RESEARCH PAPER — FOOD SCIENCE RESEARCH JOURNAL
e ISSN-2230-9403 ■ Visit us : *www.researchjournal.co.in*
Volume 7 | Issue 1 | April, 2016 | 119-124
DOI : 10.15740/HAS/FSRJ/7.1/119-124

Development of value added products utilizing finger millet malt (*Eleusine coracana*)

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Finger millet stands unique among the minor cereals because of its superior nutritional contents. The millet is a richest source of calcium among the cereals and also contains good amount of iron and zinc. Malting of finger millet improves its digestibility, sensory and nutritional quality as well as pronounced effect in the lowering the antinutrients. A study was undertaken to develop value added products by utilizing finger millet malt. In first phase of study finger millet malt was prepared and three products *viz.*, *Dhapata, Shira, Instant dhokla* were selected for value addition. Finger millet malt was incorporated in *Dhapata, shira* at the levels of 0,10,20,30,40 and in the *Instant dhokla* 0, 10, 15, 20, 25 per cent. Five variations of each product were prepared. Variation I was basic prepared without finger millet malt served as control sample and remaining four variations were experimental samples. In second phase of study all the products were organoleptically evaluated by panel members for their acceptability. The most accepted variation was selected for nutrient analysis. The proximate composition, fibre, Ca and iron were estimated in the laboratory. The results revealed that malted finger millet incorporation up to 30 and 20 per cent in *Dhapata, Shira and Instant Dhokla*, respectively was accepted by panel members. Significant increase in values of nutrient i.e protein, fibre, total mineral, carbohydrate and calcium was noticed in experimental variations of *Shira*. Incorporation of finger millet malt in *Dhapata* and *Instant Dhokla* could help to increase fiber and calcium significantly. It can be concluded from the findings of the study that finger millet malt can be utilized successfully for value addition.

Key Words : Calcium, Fiber, Finger millet malt

How to cite this article : Bhalerao, Jaishree and Farzana, Farooqui (2016). Development of value added products utilizing finger millet malt (*Eleusine coracana*). *Food Sci. Res. J.*, **7**(1): 119-124.

INTRODUCTION

Finger millet stands unique among the minor cereals because of its superior nutritional contents. The millet is a richest source of calcium among the cereals and also contains good amount of iron and zinc (Barbeau and Hilu, 1993). Finger millet (*Eleusine coracana*) is also rich in protein, phosphorus, fibre and vitamin content. The calcium content is higher than all cereals and iodine content is highest among all the food grains. Finger millet has best quality protein along with the presence of essential amino acids, vitamin A, vitamin B and phosphorus (Gopalan *et al*., 2004) Thus finger millet is a good source of diet for growing children, expecting women, old age people and patients. It contains high soluble fibre and low fat. The malted grains have high diastatic power with a type of starch that is more resistant to hydrolysis than other source of grain (Mushtari *et al.*, 2003).

In view of these beneficial aspects, finger millet has

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a very good potential for use as a health food. It can be exploited for development of therapeutic food in disease such as diabetes. Many scientists have also expressed the health benefit of finger millet and recommended it, as a better suited staple grain than any other refined cereal, such as rice and wheat, for health problems of obesity, heart disease and diabetes (Vaidehi, 1980 and Mushtari *et al.*, 2003).

Finger millet is a versatile grain that can be used in many different types of food. It is consumed by grinding the grains for porridge or in Indonesia consumed as a vegetable. Sometimes it is ground into flour and used for preparing bread or various other baked products. The sprouted seeds are nutritious and easily digested food that is recommended for infants and the elderly (National Research Council, 1996). Women who are in their postmenopausal age are advised to consume finger millet as dietary calcium provided by it checks osteoporosis.

Finger millet or ragi, one of the important minor cereals is a rich source of several phytochemicals and among them polyphenols are the most important because of their nutraceutical potentials. Polyphenols are the most important phytochemical of the finger millet because of their nutraceutical potentials such as antioxidant activity, anti-diarrheal, antiulcer and anti-cardiovascular properties (Sripriya *et al*., 1996). Besides, the polyphenol are also useful in management of several physiological disorders such as diabetes mellitus, hypertension, vascular fragility, hypercholesterolemia, prevention of oxidation of low density lipoproteins (LDLS) and improvement of the health of gastrointestinal tract (Scalbert *et al., 2*005). Hence, the present investigation was undertaken to formulate the calcium rich products using finger millet malt.

