



Nutrient analysis and acceptability of different ratio pearl millet (*Pennisetum glaucum*) based biscuits

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Received: 21 May 2019; Accepted: 15 July 2019

ABSTRACT

Biscuits being important food snacks for children and adults are rich in fat and sugar content than whole bread. Lower contents of proteins (lysine), vitamins and dietary fibers are the nutritional problems with most bakery products clamoured interest in increasing the nutrients and fiber content in the biscuits. Pearl millet (*Pennisetum glaucum*) has received considerable attention for their high content of dietary fibres, phytochemicals and nutritional value. On farm trial was conducted in the South West district of Delhi during *rabi* 2014–15, 2015–16 and 2016–17 among 30 farm women with three treatments with an objective to prepare biscuits with partial replacement of wheat flour with different proportions of pearl millet flour and to study its acceptability and nutritive value among farm women. The developed biscuits were sensory evaluated using nine point hedonic scale and evaluated for nutritive value in terms of carbohydrate, protein, fat, fiber, calcium and iron. Results showed that biscuit prepared with chick pea flour was highly acceptable whereas already established practice was least acceptable. The nutrient analysis showed highest protein; fat; carbohydrate; dietary fiber; calcium and iron in chick pea biscuit sample i.e. 16.25%; 45.36%; 75.25%; 13.53%; 41.33% and 6.53%, respectively. Replacement of wheat flour with pearl millet flour and chick pea flour increased the protein, fibers and iron contents proportionately to the level of substitution. Chick pea flour made biscuit was found most acceptable and was much appreciated when compared with other two types of biscuits among farm women.

Key words: Calcium and Iron rich biscuit, Gluten free bakery, Pearl millet

Biscuits hold a significant place in the baking industry due to variety in taste, texture and aroma. It is an unleavened crisp, sweet pastry made from refined flour, shortening and sugar, and is usually made light by the addition of baking powder. Refined wheat flour is a key ingredient for preparing cookies due to its gluten content. However, refined wheat flour is a product of refining that contains higher proportion of starch, low dietary fibre and minerals and the resultant bakery products are characterized with low proteins, fat and mineral content. Because of its acceptability in all age group, longer shelf-life, better taste and its position as snacks is considered for nutritional improvement (Gayas *et al.* 2012). Due to competition in the market for healthier, natural functional products attempts are being made in recent days to improve nutritional qualities and functionalities of biscuits in cost effective manner. It is produced by mixing various ingredients like flour, fat, sweeteners and water to

form dough. At present biscuits are prepared from refined wheat flour, which is low in quality and fiber content. Importance of bakery products has expanded especially the use of whole and natural grains and other natural ingredients. Therefore to improve its nutritive value, there is a need for replacing refined wheat flour with flour of better nutritive quality. Pearl millet (*Pennisetum glaucum*) is an important coarse cereal crop in western India (Gujarat, Rajasthan and Haryana).

Bajra, is a potential millet grain cultivated in arid and semi-arid regions of India. It is the second most cultivated and consumed millet of the country. Pearl millet is nutritionally rich in many minerals and proteins. This crop has received considerable attention for its high content of dietary fibers, phytochemicals and nutritional value. Bajra contains about 12% proteins, 5% ether extractives (including fats) and 67% carbohydrates, and it is said to be a rich source of minerals and vitamins of the B group. It is a gluten- free grain that retains its alkaline properties and considered to have one of the best protein qualities. The amino acid composition has significant effect on the nutritional quality of protein. Lysine and Methionine are the two amino acids present in pearl millet. The amino acid profile of pearl millet is better than that of sorghum and maize and is comparable to wheat, barley, and rice (Rai *et*

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et al. 2008). It has high energy, less starch, low GI (55) and is gluten free (Nambiar *et al.* 2011). Flavonoids and phenolic acid are both highly active antioxidant, which is present in pearl millet (0.9%) and (4.08 mg/g) respectively. The total antioxidant activity of pearl millet is $(1.33 \pm 0.003 \text{ mg/ml})$ calculated in terms of ascorbic acid (Daniel *et al.* 2012).

The millet-growing region in India continues to shrink owing to lack of institutional support for millet crops in contrast to wheat, rice and maize. While pearl millet is nutritious, it is one of underutilized treasures of developed countries due to non-availability, inconvenient/unready to eat form (Obilana B A 2010). As a food source it is non glutinous and non- acid forming, so it is soothing and easy to digest. The present research was aimed to evaluate the effect of replacement of wheat flour by different levels of pearl millet and chickpea on nutritional and sensory properties. Biscuits were prepared and evaluated for perceived sensory properties and nutritional value, thereby investigating the ability of pearl millet for preparation of nutritional biscuits.

MATERIALS AND METHODS

Three treatments namely; T_1 – Established practice [(biscuits with only wheat flour (100%)]; T_2 Recommended practice [whole wheat flour (50%): bajra flour (50%)] and T_3 - Recommended practice [bajra flour (50%): besan/ chick pea flour (50%)] were conducted. Purposive sampling technique was used for testing the acceptability of recipe for all the three trials.

