World Journal of Dairy & Food Sciences 10 (1): 68-73, 2015
ISSN 1817-308X

DOI: 10.5829/idosi.wjdfs.2015.10.1.92229

Effect of Oat Bran on the Quality of Enriched High Fiber Biscuits

[1]Abdul Wajid Khalil, [1]Javid Ali, [2]Tariq Masood,
[2]Muhammad Arif, [3]Mohammad Parvez and [4]Said Hassan

[1]PCSIR Laboratories Complex Jamrude Road Peshawar, KPK-Pakistan
[2]Khyber Pakhtunkhwa Agricultural University Peshawar, KPK-Pakistan
[3]Department of Biotechnology and Microbiology,
Sarhad University of Science and Information Technology, Peshawar, KPK-Pakistan
[4]Centre of Biotechnology and Microbiology University of Peshawar, KPK-Pakistan

Abstract: Enriched high fiber biscuit was made by substituted refined wheat flour with oat bran at level of 10%,20% and 30%. The sensory characteristics (Appearance, texture, taste and color), physical properties (Width, thickness and spread ratio) and particle size distribution were evaluated and compared with control sample. Hedonic Scale was used for sensory evaluation of prepared biscuit which is generally decreases with increasing the level of substitution. From overall acceptability rating, 10% oat bran incorporated biscuit obtained the highest rating compare to other treatments. At $p \leq 0.05$, there were no significant difference between the control treatment and best rated substituted biscuit (10:90) in general preference of sensory rating. The width of biscuit decreases from 5.5 to 4.2 with increasing in the level of substitution of oat bran and similar tread shown by spread radio. However, biscuit thickness increases from 0.68 to 0.91 with increasing level of substitution. Biscuit with 10% medium and coarse particle sizes gave the best results in overall sensory evaluation and spread ratios and compared with biscuit made with fine particle sizes.

Key words: Oat Bran · Particle Size · Classification of Particle Sizes · Physical Properties · Sensory Evaluation

INTRODUCTION

In recent years in Pakistan and other developing countries, the change in life style, food habits and furthermore public awareness about the health benefits of dietary fiber has increased along with its consumption in various high-fiber food and calorie-reduced products. Many studies have reported that health problems linked to chronic ailments such as cardiovascular diseases and high cholesterol [1, 2], colon cancer [1, 3], diabetes and obesity [2] and constipation [4, 5] can be reduced by increasing the consumption of whole-grain or fiber-enriched products. Increased fiber consumption has been found to be important for lowering the risk of being overweight and associated with reduced body mass index, blood pressure and glucose concentrations [2].

Worldwide Common fiber sources include bran from wheat, barley, corn and oats; fruit and vegetable fiber (Apple or sugar beet fiber); legume fiber; powdered cellulose and gums.

Oat bran was selected from cereals for its high fiber content. It becomes an important ingredient that can be incorporated in several food formulations. oat bran consisting of moisture 7.69%, Ash 2.81%, Lipid 1.00%, proteins 5.54% and total dietary fiber 26.40% [6]. Baked products with various high-fiber additives such as biscuits, cookies, cakes and pancake mixes have been introduced to satisfy consumer demands for increased fiber content in foods without sacrificing sensory quality. Because, biscuits are an important commodity consumed as snack food by all age groups. Commercially available biscuits are deficient in protein, ash and especially dietary fiber [7].

In order to overcome this deficiency several researchers have successfully used wheat bran to enhance the nutritional quality of baked products such as cookies, cakes, yeast breads and muffins. Often, the addition of wheat bran affects the physical and sensory properties of the baked products. Wheat bran supplemented cookies [8, 9] had physical properties that

Corresponding Author: Javid Ali, PCSIR Laboratories Complex Jamrude Road Peshawar, KPK-Pakistan.
Tel: +091-9216244, Fax +091-9216232,.

differed from the control. In the majority of studies reviewed, most sensory attributes of baked products were not affected adversely by the addition of wheat bran.