METHODOLOGY

Preparation of malted finger millet :

Finger millet was procured from local market for this study. The selected seeds were cleaned to remove dust, impurities and undersize seeds. The finger millet seeds were washed with water and soaked in water for 5 hr. Excess water was drained, seeds were tied in a muslin cloth and 5 kg weight was kept on it. These seeds were germinated at 27± 3ºC for 24hr and dried in shade for 2 days. The malted finger millet seeds were grounded into flour by using the electric grinder (Desai, 2010). Finger millet powder was stored in air tight container for development of recipes and chemical analysis.

Selection of level of incorporation :

Finger millet malt was incorporated at 10, 15, 20, 25, 30 and 40 per cent level in the selected recipes such as *Dhapata, Shira* along with soybean flour (10 %) to increase the protein content in *instant dhokala*. Thus, five variations of each product were prepared for further sensory analysis. Variation one was basic recipe which was prepared without incorporation of finger millet and it served as control. Variations II to V were experimental variations with varying levels of incorporation of finger millet malt.

Organoleptic evaluation of prepared products :

The organoleptic evaluation was followed to find out the maximum level of incorporation of malted finger millet in developed food products.

Selection of panel members :

The sensory threshold test was carried out on 20 members to select panel members. Different concentrations of solutions for threshold test were prepared as described by Ranganna (1979) and were requested to evaluate the solution for strength of different tastes. Considering the accuracy in evaluation of taste, 15 panel members were selected out of 20 to act as judges for sensory evaluation of products.

Sensory evaluation :

The samples with different levels of incorporation of finger millet malt were prepared. All the selected panel members were requested to evaluate the developed food products. The judges were requested to score the recipes for different sensory characters namely colour, texture, taste, flavour and overall acceptability by using hedonic scale. Highly accepted variations were selected for further nutritional analysis.

Nutrient composition of malted finger millet flour and developed products :

Malted finger millet and recipes prepared without incorporation of malted finger millet and highly accepted variations were analyzed for proximate composition and mineral content. The nutrient analysis *viz.*, moisture, total mineral, fat, fibre was carried out by (AOAC, 1975) and protein was estimated by macrokjeldhal method. The

carbohydrate content was calculated by NIN (1983) method. The calcium was estimated by EDTA (Ethylene diamine tetra acetic acid) method. The trace element, iron was estimated by atomic absorption spectrophotometer.

Statistical analysis :

The analysis of variance was followed for interpreting the differences between different variations for individual sensory characters. The statistical difference with regard to nutrient content of developed products prepared with and without incorporation of malted finger millet was tested by 't' test (Panse and Sukhantme, 1985).

OBSERVATIONS AND ASSESSMENT

The organoleptic evaluation of *Dhapata* with various levels of incorporation and without incorporation of malted finger millet (Table 1) indicated that the scores of sensory parameters ranges between 6.5 to 8.4 for 30 per cent incorporation of malted finger millet which was highly accepted by panel members. Addition of finger millet malt upto 30 per cent in *dhapata* did not affect the sensory qualities adversely. Statistical analysis showed that, there was significantly difference in all sensory parameters.

Shira was prepared by adding 0 to 40 per cent finger millet malt and were evaluated for various sensory characteristics. The data pertaining to sensory scores are presented in Table 2. As the per cent of finger millet malt incorporation increased the scores, also increased up to 30 per cent level of incorporation except colour. It can be said that addition of finger millet malt upto 30 per cent in *Shira* is possible to increase its nutrient content. Statistical analysis showed that, there was significantly difference in all sensory parameters.

The mean values of organoleptic scores for the acceptability of instant *dhokala* prepared without and with incorporation of finger millet malt are given in Table 3. Finger millet malt was incorporated in instant *dhokala* from 0 to 25 per cent level. The finger millet malt incorporation up to 20 per cent in instant *dhokala* was best accepted by panel members. Significant differences was noticed in the sensory parameters of instant *dhokala* prepared with and without finger millet malt.

Findings regarding the organoleptic evaluation of

Table 1 : Sensory scores of *Dhapata*

Variations	Level of finger millet malt incorporation (%)	Mean value of sensory scores				
		Colour	Texture	Taste	Flavour	Overall acceptability
I	0	8.1	8.3	8.2	8.2	8.2
II	10	7.2	7.5	7.5	7.4	7.4
III	20	6.8	7.0	7.1	7.2	7.1
IV	30	6.5	8.3	8.2	8.2	8.4
V	40	6.4	7.1	7.2	7.0	7.0
	C.D. (P=0.05)	0.68	0.54	0.58	0.52	0.52
	S.E. ±	0.24	0.19	0.20	0.18	0.18
	F-value	9.79**	10.41**	6.63**	9.06**	10.05**

