



Formulation and Evaluation of Finger Millet based Convenience Mixes

Rekha Sinha¹, Bindu Sharma¹

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ABSTRACT

Background: Finger millet is an inevitable traditional climate-smart crop of Jharkhand, which has the potential to address the problem of malnutrition on a sustainable basis. However, despite its nutritional and health potential, it is on the verge of extinction. The revival of finger millet in the daily diet of people requires diversification of the products suiting to the changing needs of the consumers. Rapid industrialization and urbanization and changes in the eating habits of Indian people led to a very high demand for convenience mix. Therefore, an attempt was made to develop a low-cost finger millet-based *burfi* and *halwa* mix and evaluate the nutritional quality of the mixes.

Methods: Two types of *burfi* mix and *halwa* mix were developed by using ragi malt or ragi semolina, wheat and germinated green gram supplemented with milk powder, groundnut, etc. Developed products were subjected to sensory evaluation on a 9-point Hedonic scale and analyzed for proximate composition, calcium, iron, phosphorus, copper, zinc, and β -carotene by standard methods.

Result: All products were found acceptable. Both experimental *burfi* and *halwa* mixes were found superior in terms of protein, fiber, calcium, phosphorus, iron, copper and zinc.

Key words: *Burfi* mix, Convenience mix, Finger millet, *Halwa* mix, Malting, Nutritional quality.

INTRODUCTION

Millets are annual minor cereal grains with a hard outer covering, cultivated in dryland regions, under marginal conditions of soil fertility with short growing seasons. These plant resources are climate-smart as they play a vital role in enhancing the adaptation and resilience of agricultural production systems (Eyzaguirre *et al.*, 1999; Bhag Mal 2007; Dutta *et al.*, 2007; Jarvis *et al.*, 2007). Millet provides enormous potential in our struggle against climate change, malnutrition and contributes substantially to food and nutritional security. The cultivation of millet in India has been steadily declining over the last few decades because of its lower economic gain compared with other crops. Such lower economic competitiveness is due to several factors like lack of high-yielding varieties, good quality seed, better management practices, appropriate household and community level food processing technology, as well as poor value chains (Gautam *et al.*, 2009; Gruère *et al.*, 2009). These limitations need to be addressed to allow economically viable options to farmers in dry land regions, where the cultivation of wheat and rice may be adversely affected due to climate change.

Finger millet (*Eleusine coracana* L.) locally called '*Marua*' is an inevitable traditional crop after rice in the rain-fed farming system of Jharkhand. Because of its nutritional potential in terms of fiber, unique starch pattern and high calcium and iron content, it has earned the status of nutri-cereal (Wadikar *et al.*, 2006).

The complex carbohydrate composition of finger millet has the unique property of having starch molecules which are relatively slow in absorption after digestion. This property of finger millet grains has gained importance and is being

¹Department of Community Science, Birsa Agricultural University, Ranchi-834 006, Jharkhand, India.

Corresponding Author: Rekha Sinha, Department of Community Science, Birsa Agricultural University, Ranchi-834 006, Jharkhand, India. Email: sinharekha_05@yahoo.co.in

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used for the management of diabetes. The grain is also rich in fiber content which is helpful in the prevention of constipation. However, despite its nutritional and health benefits, the utilization and cropped area under finger millet has decreased significantly, which is a matter of concern, particularly in states like Jharkhand where undernutrition is still rampant. The utilization of finger millet in the daily diet at present is largely confined to rural areas and that too is declining due to modernization, changing food preferences and a lack of diversified products of local interest (Sinha and Sharma, 2017).

In the present era of food insecurity and climate change, there is a need to diversify the use of this millet by developing value added products of local interest. Each region has its own traditional food habits and one of the ways to combat malnutrition is through value addition of the traditional products, which are liked and accepted by the population. With a view to revive the consumption of finger millet in the daily diet of tribal people of the State, two most commonly used traditional products of tribal namely, *burfi* and *halwa* were selected for value addition through incorporation of

finger millet to provide micro nutrient security to population. Rapid industrialization, urbanization and changes in the dietary habits of Indian people led to a very high demand for convenience mix. Since women are engaged in dual roles, their time for preparing foods as done in traditional times has been reduced (Shunmulkha and Kowsalya, 2015). Therefore, the present study was taken up with the specific objective of formulating and evaluating convenience food mixes from finger millet to suit the changing needs of the consumer.

MATERIALS AND METHODS

The study was carried out during 2016-18 in the Department of Home Science, Birsa Agricultural University, Kanke, Ranchi, Jharkhand, India.

Collection and preparation of ingredients

The grains of white (JWM-1) and brown (A404) cultivars of finger millet were procured from the Department of Plant Breeding and Genetics, Birsa Agricultural University, Ranchi. Other ingredients for the development of value-added products were procured in a single lot from the local market of Ranchi, Jharkhand, India.