A major problem associated with incorporating high levels of these fiber sources in food systems is the detrimental effect they have on physical and sensory properties of foods. Changes in flavor, palatability, appearance and texture are unacceptable to most marketers and consumers. The present study was aimed to investigate the sensory evaluation, physical properties and particals size of enriched high fiber biscuits.

MATERIALS AND METHODS

The refined wheat flour, oat seeds and all other biscuit ingredients were purchased from local market of Peshawar, Pakistan. The baking process was done at food pilot plant at PCSIR Labs Complex, Peshawar.

Processing of Oat Bran: The oat seeds were freed from broken seeds, dust and stones and then washed with tap water. After which they were immersed in 0.5% (w/v) sodium hypochlorite solution to prevent yeast and mould growths. The cleaned oat seeds were dried in electric cabinet dehydrator at 70°C for 10 hours. The dried seeds were ground into fine flour with a cutting mills (Pulverisite 15 French, Germany) having sieve size 0.5 mm. Then, the fine flour was allowed to pass through 40-mesh size (425 um.) test sieve to obtained fine and a very fine particle size of oat bran. The material that passed through the sieve was taken as flour and that which remained on the sieve as bran and stored at 4°C in high-density polyethylene bags (0.77 mm thick).

Preparation Method of Enriched High Fiber Biscuits: Enriched high fiber biscuits were prepared using refined wheat flour substituted with 0, 10, 20 and 30% oat brans as the base ingredient as shown in the Table 1. The other ingredients in the biscuit formulation, included sugar powder, bakery fat, raising agents (Sodium and ammonium-bicarbonates), salt, liquid glucose (Dextrose), skimmilk powder and emulsifying agents (Glycerol-mono-strearate and lecithin).

The fiber biscuit was prepared using creaming method. Firstly, the fat and sugar were mixed together until to make uniformly and airy foamy homogenous cream approximately for 20 minute in a dough mixer bowl (Swallow engineering company, England). Then, the raising agents, emulsifying agents and liquid glucose was added to the cream and mixed with a wooden spoon.

Table 1: Oat Bran was Incorporated at Different Levels with Refined Wheat Flour.

S#	Treatments	Refined flour wheat (%)	Oat bran (%)
1	T0	100	0
2	T1	90	10
3	T2	80	20
4	T3	70	30

Afterward, the wheat flour, oat fiber and skimmilk powder was also added and mixed for 5 minute in a dough mixer. The biscuit dough was divided into small portions, sheeted on stainless steel flat rolling tray to a thickness of 0.5 cm and cut using a circular die of 6.5 cm diameter. The biscuits were baked for 15 min at 180±4°C. After baking, the biscuits were cooled to room temperature and then stored in sealed polyethylene bags until use.

Methods

Physical Properties: The enriched high fiber biscuits prepared by substituted refined wheat flour with oat bran were analyzed for width, thickness and spread factor according to the method described in AOAC [10].

Sensory Evolution: The sensory evolution study of enriched high fiber biscuits was carried out at Food Technology Center (FTC), PCSIR labs complex Peshawar. 10-trained food technologists were selected for organoleptic analysis of different samples of biscuits. The sealed samples were presented in a coded letters on white tray decorated with flowers. The sensory evaluation was carried out at brunch time. A 9-point hedonic scale (1 = “dislike extremely”, 5 = “neither like nor dislike”, 9 = “like extremely”) was applied to evaluate the products for appearance, texture, taste, cooler and overall acceptability [11].

Particle Size Distribution: Particle size distribution of oat bran was determined using conventional sieving analysis. Sieves were manufactured by Fritsch, Germany. For each measurement a 100 g of powder was used. Meshes size was 315, 200, 100 and 90 µm. The powders were sieved for 5 minutes using Analysette 3 (Sparatan pulverisettco Germany) laboratory shaker manufactured by Fritsch, Germany with 2.5 mm vibration amplitude and a 3 seconds interval time. The particle size was expressed as the percentage of particles retained on each sieve [12].