The wheat, pearl millet and chickpea was used as a base material for the preparation of flour-mix and other ingredients used in the preparation of biscuits included, sugar, baking soda, baking powder, ghee, milk powder and water. All ingredients were procured from the local market of Nazafgarh, Delhi. The clean and healthy grains of Bajra were used for preparation of flour. Bajra grain was finely ground in an electric grinder and passed through a 60-mesh size sieve. The powdered sample was stored in airtight container until further use for experiments.

The cookies were prepared by partial replacement of wheat flour with pearl millet flour and chickpea flour at different proportions keeping the sugar and fat amount constant to 40 and 35 g respectively on 100 g flour basis. White wheat flour biscuits were considered as control. Fat and ground sugar was creamed in a mixer with a flat beater for 2 min at slow speed. The flour, required amount of milk and 1.5 g ammonium bicarbonate were added to the creamed mixture and mixed for 8 min at medium speed in dough mixer to obtain a homogenous mixture. Care was taken to keep the rolled out dough not too thin or too thick. Using a lid or cookie cutter, desired shapes and striped design were obtained. Then the biscuits were placed on a greased tray and baked at 170°C for 15–20 min or until the biscuits start browning slightly. The baked biscuits were cooled and stored in an airtight container for further analysis.

The nutrients present in three combinations of biscuits such as carbohydrate, protein, fat, fibre, calcium and iron were calculated as per the process suggested by Gopalan

et al. 2014. The sensory evaluation of biscuits was carried out by involving farm women as 10 member semi-trained panels. They were trained for sensory analysis and their perceptions of each attribute were recorded in terms of the score. Judgments were made through rating the products on a 9 point Hedonic scale with corresponding descriptive terms ranging from 9 ‘like extremely’ to 1 ‘dislike extremely’. The comparison of nutritional composition and sensory evaluation among various treatments was done using SPSS software.

RESULTS AND DISCUSSION

Nutrient composition: The nutrient composition of biscuits in three different formulations is conferred in Table 1. Result shows that biscuit prepared with bajra flour and chickpea flour formulation (T_3) were high in protein ($16.25 \pm 0.02 \text{ g}$), carbohydrate (75.25 g), dietary fiber (13.32 ± 0.03), iron ($6.53 \pm 0.03 \text{ mg}$) and ($41.33 \pm 0.03 \text{ mg}$) calcium over the control (T_1). The protein content in biscuits increased linearly with increasing level of chickpea and pearl millet flour. Whereas lowest protein content 10.73 g was observed in wheat flour biscuits (T_1) taken as control. Singh *et al.* (2011) reported that addition of milled millet flour to wheat flour increased the concentration of protein, fat and ash but decreased carbohydrates. Similar results were reported by Rathi *et al.* (2004) for pearl millet biscuits containing higher fat (29.60%), ash (1.75%) and fiber (7.8%) compared to control sample (i.e. 23.36, 0.82 and 1.96%, respectively). The increase in fiber content of pearl millet cookies was attributed to the high inherent fibre proportions in the pearl millet grains (Hadimani NA and Malleshi NG 1993). Florence *et al.* (2014) observed similar trend of increased fat (19.71%) and ash (0.93%) content of pearl millet cookies in comparison to control sample containing fat (16.95%) and ash (0.38%). They reported that replacement of refined wheat flour with semi-refined pearl millet flour in cookies significantly increased the levels of iron, calcium and phosphorus from 2.48, 18.26 and 86.7% to 6.71, 29.36 and 208.1% respectively. The calorific value of pearl millet based cookies was in the range of 485–492 Kcal/100g.

Sensory evaluation of different types of biscuits: The results (Table 2) revealed that the maximum score (8.40) for color was recorded in biscuits with 50% pearl millet and 50% chickpea flour (T_3). The biscuits with 50% pearl millet flour and 50% chickpea flour (T_3) scored maximum for taste and flavor whereas biscuits with 50% wheat and 50% pearl millet scored minimum. The textural quality was in increased proportion in T_3 (8.8 ± 0.2) as compared to T_1 . The overall acceptability of T_3 sample of cookies was highest (8.7 ± 0.04) with composite flour of pearl millet (50%) and chickpea flour (50%).