The grains of finger millet were cleaned by removing foreign materials and divided into two lots. One lot was conditioned with 5% water, tempered for about 10 mins, milled into a hammer flour mill and size graded into semolina or grit.

Second lot of finger millet was soaked in water for 12 hours, germinated for 48 hours and dried in the oven at 60°C. The roots and shoots are separated mechanically and roasted in a pan till the aroma develops. It is conditioned with 5% water, tempered for 10 minutes and then pulverized and sieved with an 80 mesh sieve to get the malt.

Green grams were cleaned, soaked and germinated for 24 hrs at 30°C ±2°C and dried in a dehydrator at 60±2°C for 6 hours. Dried germinated grains were milled to get fine flour. The flour was sieved through a 40 mesh sieve and stored in HDPE bags for further use.

Shelled groundnut was roasted in a hot iron pan over medium-high heat with continuous stirring until the groundnuts darken in colour. Skin was peeled off and coarsely ground in a Food Processor.

Development of products

Two semi-processed convenience mixes namely the *burfi* mix and *Halwa* mix were developed.

Burfi mix

Two types of *burfi* mix were developed and in each type, both white and brown cultivar was used. In type-I *burfi* mix, finger millet malt was mixed with roasted germinated green gram and milk powder, whereas in type-II, in addition to finger millet malt, germinated green gram and milk powder, roasted groundnut powder was also used. For making *burfi*, thick sugar syrup was made by heating 300 g sugar with 100 ml water. *Burfi* mix (300 g) and ghee (200 g) were added and

cooked till the mixture started leaving the side of the pan. It was spread on a greased plate and cut into small pieces.

Halwa mix

Finger millet semolina of White cultivar was used to develop type-I *halwa* mix, whereas finger millet malt of white cultivar in type-II (W) and finger millet malt of brown cultivar were used in type-II (B) along with other ingredients namely wheat semolina, milk powder, sugar, ghee and flavoring agents. For making *Halwa*, *halwa* mix (250g) was added to heated ghee (60g) and fried for 1-2 minutes. Water was added and cooked till done.

Sensory evaluation

Burfi prepared only with roasted wheat and *Halwa* prepared with wheat semolina served as control. The sensory evaluation of *burfi* and *halwa* made from formulated convenience food mixes was performed by 20 panelists. The panelists were asked to evaluate colour, appearance, aroma, texture, taste and over all acceptability on a 9- point hedonic scale (Lawless and Klein, 1991).

Nutrient analysis

Three identical preparations of each type of product were pooled together into one sample and dried in a hot air oven at 60±2°C till constant weight was obtained. Dried samples were milled in a sample grinder and kept in an airtight container for chemical analysis. All analysis was done in triplicate.

Moisture, Crude protein (Micro-kjeldahl, Nx6.25), crude fiber and total ash of all products were determined by the standard method of AOAC (1990). For the estimation of minerals about 0.5 g of the sample was digested with a diacid mixture of Nitric acid and Perchloric acid (5:1, v/v). After digestion, the sample was heated to near dryness and volume was made to 25 ml with double distilled water. Atomic absorption spectrophotometer (Elico) was used for the estimation of calcium, Iron, copper and zinc by the method of Lindsey and Norwell, 1969. Phosphorus was determined calorimetrically by the method of Chen *et al.* (1956). β -Carotene was analyzed by the method of AOAC (1985).

Statistical analysis

The data obtained were subjected to analysis of variance (ANOVA) in a complete randomized design using Statistical Package for Social Sciences (SPSS).

RESULTS AND DISCUSSION

Sensory evaluation of *burfi* mix

The maximum scores for the organoleptic evaluation of *burfi* prepared from *burfi* mix are given in Table 1. *Burfi* mix containing only roasted wheat flour served as control. Both types of *burfi* developed from mix I and mix II were organoleptically acceptable and comparable to the control. Though the appearance of Type I (B) was significantly different from the control, yet was acceptable and fell into the category of 'moderately desirable'. The results showed that there were non-significant differences in the scores of

aroma, texture, taste and overall acceptability of all types of *burfi*.

Sensory evaluation of *halwa* mix

Sensory scores of *Halwa* mix are given in Table 2. Two types of *Halwa* mix were prepared by replacing 50 percent of wheat semolina with finger millet semolina (white cultivar) and white and brown finger millet malt powder. All the sensory scores assigned to the experimental *halwa* mix were in the class of "moderately liked". Though the colour of all the treatments

and taste of type II and III were significantly different from the control, it was acceptable and liked by panelists. Except for colour and taste, other organoleptic characteristics of all the treatments of the *halwa* mix were alike to the control.

Chemical composition of *burfi* mix

Chemical composition of *burfi* mix is given in the Table 3. The moisture content of Type I and Type II *burfi* mix was significantly higher as compared to the control and this might be due to the higher protein content of green gram, milk

Table 1: Sensory evaluation of the *burfi* prepared from *burfi* mix.

