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Development and evaluation of traditional food products from high fibre food mix

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Abstract
Obesity is one of the major risk factors for morbidity and mortality including type 2 diabetes, cardiovascular, osteoarthritis, malignant and metabolic diseases. Observational research studies consistently indicated that habitual increased intake of fiber rich foods is associated with lowering effect of body weight. Hence, the present study was undertaken to develop and evaluate the high fiber food mix and traditional products. The high fiber food mix was developed by using region specific ingredients. From the developed high fibre mix dosa, roti and mudde were prepared and evaluated for sensory evaluation. The developed mix contained protein, fat, carbohydrate, energy and dietary fibre of 15.80±0.32g, 2.60±0.12g, 60.75g, 320 kcal and 29.50±0.91g respectively. Dosa, roti and mudde products prepared from high fiber mix were found to be acceptable for their color, flavour and taste, texture with the overall acceptability scores of 7.1±0.93, 7.3±0.78 and 7.3±1.12 respectively.

Keywords: High fibre, millet, obesity and organoleptic evaluation

1. Introduction
Obesity is one of the risk factors for morbidity and mortality including type 2 diabetes, cardiovascular, osteoarthritis, malignant and metabolic diseases. Obesity in adults is increasing at the global level and more than one in eight adults are obese (Anon., 2018) [2]. Obesity is a medical issue which results in more cost on health systems in both developing and developed countries. Dietary fibers are often characterized by high nutritional quality, as they are able to cure many chronic diseases and improve sensory characteristics of foods. In recent years, millets are recognized as important substitute for major cereal crops. The nutritive value of millets is comparable to other cereals with regard to protein, fat and mineral contents (Gopalan *et al.,* 2004) [1]. Besides, their use as staple food by few communities, millets also serve the purpose of therapeutic foods. The millet grain contains a high proportion of dietary fiber which helps in prevention of constipation, lowering cholesterol and slow release of glucose to the blood stream during digestion. It is reported that cardiovascular diseases, duodenal ulcers and hypoglycemia occur rarely in regular millet eaters. Observational studies consistently demonstrate that habitual increased intake of fiber rich foods are associated with lower body weight (Pereira *et al.*, 2001) [3].
Several experiments have proved the beneficial role of millets as an effective faecal bulking, hypoglycemic and hypolipidemic agent due to the presence of higher proportion of unavailable complex carbohydrate, resistant starch and slow release of sugars (Krishnakumari and Thayumanavan, 1997) [11]. Further, millets having high satiety value can be utilized in designing therapeutic, nutritious and acceptable food products as an effective therapy in the treatment of overweight and obesity. In the present situation it is the need of the day to exploit the positive nutritional benefits of millets and popularize them among all sectors of the society for achieving nutritional and therapeutic food security. Considering the therapeutic benefits of millets it is essential to develop foods suitable for weight reduction. The millets in combination with pulses, vegetables and spices can be utilized to develop high fiber food mix. Further to develop traditional food products with suitable protocol to cater to the needs of the urging society. Hence the present study was undertaken with an objective to develop and evaluate millet based high fiber food mix based products.

2. Material and methods
2.1 Development of millet based mix
Locally grown region specific millets, pulses, vegetables and some of the functional foods were identified for development of high fiber food mix. Millet based food mix was prepared by using the identified ingredients *viz.,* finger millet (*Eleusine coracana*),

little millet (*Panicum sumatrense*), defatted soya (*Glycine max*) flour, whole green gram (*Vigna radiata*), fenugreek seeds (*Trigonellafoenum-graecum*), cluster bean (*Cyamopsis tetragonoloba*), drumstick leaves (*Moringa oleifera*) and curry leaves (*Murraya koinigii*) at definite proportion. All the ingredients used for the study were procured from local market of Bengaluru. Fresh cluster bean, Drumstick leaves and curry leaves were washed thoroughly, blanched for one minute and oven dried and made into flour. Further finger millet, little millet and whole green gram and fenugreek seeds were cleaned and made into flour. Millet based mix was developed by mixing thoroughly the flours, dehydrated vegetable flour and defatted soya flour and kept airtight for further nutrient analysis and preparation of the product for use.

2.2 Nutrient analysis

Proximate composition of developed mix was analyzed by using standard protocol (AOAC, 1990) [4]. Further, carbohydrate content was calculated by differential method and calorific value was obtained by multiplying the carbohydrate and protein content by four and fat by nine Kcals. Dietary fiber was analysed by AOAC protocol 993.19 and 991.42 by fibra plus instrument. Micronutrients *viz.*, iron, zinc, copper and calcium were analyzed by atomic absorption spectrometry (AOAC, 1990) [4].

2.3 Preparation of traditional products

Based on the preliminary survey conducted at villages of Bengaluru rural and urban district two breakfast products commonly consumed namely roti and dosa and one main item of lunch mainly ragi balls (Dumpling) were selected for preparation using the developed food mix (Fig.1). The products were prepared according to local culinary method practiced. The nutrient composition of the prepared products was computed using National Institute of Nutrition (NIN), lab manual.