RESULTS AND DISCUSSION

The effect of oat bran addition at level of 10, 20 and 30% was substituted refined wheat flour by 90, 80 and 70% respectively on the sensory characteristics such as

Table 2: Effect of Oat Bran on the Sensory Evaluation of Enriched High Fiber Biscuits.

Treatments	Level of Oat bran with wheat flour (w/w)	Colour	Appearance	Taste	Texture	Overall Acceptability
T0	Wheat flour: oat bran					
	100 : 0	7.8	7.7	8.3[a]	7.3	7.8
T1	90 : 10	7.2	7.1	7.0[b]	6.8	6.7
T2	80 : 20	6.0	5.8	6.5[bc]	6.6	5.7
T4	70 : 30	5.5	5.7	5.4[c]	5.9	5.4

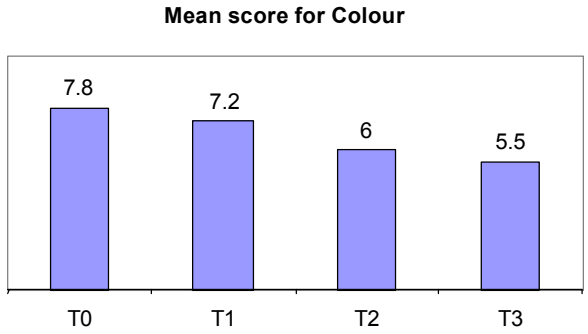

Fig. 1: Mean Score for Color.

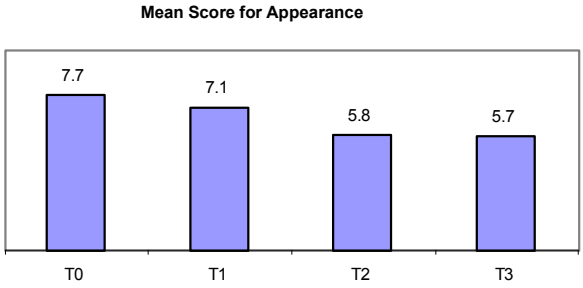

Fig. 2: Mean Score for Appearance.

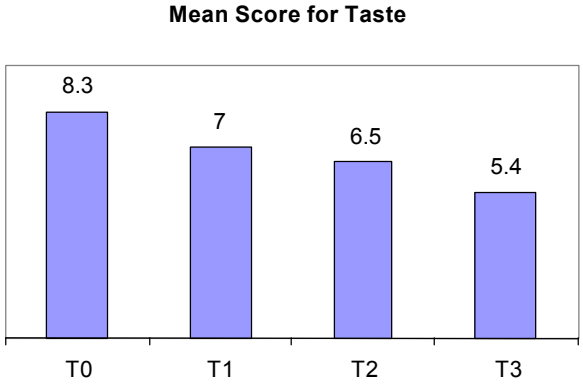

Fig. 3: Mean Score for Taste.

appearance, texture, taste, color and overall acceptability of enriched high fiber biscuits. Biscuit prepared without oat bran was kept as control (100: 0).

Mean score for sensory evaluation of biscuit given in (Table 2) indicated that there are significant differences ($p \leq 0.05$) between treatments for sensory attributes like color, appearance, taste, texture and overall acceptability. Sensory rating of biscuit for colour shows that control treatment T0 (7.8) ranked at top due to excellent appearance, followed by T1 (7.2) & T2 (6.0) while minimum colour observed in T4 (5.5). The mean score of colour had been decline from 7.8 to 5.5 (Figure 1). These results are in Accordance to the Latidoye and Sobowale [13] who reported that increasing level of substitution the color of biscuit turned from light brown to dark brown, leading to lower acceptance. The darker colour may be due to the non enzymatic reaction (Maillard reaction) between reducing sugar molecules and lysine protein explained by Decker *et al.* [3] and Tsuji *et al.* [14] the darker colours of the enriched high fiber biscuits have been reported [15] that browning colour of bakery product like bread, biscuit might be due to caramelization, dextrinisation of starch or maillard reaction. Mean score of appearance had been decreased from 7.7 to 5.7. (Figure 2). The appearances of biscuit had lower lightness as bran level increased from 10 to 20 and 30%.Mean score of taste had been decreased from 8.3 to 5.4 with increasing level of substitution. Mean for taste shown in (Figure 3) revealed that the control treatment had highest score T0 (8.3) followed by treatment T1 (7.0) followed by T2 (6.5) while T4 (5.4) had least score. The reason explained by Stanyon and Costello [16] that as more wheat bran was added, biscuits became drier and required more saliva to masticate. The drying effect of wheat bran might be explained by its water-absorptive properties. Both wheat bran and flour absorb water, but during baking wheat bran may lose water more readily than flour. Biscuits containing wheat bran had less flour; consequently, less water may have remained after baking and the resultant biscuits therefore were perceived as dry by panelists.