NS=Non-significant * and ** indicate significance of values at P=0.05 and 0.01, respectively

Table 2 : Sensory scores of *Shira*

Variations	Level of finger millet malt incorporation (%)	Mean value of sensory scores				
		Colour	Texture	Taste	Flavour	Overall acceptability
I	0	8.4	8.1	8.0	8.2	8.4
II	10	7.6	7.4	7.6	7.4	7.4
III	20	7.5	7.6	7.6	7.8	7.8
IV	30	7.2	8.2	8.2	8.4	8.4
V	40	7.1	7.2	7.0	7.6	8.1
	C.D. (P=0.05)	0.56	0.58	0.63	0.58	0.55
	S.E. ±	0.20	0.21	0.22	0.21	0.20
	F-value	6.2**	4.4**	2.8*	3.8**	3.4*

NS=Non-significant * and ** indicate significance of values at P=0.05 and 0.01, respectively

products prepared under study demonstrated that commonly used recipes such as *Dhpata, shira*, instant *dhokala* can be prepared by utilizing finger millet malt. The organoleptic scores obtained by various recipes with 20 to 30 per cent incorporation of finger millet malt indicated that finger millet malt can be utilized for value addition.

The results of nutritional analysis of unmalted and malted finger millet is given in (Table 4). The processing influenced the nutrient content of finger millet. Malted finger millet contained slightly more amount of moisture, protein, fibre, fat as compared to unmalted finger millet whereas, total mineral and calcium increased significantly. The calcium content increased from 350 to 400 mg/100g. It is reported that during malting process calcium content increases whereas iron content decreases (Sangita and Sarita, 2000) which are accordance with the estimated values in the present study. Rao (1994) also found that malting decreases tannin, phytin phosphours *i.e.* reduced antinutritional factors from raw finger millet. Eipeson *et al.* (2007) concluded malting improves the bio-accessibility of iron and manganese of finger millet. Malleshi and Desikachar (1986) noticed that the malting process was useful to increase the

Table 3 : Sensory scores of *Instant dhokala*

Variations	Level of finger millet malt incorporation (%)	Mean value of sensory scores				
		Colour	Texture	Taste	Flavour	Overall acceptability
I	0	8.4	7.8	7.7	7.8	7.8
II	10	7.4	7.7	7.2	7.4	7.4
III	15	7.2	7.5	7.3	7.2	7.2
IV	20	7.2	8.0	7.8	7.7	7.8
V	25	6.4	6.3	6.3	5.8	6.0
	C.D. (P=0.05)	0.72	0.73	0.77	0.82	0.82
	S.E. ±	0.26	0.26	0.28	0.29	0.29
	F-value	7.92*	6.41*	4.34*	6.98*	6.33*

NS=Non-significant * and ** indicate significance of values at P=0.05 and 0.01, respectively

Table 4 : Nutrient composition of unmalted and malted finger millet flour

Nutrients	Unmalted finger millet flour	Malted finger millet flour	't' value
	Mean ± SD	Mean ± SD	
Moisture (g/100g)	12.72 ± 0.05	12.76 ± 0.1	0.61^{NS}
Protein (g/100g)	7.26 ± 0.23	7.45 ± 0.45	0.65^{NS}
Fat (g/100g)	1.24 ± 0.05	1.31 ± 0.02	0.06^{NS}
Fibre (g/100g)	3.5 ± 0.057	3.9 ± 0.1	0.85^{NS}
Total mineral (g/100g)	2 ± 0.06	2.5 ± 0.06	9.79*
Carbohydrate (g/100g)	73.28 ± 0.02	72.08 ± 1	2.07^{NS}
Iron (mg/100g)	3.38 ± 1	3 ± 0.86	0.49^{NS}
Calcium (mg/100g)	350 ± 5	400 ± 5	12.24**

NS=Non-significant * and ** indicate significance of values at P=0.05 and 0.01, respectively

Table 5 : Nutrient composition of *Dhapata*

Nutrients	Control	Accepted variation	't' value
	Mean ± SD	Mean ± SD	
Moisture (g/100g)	9.6 ± 0.2	10.4 ± 0.1	6.19*
Protein (g/100g)	12.11 ± 0.1	11.95 ± 0.1	1.95^{NS}
Fat (g/100g)	4.9 ± 0.1	5 ± 0.1	1.22^{NS}
Fibre (g/100g)	1.6 ± 0.1	2.8 ± 0.1	14.69*
Total mineral(g/100g)	2 ± 0.05	2.1 ± 0.2	0.84^{NS}
Carbohydrate(g/100g)	69.79 ± 0.1	67.75 ± 1.2	2.93^{NS}
Iron (mg/100g)	4.6 ± 0.3	4.1 ± 0.1	2.73^{NS}
Calcium (mg/100g)	49.45 ± 0.5	251 ± 5	69.47**

NS=Non-significant * and ** indicate significance of values at P=0.05 and 0.01, respectively

calcium, phosphorus and vitamin C content of finger millet flour. Malting of finger millet improves digestibility and bioavailability of nutrients, improves sensory and nutritional quality.