2.4 Organoleptic evaluation: Dosa, roti and mudde prepared from high fibre food mix (experimental) and same products prepared from ragi as control were subjected for organoleptic evaluation by a panel of 30 semi-trained members using nine point hedonic scale (where 9-like extremely and 1- dislike extremely) for appearance, colour, aroma, taste, texture and overall acceptability.

2.5 Statistical analysis

All analyses were carried out in triplicate. Results were mentioned with standard deviation.

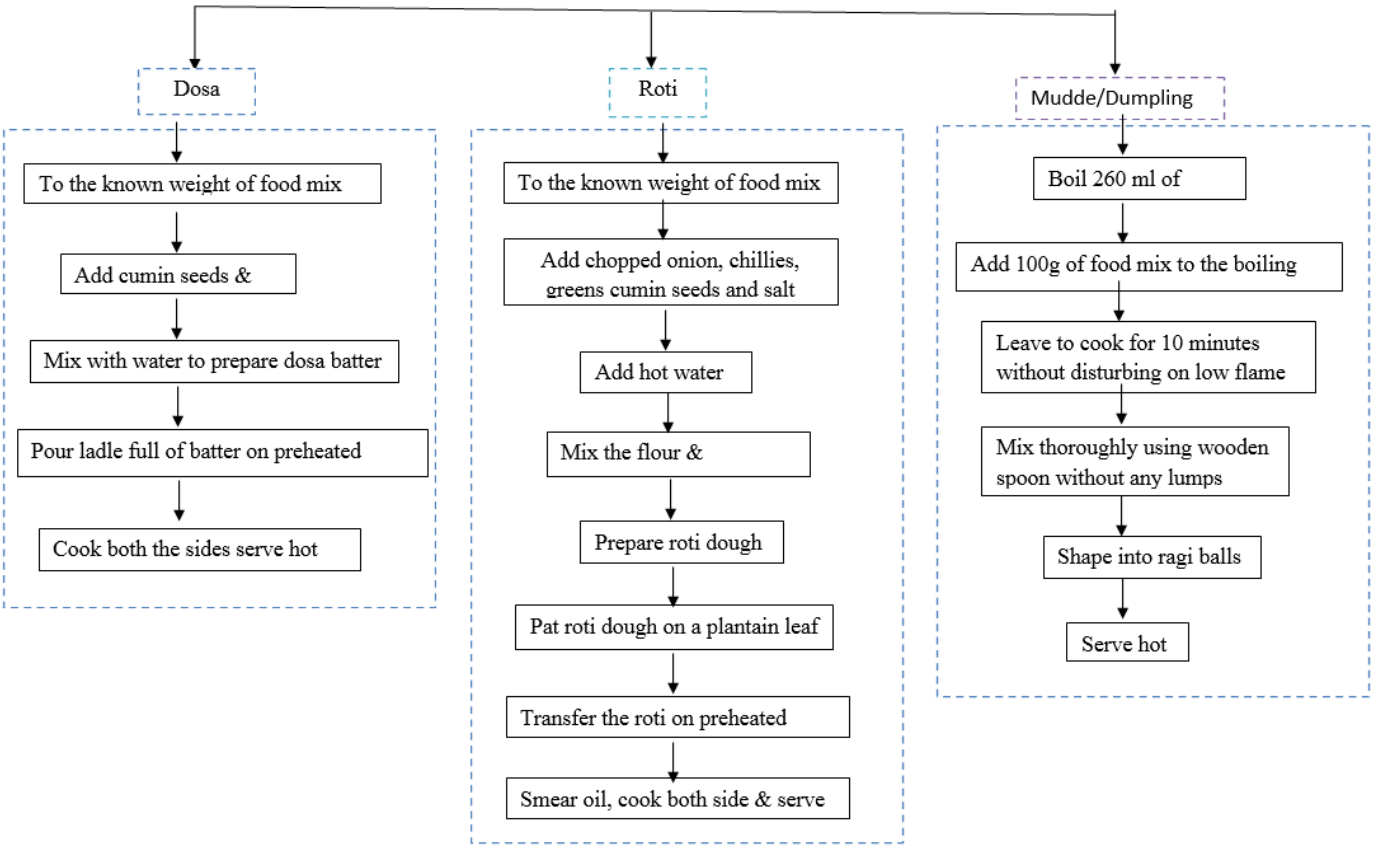

Fig 1: Preparation of traditional products using high fiber food

3. Results and Discussion

The nutrient composition of millet based mix is presented in table 1. The developed food mix contained 9.10±0.07g of moisture, 15.80±0.32g of protein, 2.60±0.12g of fat, 60.75g of carbohydrate, 320 kcal energy, 3.60±0.18 g of ash, 10.11±0.83 g of crude fiber and dietary fiber 29.50±0.91 g per 100 g. The nutritional roles of fiber have not been fully established but it is known that fiber contributes to the health of the gastrointestinal system and metabolic system in man. Iron and calcium were found to be 8.33±0.12 and 366±0.08 mg per 100 g respectively. The developed mix contains noticeably good amount of protein, low amount of fat, energy and high amount of dietary fiber and minerals. The developed mix was found to be higher in terms of protein and dietary fiber compared to the millet based composite food developed and evaluated by Sunanda *et al.*, 2003 [5] where in the protein content ranged from 10.21 to13.42 per cent and dietary fiber ranging from 20.60 to 23.4 per cent. Composite flour mix