Product	Colour	Appearance	Aroma	Texture	Taste	Overall acceptability
Control	8.2±0.24	8.2±0.20	7.5±0.22	7.5±0.6	7.5±0.37	7.7±0.15
Type I(B)	7.4±0.24	7.1±0.23	7.6±0.22	7.0±0.29	7.9±0.27	7.3±0.21
Type I(W)	7.6±0.16	7.9±0.23	7.5±0.22	7.7±0.15	7.8±0.24	7.7±0.16
Type II(B)	7.5±0.34	7.7±0.21	7.8±0.32	7.9±0.27	7.9±0.27	7.8±0.25
Type II(W)	7.4±0.26	7.7±0.10	7.3±0.21	7.3±0.30	7.6±0.12	7.4±0.20
C.D	N.S	0.68	N.S	N.S	N.S	N.S

Values are mean ± SE of twenty replications.

Type I (B) = Wheat+ finger millet (brown cultivar) + Green gram + S.M.P.

Type I (W) = Wheat+ finger millet (white cultivar) + Green gram + S.M.P.

Type II (B) = Wheat + finger millet (brown cultivar) + Green gram + SMP +Groundnut.

Type II (W) = Wheat + finger millet (white cultivar) + Green gram + SMP +Groundnut.

Table 2: Sensory evaluation of *halwa* mix.

Product	Colour	Appearance	Aroma	Texture	Taste	Overall acceptability
Control	8.21±0.13	7.60±0.22	7.4±0.26	8.00±0.21	8.20±0.13	7.90±0.10
Type I	7.50±0.16	7.70±0.30	7.50±0.16	7.80±0.29	7.90±0.16	7.60±0.16
Type II (B)	7.30±0.21	7.40±0.30	7.4±0.26	7.30±0.21	7.50±0.16	7.50±0.16
Type II (W)	7.5±0.16	7.60±0.26	7.40±0.26	7.40±0.153	7.50±0.16	7.50±0.16
CD	0.49	NS	NS	NS	0.59	NS

Value of Mean ± SE of twenty replications.

Type I = finger millet semolina + wheat semolina.

Type II (B) = Malt (Brown cultivar) + wheat semolina.

Type II (W) = Malt (White cultivar) + wheat semolina.

Table 3: Chemical composition of *Burfi* mix prepared from Finger millet (On dry weight basis).

Name of the nutrient	Control	Type-I	Type-II	C.D (P≤0.05)
Moisture (%)	1.91±0.01	3.79±0.04	2.95±0.04	0.13
Protein (%)	12.69±0.10	22.35±0.16	19.50±0.28	0.71
Fat (%)	2.07±0.03	1.25±0.02	8.24±0.03	0.31
Ash (%)	2.75±0.02	4.01±0.02	3.45±0.009	0.09
Fibre (%)	1.81±0.01	2.37±0.01	3.00±0.03	0.81
Iron (mg/100g)	5.26±0.03	3.52±0.01	3.82±0.03	0.07
Calcium (mg/100g)	72±1.32	682.33±1.45	466.00±2.08	5.82
Phosphorus (mg/100gm)	364.00±0.57	537.33±1.45	445.00±1.73	4.74
β - carotene (µg/100g)	33.50±0.86	41.66±0.88	50.16±0.44	2.67
Copper (mg/100g)	0.57±0.01	0.41±0.01	0.53±0.01	0.03
Zinc (mg/100g)	2.31±0.02	1.80±0.006	2.39±0.003	0.04

Values are mean ±SE of three replication.

Type I= Wheat+ Ragi+ Green gram + S.M.P.

Type II= Wheat + Ragi + Green gram + SMP +Groundnut.

powder and groundnut. Anu *et al.* (2007) reported an increase in the moisture content of biscuits with an increase in the protein content. The protein content of the control was significantly lower than Type I and II. The highest protein in finger millet-based *burfi* mix as compared to the control might be due to higher levels of the protein in additional ingredients like green gram, skimmed milk powder and groundnut. The higher protein content observed in the type I *burfi* mix may be attributed to the incorporation of a higher level of skimmed milk powder. The fat content of different types of *burfi* mix varied significantly with each other. The higher fat content observed in Type II may be due to the higher fat content of groundnut. The control *burfi* mix contained lower ash and fiber contents, which were significantly higher in the experimental *burfi* mix. The iron content of the control, Type I and II was 5.26, 3.52 and 3.82 mg/100 g, respectively. Control *burfi* mix exhibited higher iron content which might be due to higher iron content of wheat flour as compared to ragi. Calcium and phosphorus contents of the experimental *burfi* mix were significantly higher than control which might be due to incorporation of skimmed milk powder in addition to finger millet. Significantly higher content of β -carotene was observed in Type II and Type I *burfi* mix. On comparing the overall mean values, Cu content was found to be the highest in the control and lowest in the Type I *burfi* mix, whereas the highest Zn content was observed in the Type II *burfi* mix followed by the control.