Mean score of texture had been decreased from 7.3 to 5.9 with increasing level of substitution from 0 to 30%. (Figure 4). Observation on the texture characteristics was reported by Stanyon and Costello [16] that in general, as wheat bran was substituted for more flour, biscuits became less cohesive and more crumbly. As wheat bran increased, gluten proteins, responsible for the cohesiveness or structure of baked products, were diluted and the formation of gluten became more difficult. Wheat bran particles probably interfered with the development of gluten complex.

Table 3: Effect of Oat Bran on the Physical Properties of Enriched High Fiber Biscuits

Treatments	Level of Oat bran with wheat flour (w/w)	Width(w) (cm)	Thickness (cm)	Spread ratio (w/t)
T0	Wheat flour : oat bran			
100 : 0	5.5	0.68	8.0	
T1	90 : 10	5.1	0.73	7.0
T2	80 : 20	4.8	0.87	5.5
T4	70 : 30	4.2	0.91	4.6

Table 4: Average Particle Size of Oat Bran used for Enriched High Fiber Biscuits

Sieve size	Particle size (µm)	Oat bran (%)	Bran size Classification
45	315	71.18	Coarse
70	200	12.72	Medium
140	100	8.95	Fine

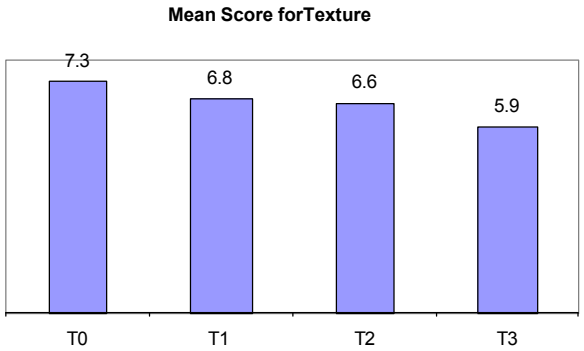

Fig. 4: Mean Score for Texture.

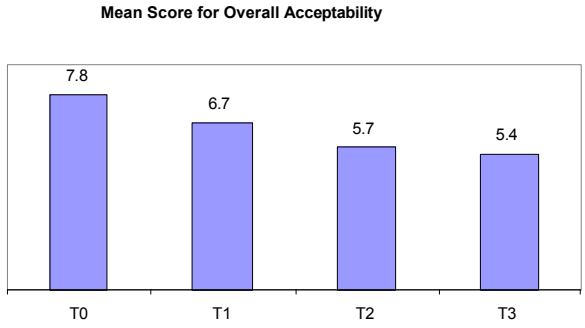

Fig. 5: Mean Score for Overall Acceptability.

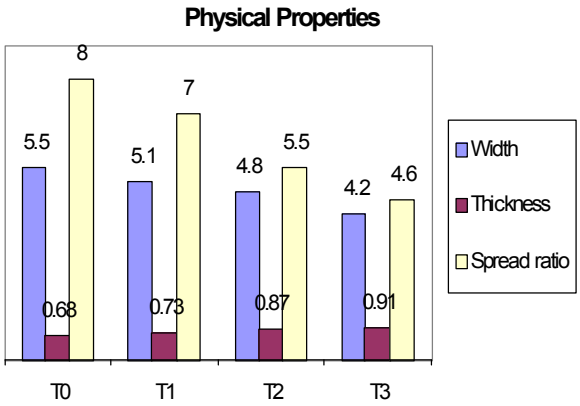

Fig. 6: Physical Properties enriched high fiber biscuit.