Sehgal A and Kawatra A (2007) prepared sweet, salty and cheese biscuits using pearl millet flour, refined wheat flour and green gram flour and found highly acceptable biscuits with non-significant difference. Oluwamukomi *et al.* (2011) reported that biscuit from wheat, cassava and soy

Table 1 Nutritive value of different types of biscuits

Treatment	Energy (kcal)	Protein (g)	Carbohydrate (g)	Fat (g)	Fibre (g)	Calcium (mg)	Iron (mg)
T ₁ (W::100)	1582 ± 0.02	10.73 ± 0.02	77.17 ± 0.08	51.7 ± 0.10	11.53 ± 0.03	30.94 ± 0.03	4.1 ± 0.04
T ₂ (W:P::50:50)	1398 ± 0.03	10.92 ± 0.03	75.97 ± 0.02	43.88 ± 0.09	11.50 ± 0.04	29.14 ± 0.04	5.26 ± 0.03
T ₃ (P:C::50:50)	1416 ± 0.01	16.25 ± 0.03	75.25 ± 0.09	45.36 ± 0.08	13.32 ± 0.03	41.33 ± 0.03	6.53 ± 0.03

*Each value is an average of three determinations

Table 2 Sensory analysis of different types of biscuits

Treatment	Color	Flavor	Texture	Taste	Appearance	Overall acceptability
T ₁ (W::100)	7.8±0.58	7.8±0.58	7.6±0.51	8.2±0.1	7.8±0.58	7.5±0.03
T ₂ (W:P::50:50)	7.6±0.51	7.6±0.51	7.8±0.58	7.8±0.58	7.8±0.58	7.7±0.05
T ₃ (P:C::50:50)	8.6±0.24	8.8±0.78	8.8±0.2	8.8±0.1	8.6±0.24	8.7±0.04

*Each value is an average of three determinations

composite flour were acceptable in terms of colour, aroma and overall acceptability up to supplementation level of 60% cassava flour. Florence *et al.* (2014) reported similar results for gluten-free cookies prepared semi refined PMF.

A novel biscuits product, fortified with bajra flour was successfully produced. The formulation made with up to 50% bajra flour and 50% chickpea flour as replacement of wheat flour had highest acceptability. In the light of scientific data of present investigation, it was concluded that pearl millet and chickpea flour can be successfully utilized up to 50% ratio each in the preparation of biscuit without adversely affecting physical, chemical and organoleptic qualities of biscuits. Biscuits prepared by using composite flour of pearl millet and chickpea were found to be rich source of protein, calcium, iron and fiber. Adding bajra flour in bakery products is a useful strategy to increase the consumption of carbohydrate and iron in the human diet. Bajra is low cost cereal, so it is economical and can be used as a healthy alternative to other grain to make our diet more wholesome and nutritious. This investigation will be beneficial in encouraging the utilization of pearl millet, which is still unexploited despite its numerous nutritious and therapeutic benefits. Demand for such pearl millet products will increase in future considering its positive health benefits.

REFERENCES

- Daniel M, Denni M and Chauhan D. 2012. Polyphenols, phospholipids and fixed oil composition of pearl millet [*Pennisetum glaucum* (L.) R. Br.]. *International Journal of Pharmacy and Life Sciences* 3(11): 2098–102.
- Florence Suma P, Urooj A, Asha MR and Rajiv J. 2014. Sensory, physical and nutritional qualities of cookies prepared from pearl millet (*Pennisetum typhoideum*). *Journal of Food Process and Technology* 5(10): 377–82.
- Gayas B, Shukla R and Khan B. 2012. Physico - Chemical and Sensory Characteristics of Carrot Pomace Powder Enriched Defatted Soy flour Fortified Biscuits. *International journal of Scientific and Research Publications* 8: 51–62
- Gopalan C, Shastri B V and Balasubramanian S C. 2014. *Nutritive value of Indian foods*. National Institute of Nutrition, Hyderabad.
- Hadimani N A and Malleshi N G. 1993. Studies on milling, physio-chemical properties, nutrient composition and dietary fiber content of millets. *Journal of Food Science and Technology* 32(1):17–20.
- Nambiar V S, Dhaduk J J, Sareen N, Shahu T and Desai R. 2011. Potential Functional Implications of Pearl millet (*Pennisetum glaucum*) in Health and Disease. *Journal of Applied Pharmaceutical Science* 1(10): 62–7.
- Obilana AB. 2004. *Encyclopedia of Grain Science: Sorghum – Production* ICRISAT. Colin Wrigley, Harold Corks, Charles E Walker (Eds). Elsevier Ltd.
- Oladunmoye O O, Akinoso R and Olapade A A. 2010. Evaluation of some physical-chemical properties of wheat, cassava, maize and cowpea flours for bread making. *Journal of Food Quality* 33: 693–708.
- Rai K N, Gowda C L L, Reddy B V S and Sehgal S. 2008. Adaptation and potential uses of sorghum and pearl millet in alternative and health foods. *Journal Of Comprehensive Reviews in Food Science and Food Safety* 7: 340–52.
- Rathi A, Kawatra A, Sehgal S and Housewright B. 2004. Influence of depigmentation of pearl millet (*Pennisetum glaucum* L.) on sensory attributes, nutrient composition and *in vitro* digestibility of biscuits. *LWT - Food Science and Technology* 37: 187–92.
- Sehgal A and Kawatra A. 2007. Use of pearl millet and green gram flours in biscuits and their sensory and nutritional quality. *Journal of Food Science and Technology* 44(5): 536–8.
- Sehgal A and Kawatra A. 2006. Nutritional evaluation of pearl millet based sponge cake. *Journal of Food Science and Technology* 43(3): 312–3.