 70:30
S4 - WF: MBMB 60:40
S5 - WF: MBMB 50:50
Values are mean ± SD (n=25)
Data analyzed by Holm Sidak method, * p≤0.05

Table 2: Macronutrient composition of the prepared noodles

Noodle variation	Energy (Kcal/100 g)	Carbohydrates (%)	Protein (%)	Fat (%)	Ash (%)
Control	487.7	59.09	10.1	23.44	1.83
S 1	478	60.96	11.5	21.20	2.18
S 2	487	59.26	10.42	23.15	2.97

S1 - WF: MBMB 90:10

S2 - WF: MBMB 80:20
Values are mean ± SD (n=25)
Data analyzed by Holm Sidak method, * p≤0.05

Table 3: Moisture content of the developed product

Noodle variation	Moisture (%)
Control	5.54
S 1	5.16
S 2	4.20

S1 - WF: MBMB 90:10
S2 - WF: MBMB 80:20
Values are mean ± SD (n=25)
Data analyzed by Holm Sidak method, * p≤0.05

The nutritional profile of the developed product was analyzed for the nutritional characteristics using standard AOAC methods and depicted in the table 2. There is no significant change in macronutrient composition of the noodles with incorporation of MBMF. There was also no much change in terms of moisture content of the noodles as well (Table 3). However Iron levels were found to be increased with the incorporation of higher amounts of MBMF which was doubled at 20% incorporation (Table 4)

Table 4: Micronutrient composition of the developed product

Noodle variation	Calcium (mg/100g)	Iron (mg/100g)
Control	38.04	3.85
S 1	30.96	4.25
S 2	30.23	5.38*

S1 - WF: MBMB 90:10
S2 - WF: MBMB 80:20
Values are mean ± SD (n=25)
Data analyzed by Holm Sidak method, * p≤0.05

Food fortification has been defined as the addition of one or more essential nutrients to a food, whether or not it is normally contained in the food, for the purpose of preventing or correcting a demonstrated deficiency of one or more nutrients in the population or specific population groups [21]. The main objective is to increase the level of consumption of the added nutrients to improve nutritional status of a given population with incorporation of nutrient rich ingredient into the usual recipe. Several authors have tried to incorporate barnyard millet flour to increase protein content in rice-based recipes, to reduce gluten content and enhance iron in wheat-based recipes [20, 22-24]. Unlike other studies, we have used malted barnyard millet flour in our study to reduce anti-nutritional factors which can reduce iron bioavailability and to increase protein digestibility.

Conclusion

Noodles using composite flour containing wheat flour and malted barnyard millet flour was developed and evaluated for sensory attributes and nutritional composition. The results obtained showed that the noodles made up of composite flour with wheat flour to malted barnyard millet flour ration of 80:20 was acceptable in terms of sensory attributes. The nutritional composition of the developed product was determined using standard procedures and it was seen that there was a marked improvement in terms of iron levels. Malting process reduces anti-nutritional factors and thus can enhance iron bioavailability. Thus, it is concluded that partial replacement of wheat flour with malted barnyard millet flour can improve the iron levels and its bioavailability and thus serve as a important strategy to combat iron deficiency anemia.

References

1. https://instantnoodles.org/en/noodles/market.html Global demand, World instant noodles association, 2019
2. fssai.gov.in
3. Tulchinsky TH, Micronutrient Deficiency Conditions: Global Health Issues, Public Health Rev. 2010; 32(1):243-255.
4. Younis K, Ahamad S Badpa A. Malnutrition: Causes and Strategies. J Food Process Technol. 2015; 6:4
5. Brouwer HT, de Wolf C, van der Heijden L, Nguyen K, Kok F. Suitability of instant noodles for iron fortification to combat iron-deficiency anemia among primary schoolchildren in rural Vietnam. Food and Nutr Bulletin, 2007, 291-298.
6. Pakhare KN, Dagadkhair AC, Udachan IS, Andhale RA. Studies on Preparation and Quality of Nutritious Noodles by Incorporation of Defatted Rice Bran and Soy Flour. J Food Process Technol. 2016; 7:10.
7. Shivananjappa M. Meats are malady and Millets are magical. J Nutr Food Res Technol. 2018; 1(1):14-15.
8. Chandel G, Meena RK, Dubey M *et al*. Nutritional properties of minor millets: neglected cereals with potentials to combat malnutrition. Curr Sci. 2014; 107(7):1109-1111.
9. Rachie KO. The Millets: Importance, utilization and outlook. Int Crop Res Institute, Hyderabad, 1975, 1-2.
10. Rao Subba MV, Muralikrishna G. Non-starch polysaccharides and bound phenolic acids from native and malted finger millet (Ragi, *Eleusine coracana,* Indaf-15). Food Chem, 2001, 187-192.
11. Taneya ML, Biswas MM, Shams-Ud-Din M. The studies on the preparation of instant noodles from wheat flour supplementing with sweet potato flour. J Bangladesh Agricull University. 2014; 12(1):135-142.
12. Kulkarni S, Desai A, Ranveer R, Sahoo A. Development of nutrient rich noodles by supplementation with malted ragi flour. Int Food Res J. 2012; 19(1):309-313.
13. Horwitz W, Official methods of analysis of the AOAC, 13th Ed, 1980.
14. Raghuramulu N, Nair MK, Kalyanasundram SA. Manual of laboratory techniques (I Ed.) Hyderabad: National Institute of Nutrition, 1983.
15. Devaki CS, Premavalli KS. Development of bitter gourd fermented beverage using response surface methodology. J. Phar. Nutri. Sci. 2012; 2(1):94-103.
16. Pushpamma P, Rao KC. Varietal preference, marketing, storage, processing and utilisation of sorghum and millet in Andhra Pradesh. M.Sc.thesis. Hyderabad, Andhra Pradesh, India: Andhra Pradesh Agricultural.
17. Geetha K, Gouramma BS, Vaidehi MP. Processing and functional quality of Baragu and product acceptability. Mysore J of Agricultural Sci, 1994, 82-85.
18. Veena B, Chimmad BV, Naik RK, Malagi U. Development of Barnyard Millet Based Traditional Foods. Karnataka J of Agricultural Sci 2004; 522-527.
19. Surekha N, Naik RS, Mythri S, Devi R. Barnyard Millet (*Echinochloa Frumentacea* Link) Cookies: Development, Value Addition, Consumer Acceptability, Nutritional and Shelf Life Evaluation. IOSR J of Environmental Sci Toxicol and Food Technol, 2013, 1-10.
20. Ugare R, Chimmad B, Naik R, Bharati P, Itagi S.

Glycemic index and significance of barnyard millet (Echinochloa frumentacae) in type II diabetics. J Food Sci Technol. 2014; 51(2):392-395. doi:10.1007/s13197-011-0516-8

21. Gregory JR, Collins DL, Davies PSW, Hughes JM, Clarke PC. National Diet and Nutrition Survey of Children Aged 1.5 to 4.5 Years. HMSO, London, 1995.
22. Joshi S, Srivastava S. Barnyard Millet as a Substitute of Rice in Preparation of khichdi for Diabetics. Int J of Sci and Res, 2015, 1798-1802.
23. Nazni P, Karuna TD. Development and Quality Evaluation of Barnyard Millet Bran Incorporated Rusk and Muffin. J of Food & Ind Microbiol, 2016; 2(116).
24. Verma SS. Comparative study on nutritional and sensory quality of barnyard and foxtail millet food products with traditional rice products. J of food scientists and Technol, 2015; 5147-5155.