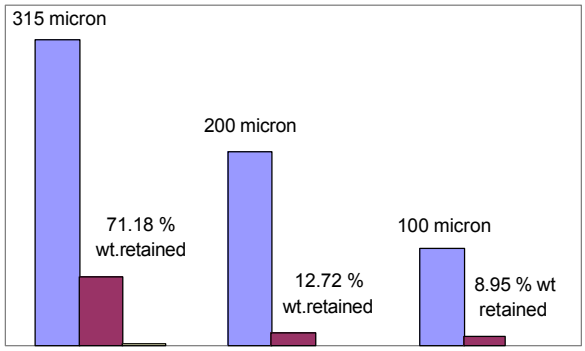

Fig. 7: Particle Size Distribution of Oat Bran.

Overall acceptability was determined on the basis of quality scores obtained from the evaluation of color, appearance, taste and texture of the biscuit. The mean regarding overall acceptability of biscuit are shown in Figure 6 revealed that the overall acceptability of T1 (90% wheat flour +10% oat bran) was highest while 30% oat bran has lowest acceptability. The decrease in overall acceptability was due to decrease in color, appearance, taste and texture score. At 10% (90 wheat flour + 10% oat bran) level of incorporation, biscuit had highest scores for the entire sensory attributes than other treatment.

Physical Properties: The result of the physical analysis of the enriched high fiber biscuit produced from refined wheat flour and oat bran is shown in Table 3 which shows that the oat bran of various levels has a significant effect on width, thickness and spread ratio of biscuit. The result obtained agreed with result reported [17].

The width of biscuit decreases from 5.5 to 4.2 with increasing in the level of substitution of oat bran. The result shows that control treatment T0 has the maximum width 5.5cm, followed by T1 (5.1) and T2 (4.8) while minimum width was observed in T4 (4.2).However, biscuit thickness increases from 0.68 to 0.91 with increasing level

of substitution. The result shows that T4 has maximum thickness 0.91 followed by T3 (0.87) and T2 (0.73) while minimum thickness was observed in control treatment T0 (0.68). Similar trend was recorded on spread ratio. The spread ratio of biscuit decreases from 8.0 to 4.6 with increasing level of oat bran from 10, 20 to 30%. Spread ratio of biscuit decreases with increase in incorporation of oat bran was investigated [18]. The result shows that control T0 has the maximum spread factor 8.0, followed by T1 (7.0) and T2 (5.5) while minimum observed in T4 (4.6) (Figure 6).

Particle-Size Distributions: The Sieve No., Particle-size (μm), Percent of oat bran retained on sieve and bran size classification of oat bran as shown in Table 4 and Figure 7. Oat bran was sieved and separated to pass through a sieve-shaker (Sieve 100, 200 and 315 micron). The throughs were classified as coarse bran over 315 micron sieve, over 200 micron sieve was classified as medium bran and overs of the sieve No. 100 micron were classified as fine bran. Classification was made according to the Ozturk *et al.* [19] and further investigated that in cookies, medium (212–425 μm) and coarse (425–850 μm) particle sizes gave better spread ratios, color and overall sensory scores compared with cookies made with finer particle sizes (<212 μm). These three types of particle sizes were used in preparation of Enriched high fiber biscuits and were made from substituted refined wheat flour with oat bran at the level of 10, 20 and 30% using coarse, medium and fine size bran. Biscuit prepared without oat bran was kept as control. The blends were labeled control, 10% coarse, 10% medium, 10% fine, 20% coarse, 20% medium, 20% fine, 30% coarse, 30 medium and 30% fine.