developed from millets and legumes by Chethana, 2008 [8] also had lower protein (10.8 to 11.15 g/100 g) and fat content (0.67 to 1.44 g/100g) compared to the mix developed under the study. The use of soya bean and green gram in addition to millets are the contributing factors for higher protein content. Incorporation of vegetables in addition to whole grains increased the dietary fiber content.

Table 1: Nutrient composition of high fiber food mix (100g)

Nutrients	Quantity
Moisture (g)	9.10±0.07
Protein (g)	15.80±0.32
Fat (g)	2.60±0.12
Total Carbohydrates (g)*	60.75
Energy (k cal)*	320
Ash (g)	3.40±0.18
Crude fiber (g)	9.11±0.83
Dietary fiber (g)	29.50±0.91
Iron (mg)	8.33±0.12
Calcium(mg)	366±0.08

*: Calculated values

The nutritional composition of developed products is presented in table 2. Highest moisture content was observed in mudde (54.5 %) followed by dosa (53.01%) and roti (40.85%) with the protein content of 7.50g, 7.72g and 9.67g per 100 g respectively. Variation in moisture content attributed to difference in water uptake on cooking by application of different degree of heat under various cooking methods which was also reported in the assessment of rice cooking quality (Suman and pinky, 2005) [6]. The carbohydrate content in the developed products ranged from 30.37 to 39.19 per cent. The lower carbohydrate and high dietary fiber in products may be attributed to the inclusion of high fiber ingredients in mix preparation. In all the products fat content was found to be low. The developed products are beneficial for obese and diabetics subjects as the report of Lindstrom *et al.*, 2006, low dietary fat and fiber intake are significant compounds of sustained reduction in weight and diabetes. Considerable evidence supports that increasing consumption of dietary fiber is associated with lower risk of obesity in adults (Anderson *et al.*, 2009) [9]. It was observed that dosa, mudde and roti showed the high dietary fiber content as 15.28, 19.03 and 14.75 per cent respectively. The total ash content ranged from 1.74 to 2.19 g per 100 g of developed products. Ash is a non-organic compound indicating the mineral content of food. Nutritionally, ash aids in the metabolism of other organic compounds such as carbohydrate and fat (Sowoola *et al.*, 2002) [10].

Table 2: Nutrient composition for products prepared from RTU High fiber mix

Nutrients	Per 100 g of cooked products		
	Dosa	Roti	Mudde
Moisture (g)	53.01	40.85	54.5
Protein (g)	7.72	9.67	7.5
Ash (g)	1.76	2.19	1.74
Fat (g)	1.34	1.67	1.3
Energy (k.cal.)*	165	207	160
Total Carbohydrates (g)*	31.47	39.19	30.37
Crude fiber (g)	4.72	5.87	4.55
Dietary fiber (g)	15.28	19.03	14.75
Iron (mg)	4.26	5.3	2.6
Calcium (mg)	189.63	236.12	183

*Calculated value

Organoleptic characteristics of the products (Table 3) showed the similar acceptability as that of control products. Dosa, roti and mudde products prepared from high fiber mix were found to be acceptable for their color, flavour and taste, texture with the overall acceptability scores of 7.1, 7.3 and 7.3 for the respectively.

Table 3: Mean (n=30) sensory scores for the products from high fiber mix

Parameters	Dosa		Roti		Mudde	
	A	B	A	B	A	B
Appearance	7.6±0.78	7.0±0.58	7.5±0.45	7.1±0.54	8.1±0.64	7.3±0.64
Aroma	7.3±0.88	7.1±0.63	7.6±0.54	7.2±0.63	7.6±0.48	7.2±0.75
Texture/ consistency	7.5±0.96	7.2±0.58	7.6±0.63	7.4±0.39	7.9±0.53	7.4±0.69
Taste	7.5±0.99	7.1±0.67	7.8±0.73	7.2±0.65	7.8±0.39	7.0±0.78
Overall acceptability	7.4±1.23	7.1±0.93	7.8±1.03	7.3±0.78	7.8±0.98	7.3±1.12

Note: A-Control, B – Experimental

4. Conclusion

Transition in lifestyle with more consumption of junk foods and reduced intake of fruits and vegetables coupled with sedentary life style are the main causes for overweight and obesity. This is because most of the junk foods are rich in fat salt, preservatives, simple sugars and less in complex carbohydrates. The intake of fiber in such foods is far behind the recommendation. However inclusion of such high fibre food mix products whole in the daily diet enhances the dietary fiber intake. This along with modification in lifestyle would benefit in weight reduction along with obesity management.

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