Development and quality evaluation of foxtail millet \[\text{Setaria italica (L.)}\] incorporated breads*

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Abstract: Foxtail millet \[\text{Setaria italica (L.)}\] is an important underutilized millet grain, grown in various parts of India. It grows well even under adverse agro climatic conditions. It is good source of dietary fiber and ß carotene. Foxtail millet incorporated breads were developed by incorporating foxtail millet flour at 10, 30 and 50 per cent level in the recipe. Height of the breads affected significantly at 50 per cent incorporation of foxtail millet flour. Value addition to breads with foxtail millet resulted in significant change in colour of both crust and crumb. Crumb colour changed from white to dull yellowish with increased incorporation of millet flour. The highest L value was found for 50 per cent (67.24) incorporated breads followed by control (53.56), 30 per cent (48.47) and 10 per cent (40.86). Compressive test of bread crumb showed significant difference between control and foxtail millet incorporated breads. Increase in foxtail millet resulted in increased hardness with harder crust and grainy texture. Sensory evaluation scores revealed that the higher proportion of foxtail millet incorporation although decreased scores for colour, appearance and texture, the taste, flavour and overall acceptability improved and are on par with control bread. Thus, the study indicated the potentials of development of foxtail millet incorporated breads at 50 per cent level.

Key words: Bread, Colour, Foxtail millet, Proximate composition, Sensory evaluation, Texture

Introduction

The demand for processed foods is ever increasing due to the technological, industrial and economic advances of the developing societies of the world including India. The bakery industry has been steadily growing in the country, being the largest among the processed food industries. With changing lifestyle, urbanisation, increase in per capita income and working spouse have all made bread a staple food in India as its in other western countries. Indian bread market is very low as compared to USA and UK. The bread market has a business volume of 1.5 million tonnes. The bread industry has a production of approximately 27 lakh tonnes.

The bread formula consists of refined flour, fat, sugar and other additives. It is well documented that most of the ingredients used in commercial bread lack important nutrients. The refined flour lacks in dietary fiber and micronutrients which are important health promoting components. There is a growing awareness among the consumers regarding the constituents that affect health both positively and negatively. Number of such health conscious consumers is fast increasing and so is the health food industry. New foods with new health claims are flooding the market to meet the diverse demands of consumers. However, there is ample scope to enhance the nutritional value of breads both quantitatively and qualitatively using nutritious food ingredients such as millets. There have been reports of bread made from blend of other flour such as rice (Yalimaki. et al, 1991), composite flour of wheat, plantain and soybeans (Olajuyegbe et al., 2006), sunflower seed flour (Skrbic and Filipcev, 2008), flax seed (Koca and Anil., 2007), composite flour of wheat, barnyard millet, proso millet and finger millet (Singh et al., 2012). Value addition to existing foods with new health claims are flooding the market to meet the diverse demands of consumers. However, there is ample scope to enhance the nutritional value of breads both quantitatively and qualitatively using nutritious food ingredients such as millets. There have been reports of bread made from blend of other flour such as rice (Yalimaki. et al, 1991), composite flour of wheat, plantain and soybeans (Olajuyegbe et al., 2006), sunflower seed flour (Skrbic and Filipcev, 2008), flax seed (Koca and Anil., 2007), composite flour of wheat, barnyard millet, proso millet and finger millet (Singh et al., 2012). Value addition to existing foods with foxtail millet is a simple and feasible way of enhancing nutritional values of foods and in turn the health benefits.

Millet have been in food use since time immemorial and an array of traditional healthy foods are prepared across rural India. However, food use of millets is fast decreasing due to several reasons. Apart from health benefits, millets are also good source of energy, protein, vitamins and minerals (Ravindran, 1991). Millet foods are also known for their low glycemic index (Itagi, 2003 and Singh et al, 2010). There is therefore a need to revive these important groups of health promoting foods to enhance nutritional quality of diets of consumers. Among the millets foxtail millet (Setaria italica) is an important underutilized grain, grown in various parts of India. It grows well even under adverse agro climatic conditions. It is also called as navane. Among the millets, foxtail millet is a good source of protein (12.3 g/100g) and dietary fiber (14 g/100g). The carbohydrate content is low (60.9 g/100g). Besides, it is rich in minerals (3 g/100g) and phytochemicals. Foxtail millet is a good source of ß carotene (126-191 µg/100g, Goudar et al., 2011). This millet has been proved to be suitable for people suffering from metabolic disorders (Itagi, 2003). Hence, in the present study foxtail millet was chosen for development of nutritious bread.

Material and methods

The present study was carried out in the Department of Bioresource Engineering, McGill University, MacDonald Campus, Montreal, Canada, during the period of May to July, 2012. The study aimed to explore the potential use of foxtail millet in bakery products especially bread and quality evaluation of developed breads in terms of texture, colour and sensory evaluation.

Foxtail millet flour was obtained from the University of Agricultural Sciences, Dharwad, Karnataka, India. All other materials such as all purpose flour, yeast, sugar and salt were purchased from local market of Montreal, Canada.

All purpose flour was replaced by foxtail millet flour at 10, 30 and 50 per cent level for the development of breads. For preparation of bread optimum straight dough bread making
technique Anon., 1995, (Table 1) was used. Dough was prepared using electronic dough kneading machine (Professional 5 plus Kitchen Aid). Processing chart of bread development is given in Fig. 1.