CONCLUSION

The study concludes that the biscuit can be made with substitution of oat bran upto 10% without adversely affecting the sensory characteristic and physical properties of biscuit. Similarly, medium and coarse particle sizes of oat bran can be used to produce highly acceptable biscuit incorporated with up to 10% oat bran.

ACKNOWLEDGMENT

The authors wish to thank PCSIR Laboratories Complex Jamrude Road Peshawar, KPK-Pakistan for their support.

REFERENCES

1. Gordon, D., 1999. Defining dietary fiber. Cereal Foods World, 44(2): 74-77.
2. Jones, J.M., 2006. Nutrition. Cereal Foods World, 51(5): 284-6.
3. Decker, E., G. Beecher, J. Slavin, HE. Miller and L. Marquart, 2002. Whole grains as a Source of Antioxidants. Cereal Foods World, 47(8): 370-3.
4. Lue, S., F. Hsieh and H.E. Huff, 1991. Extrusion cooking of corn meal and sugar beet fiber: effects on expansion properties, starch gelatinization and dietary fiber content. Cereal Chem, 68(3): 227-34.
5. Kantor, L.S., J.N. Variyam, J.E. Allshouse, J.I. Putnam and B.H. Lin, 2001. Choose a variety of grains daily, especially whole grains: a challenge for consumers. J. Nutr., 131(S47): 3-86.
6. Chen, H., G.L. Rubenthaler, H.K. Leung and J.D. Baranowski, 1988. Chemical, Physical and Baking Properties of Apple Fiber Compared with Wheat and Oat Bran. Cereal Chem, 65(3): 244-247.
7. Rauf, M.A., 1993. Chemical and Biological evaluation of some commercially available biscuits. M.sc. thesis, deptt. Food technol., univ, agri., Faisalabad.
8. Jeltema, M.A., M.E. Zabik and L.J. Thiel, 1983. Prediction of cookie quality from dietary fiber components. Cereal Chem., 60: 227-2.
9. Vratania, D.L. and M.E. Zabik, 1980. Bran as a source of dietary fiber in oatmeal cookies. J. Am. Diet. Assoc, 77(l): 26.
10. AOAC, 2002. Official Methods of Analysis of the Association of Official Analytical Chemists, Arlington, V.A, USA. Chapter 17.
11. Lawless, H.T. and H. Heymann, 1998. Sensory evaluation of food: principles and practices. New York: Kluwer Academic/Plenum Publishers., pp: 827.
12. Toma, R.B., P.H. Orr, B. Dappolonia, F.R. Dintzis and M.M. Tabekhia, 1979. Physical and chemical properties of potato peel as a source of dietary fiber in bread. J. Food Sci., 44: 1403-1407, 1417.
13. Latidoye, O.P. and Sobowale, 2011. Microbiological Quality Analysis of Meat Pies Sold By Street Hawkers: A Case Study of Mainland Local Government Area of Lagos, Nigeria Journal of Medical and Applied Biosciences, 2: 1-8.
14. Tsuji, H., M. Kimoto and Y. Natori, 2001. Allergens in major crops. Nutrition Research, 21: 925-934.

15. Sudha, M.L.R., K. Vetrimani and K. Leelavathi, 2007. Influence of fiber from different cereals on the Rheological characteristics of wheat flour dough and on biscuit quality. Food Chem., 100: 1365-1370.
16. Stanyon, P. and C. Costello, 1990. Effects of Wheat Bran and Polydextrose on the Sensory Characteristics of Biscuits. Cereal Chem., 67(6): 545-547.
17. Sievert, D., Y. Pomeranz and Abdelrahman, 1990. Functional Properties of Soy Polysaccharides and Wheat Bran in Soft Wheat Products. Cereal Chem., 67(l): 10-13.
18. Neha, M. and R. Chandra, 2012. Development of functional biscuit from soy flour &rice bran. International J. Agricultural and Food Science, 2: 12-17.
19. Ozturk, S., O. Ozboy, I. Cavidoglu and H. Koksel, 2002. Effects of brewer's spent grain on the quality and dietary fibre content of cookies. J. Inst Brew, 108: 23-27.