The nutrient analysis of developed variations showed that addition of malted finger millet could increase the nutrient content of the developed products. The nutritional composition of *dhapata* developed by incorporation of finger millet malt is recorded in Table 5. *Dhapata* with addition of finger millet malt depicted that significant increase in values of nutrient i.e fibre and calcium. The calcium content increased from 49.45 to 251 mg/100g and fibre 1.6 to 2.8 mg/ 100g . It can be said that addition of malted finger millet in *dhapta* is beneficial to increase nutrient composition of the diet. Increase in calcium, fibre helps to maintain bone health, associated problems and gastrointestinal problems. So developed product contents good amount of calcium with increased bioavailability. So it will be helpful to maintain the level of calcium.

Nutritional composition of *Shira* with addition of malted finger millet presented in (Table 6) showed that significant increase in values of nutrients *viz.*, moisture, protein, fibre, total mineral, calcium except iron. The calcium content increased from 19.3 to 146.6 mg/100g.

In (Table 7) depicted that fibre and calcium content was increased significantly where as moisture, fat, total mineral increased numerically but not reached at the level of significance and carbohydrate content was significantly decreased with incorporation of malted finger millet in the *instant dhokala*. It can be noticed that the value obtained for fibre of *dhapata, shira* and instant *dhokla* was increased significantly due to finger millet malt addition. The increase in fibre content of developed product is good for therapeutic purpose. Recently, it is always suggested that amount of fibre must be increased in the diet as dietary fibre serves many purposes such as hypocholestertmic, hypoglycemic and it helps to relive constipation.

Conclusion :

It is concluded that 30 per cent level of incorporation of finger millet malt in *dhapata, shira* and 20 per cent level of incorporation in instant *dhokla* was most accepted level of incorporation which helped to enhance the nutrient content. These products can be used as

Table 6 : Nutrient composition of *Shira*

Nutrients	Control	Accepted variation	't' value
	Mean ± SD	Mean ± SD	
Moisture (g/100g)	24.8 ± 0.5	29.33 ± 0.3	13.45**
Protein (g/100g)	5.5 ± 0.3	6.7 ± 0.2	5.76*
Fat (g/100g)	10.4 ±0.4	11.1 ±0.9	1.23 NS
Fibre (g/100g)	0.15 ±0.5	1.9 ±0.4	4.73*
Total mineral (g/100g)	0.11 ±0.07	0.93 ±0.3	4.61*
Carbohydrate (g/100g)	59.05 ±1	50.07 ±1	10.99**
Iron (mg/100g)	1.09 ±0.3	1.9 ±0.4	2.80 NS
Calcium (mg/100g)	19.3 ±1.5	146.6 ±5.77	36.98**

NS=Non-significant * and ** indicate significance of values at P=0.05 and 0.01, respectively

Table 7 : Nutrient composition of *Instant dhokla*

Nutrients	Control	Accepted variation	't' value
	Mean ± SD	Mean ± SD	
Moisture (g/100g)	20 ± 2	22.8 ± 2	1.71 NS
Protein (g/100g)	20 ±1	19.8 ± 0.9	0.25 NS
Fat (g/100g)	11 ± 1	11. 2 ± 0.2	0.33 NS
Fibre (g/100g)	4.6 ±0.2	6 ± 0.1	10.84**
Total mineral (g/100g)	2.91 ± 0.4	2.99 ± 0.3	0.27 NS
Carbohydrate (g/100g)	41.5 ± 1.5	37.21 ± 0.7	4.48*
Iron (mg/100g)	6.3 ± 0.3	6.6 ± 0.3	4.08 NS
Calcium (mg/100g)	70 ± 10	180 ± 10	13.47**

NS=Non-significant * and ** indicate significance of values at P=0.05 and 0.01, respectively

supplementary foods to prevent calcium deficiency. Therefore, finger millet can be utilized successfully in different products.

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Received : *04.03.2016;* **Revised:** *11.03.2016;* **Accepted :** *26.03.2016*