Assessment of physical characteristics of breads is an important aspect which determines the consumer acceptability. Physical characteristics of the breads were studied employing standard procedure. Average weight of breads was recorded in grams using electronic balance. Length, width and height of bread loaves were measured using measuring scale.

Chromatic components ‘L’ (black to white) ‘a’ (redness to greenness) and ‘b’ (yellowness to blueness) values of bread crust and crumb were measured using chromo meter (Minolta CR-400, Konica Minolta Sensing, Inc., Osaka, Japan). Bread slices were subjected to a compression test to know the hardness of bread by texture analyser (Instron, model-4500). Bread slices of 25 mm thickness were tested under the compression mode and tensile mode using 20 mm diameter compression probe. A crosshead speed of 12.5 mm/min was used to record the maximum force expressed as the hardness of the bread in Newtons (N). All textural measurements were done in triplicate.

The breads were evaluated for sensory quality using nine points hedonic scale by semi trained panel of 15 to 20 judges comprising of staff and students of the Department of Bioresource Engineering, Macdonald Campus, McGill University, Montreal, Canada.

The moisture, protein, fat and ash contents were analysed using AOAC (Anon., 1990) procedure. Statistical analysis was conducted using software JMP ver 8.0, SAS Institute Inc, Corg (NC), 27513, USA. Turkey Kramer test was used to locate the differences among the physical characteristics of breads with millet flour.

Results and discussion

Physical characteristics are important determinants of product acceptability, because eyes evaluate the products for colour and appearance before the tongue tastes them. The results of the evaluation of physical characteristics of value added foxtail millet breads in comparison with control breads are presented in table 2. Non significant difference was observed with respect to weight of the control (116.30 g) and 10 per cent foxtail millet incorporated breads (116.44 g). As the millet incorporation increased, the height of the bread decreased significantly (Fig 2 and 3). Fifty per cent (3.83 cm) millet incorporated breads showed significantly less height compared to control breads (6.70 cm). It may be due to lack of gluten in millet. With respect to length and breadth, 10 per cent millet incorporated breads were on par with control breads. But, these two parameters affected significantly with increased proportion of millet in the recipe (Table 2).

Value addition to breads with foxtail millet incorporation resulted in significant change in colour of both crust and crumb (Table 3, Fig 2 and 3). The $L^*$ value indicates the measure of lightness of a sample and is considered to be an expression the whiteness in sample. The value ranged from 0 (black) to 100 (perfect white), with higher values indicating brighter samples.
Values with the same letter in the same row are not significantly different.

Ten and 30 per cent millet incorporated breads showed significantly lower L\textsuperscript{b} value for crust compared to control bread (53.56), whereas 50 per cent in formulation level had significantly higher L\textsuperscript{b} value (67.24) compared to control, as the level of millet incorporation increases, the L\textsuperscript{b} value for crust increased, but significantly lower compared to control bread (72.71). The a* value is a measure of the degree of redness or greenness of a sample, ranging from -100 to +100. A positive value indicates redness, and a negative value expresses greenness. Higher incorporation of millet showed significantly lower a* value for crust compared to control breads. The b* value is a measure of the degree of yellowness (positive values) or blueness (negative values) of a sample, ranging from -100 to +100. A positive value indicates yellowness, and a negative value indicates blueness. Higher level in the formulation produced breads with higher b* value, indicates that millet breads were yellow in colour. It may be due to colour of foxtail millet flour. Sciarini et al. (2010) observed similar results in soy and corn flour incorporated bread.

Compressive test of bread crumb showed significant difference between control and foxtail millet incorporated breads. As shown in Table 4, millet breads were harder than the control bread. Increased incorporation of foxtail millet increased hardness (5.30) with harder crank and grainy texture. Wheat contains protein called gluten, which produces porous and soft baked products. The main function of gluten in bread making is to hold water and forms strong elastic wall which holds carbon dioxide produced during fermentation. Therefore, substitution of wheat flour with gluten free flours such as millet flour reduced gluten content and thus produced harder bread with grainy crumb. Similar results were observed in oat, millet and sorghum incorporated breads (Angiolini and Collar, 2012).

Different trials were conducted incorporating 10 to 50 per cent foxtail millet in the bread formulae replacing refined flour to arrive at most acceptable foxtail millet breads. Non significant differences were found between control and 50 per cent foxtail millet incorporated breads with respect to colour, flavour, taste and overall acceptability. Sensory scores indicated that refined flour could be replaced to an extent of 50 per cent with foxtail millet flour (Table 5) without affecting the sensory quality of breads. Similarly, Oladunmoye et al. (2010), developed acceptable composite breads from 50:30:20, 60:20:20, 70:20:10, 80:10:10, 85:10:5 and 90:5:5 ratio of wheat : cassava/maize : cowpea flours.

Proximate composition of highly acceptable foxtail millet bread in comparison with control bread is given in Table 6. Foxtail millet bread was high in protein and total ash content compared to control bread. It may be due to higher mineral composition of foxtail millet grains. These observations are in close resemblance with the results reported by Alobo (2001) in pearl millet-sesame composite bread.
composite biscuits. Similar results of increased total minerals were observed (Gurupavithra et al., 2013) in popped foxtail millet.

From the present study it can be concluded that, foxtail millet could be incorporated up to 50 per cent level in refined wheat flour for bread preparation. Sensory characteristics of foxtail millet breads were similar to that of control breads with respect to colour, flavour and taste while physical properties like hardness increased significantly.

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References