Chemical composition of *halwa* mix

The chemical composition of the *halwa* mix is given in Table 4. The moisture content of three types of *halwa* mix ranged from 0.21 to 1.027 percent. Significantly higher moisture content observed in type I and II as compared to the control might be due to its high protein content which indicated a possible relationship between water absorption and protein

content. The result obtained in this study is in agreement with earlier workers (Singh *et al.*, 2006; Sinha *et al.*, 2013) who also reported that moisture content increased in soy-fortified products. The protein content of the *halwa* mix varied from 5.08 to 12.14% on a dry weight basis. No significant difference was observed in fat content. A range of 0.15 to 2.09 % of mean values for ash content was observed in different types of *Halwa* mix. Among the treatment *halwa* mix, higher ash content was found in Type II followed by Type I. The Crude fiber content in the control, type I and type II *halwamix*, was 0.17, 0.40 and 0.54%, respectively. Significantly higher ($P \leq 0.05$) fiber content was observed in the finger millet-incorporated *halwa* mix. Significantly higher fiber content was observed in the type II *halwa* mix prepared from finger millet malt as compared to type I. This might be attributed to an increase in the volume of seed after germination. Similarly, Singh *et al.* (2006) reported an increase in the crude fiber content of cake containing malted pearl millet flour. The iron content of the control, Type I and Type II was 1.85, 2.52 and 2.52 per cent (on a dry weight basis), respectively. The iron content was found to be significantly higher ($p \leq 0.05$) in Type I and Type II *halwa* mixes prepared by incorporation of Ragi. The calcium content of different types of *halwa* mixes varied significantly with each other. Maximum calcium content was found in Type II followed by Type I. The phosphorus content was observed maximum in the Type II *halwa* mix (290.33 ± 0.88 mg/100 g) and minimum in the control (49.16 mg/100 g). Significant differences ($P \leq 0.05$) were observed in phosphorus content among all types of *halwa* mix. β -Carotene, Cu and Zn were not detected in the control sample, whereas, they were present in a fair amount in the treatment samples. The study is in agreement with earlier studies (Singh and Sehgal, 2008; Shunmukha and Kowsalya, 2015; Thilagamani and Mageshwari, 2011) which also reported high calcium, iron,

Table 4: Chemical composition of finger millet incorporated *Halwa* mix (On dry weight basis).

Name of the nutrient	Control	Type-I	Type-II	C.D ($P \leq 0.05$)
Moisture (%)	0.21 $\pm$ 0.01	0.65 $\pm$ 0.01	1.027 $\pm$ 0.03	0.08
Protein (%)	5.08 $\pm$ 0.09	11.38 $\pm$ 0.19	12.14 $\pm$ 0.02	0.44
Fat (%)	0.42 $\pm$ 0.01	0.42 $\pm$ 0.01	0.47 $\pm$ 0.01	N.S
Ash (%)	0.15 $\pm$ 0.003	1.99 $\pm$ 0.01	2.09 $\pm$ 0.003	0.039
Fibre (%)	0.17 $\pm$ 0.01	0.40 $\pm$ 0.02	0.54 $\pm$ 0.02	0.07
Iron (mg/100 g)	1.85 $\pm$ 0.02	2.52 $\pm$ 0.03	2.57 $\pm$ 0.02	0.06
Calcium (mg/100 g)	12.14 $\pm$ 1.13	360.94 $\pm$ 2.024	371.71 $\pm$ 1.64	5.79
Phosphorus (mg/100 g)	49.16 $\pm$ 0.726	281.0 $\pm$ 0.577	290.33 $\pm$ 0.88	2.60
β -carotene (μ g/100 g)	-	7.75 $\pm$ 0.14	8.21 $\pm$ 0.50	N.S
Copper (mg/100 g)	-	0.88 $\pm$ 0.01	0.95 $\pm$ 0.04	N.S
Zinc (mg/100 g)	-	0.43 $\pm$ 0.00	0.47 $\pm$ 0.012	N.S

Values are mean $\pm$ SE of three replications.

Control - Semolina only.

Type I - Semolina + Ragi semolina.

Type II - Semolina + Ragi malt.

phosphorous and zinc content of millet-based convenience mix.

CONCLUSION

Finger millet malt or finger millet semolina can be successfully utilized for the development of *burfi* and *halwa* mix with superior nutrient composition. The utilization of finger millet increased the total mineral, fiber, calcium, iron, phosphorous, copper and zinc content of the convenience mix, which has the potential to be exploited for commercial ventures.

Conflict of interest

All authors declared that there is no conflict of interest.

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