International Journal of Natural and Social Sciences
Print: 2617-6637 < ISSN > Online: 2313-4461

Optimization of mixed peels from banana, carrot and apple to develop high fiber biscuit

Nahidur Rahman[1]*, Md. Borhan Uddin[1], Md.Fahad Bin Quader[1], Muhammad Abu Bakar[2]

[1]Department of Food Processing and Engineering, Faculty of Food Science and Technology, Chattogram Veterinary and Animal Sciences University, Khulshi, Chattogram-4225, Bangladesh
[2]Phytochemistry Research Division, Bangladesh Council of Scientific and Industrial Research, Chattogram-4220, Bangladesh

ARTICLE INFO

Article history

Accepted 24 March 2020
Online release 24 April 2020

Keyword

Fiber enriched biscuits
Mixed peel powder
Sensory evaluation
Nutritive value

***Corresponding Author**

Nahidur Rahman
nahidurcvasu@gmail.com

ABSTRACT

The study was carried out to explore the use of mixed (banana, carrot and apple) peel powder with wheat flour in the preparation of high fiber biscuits. The effects of the mixed peel powder (MPP) on the nutritional quality and sensory characteristics of the biscuits were also studied. The MPP was prepared through the process of drying and grinding. Biscuits were prepared from blend of whole wheat flour along with MPP using the traditional creamery method. Sensory evaluation was carried out using a group of trained panelists. MPP and prepared biscuits were analyzed for their proximate and mineral contents. All the obtained data were analyzed statistically to determine the level of significance of variation in observations. MPP was characterized by lower moisture content, protein and carbohydrate while having higher content of fat, fiber, ash and some other minerals (Fe, K, Mn, Mg and Ca) compared to wheat flour. Wheat flour when substituted with 5% of MPP resulted in better quality, nutritious and fiber enriched biscuits (carbohydrate 68.47%, protein 14.45%, fat 4.74%, ash 1.98% and fiber 3.00%). Fe, K, Mn and Ca contents were also found to be higher in the developed biscuit than the control biscuit made with wheat flour. The newly formulated biscuit was found to be more acceptable in terms of nutritional and sensory characteristics.

INTRODUCTION

Biscuit is one of the most commonly accepted snack foods amongst children and adult. Because of the high consumption of biscuits, they can potentially be used as carriers of dietary fibers (Lebesi and Tzia, 2009; Jauharah et al., 2014). High dietary fiber diets are associated with the prevention, reduction and treatment of some diseases, such as coronary heart diseases and large intestinal cancer (Figuerola et al., 2005; Gupta, 2006). Furthermore, increased consumption of dietary fiber improves serum lipid concentrations, lowers blood pressure, improves blood glucose in diabetes, promotes regularity, aids in weight loss and appears to improve immune function (Anderson et al., 2009).

Nowadays, the consumers' trends has been shifted towards food with more natural antioxidants, dietary fiber, natural color and flavor, minerals, vitamins and free of synthetic additives etc. That's why diets rich in fruits and vegetables are gaining importance as they have a more balanced dietary fiber profile in terms of soluble and insoluble dietary fiber. Peels are the major by-products obtained during the processing of various fruits and vegetables and these shown to be a good source of dietary fibers and other bioactive compounds. However, these plant by-products can be utilized in various industries as novel, low-cost, economical and natural sources of dietary fiber, antioxidants, pectin, enzymes, organic acids, food additives, essential oils etc. through different methods of extraction, purification and fermentation (Kodagoda et al., 2017).

At present up to one third of fruits and vegetables in the form of peels and skins are discarded during preparation and processing, therefore creating a 'waste', while decreasing the maximum nutritional potential. Today researchers are discovering new alternative uses for such 'waste' or byproducts as potential value added ingredients. Peel powder

How to cite this article: N Rahman, MB Uddin, MFB Quader and MA Bakar (2020). Optimization of mixed peels from banana, carrot and apple to develop high fiber biscuit. International Journal of Natural and Social Sciences, 7(1): 21-25. DOI: https://doi.org/10.6084/m9.figshare.12195978

prepared from banana, apple and carrot are good source of fiber and contains large amount of bioactive compounds. Presence of fiber content in biscuit improves its nutritional quality, acceptability and improvements are achieved by changing the ratio of fiber content in basic recipes (Kohajdova et al., 2009). Therefore, optimized and mixed banana, apple and carrot peel powders (MPP) can be used to develop fiber rich biscuits to improve its nutritional properties. Apart from the loss of valuable dietary fiber, another issue that justifies the development of fiber-rich products is waste management. Recovering the fiber for edible uses increases the economic value of fruit or vegetable processing and decreases waste. The principal aim of this study was to process discarded peels declared as 'waste' during fruit and vegetable processing, into a dietary fiber supplement. The investigation was designed to prepare dried and mixed powder of banana, apple and carrot peel and then preparation of fiber rich biscuit from wheat flour mixed with prepared mixed peel powder.

MATERIALS AND METHODS

Raw ingredients

Ingredients for biscuits formulation such as wheat flour, sugar, baking powder, milk were purchased from the local market. Raw mature, ripen banana (*Musa sapientum*), carrot (*Daucus carota*), apple (*Malus domestica*) were also procured from the local market of Chattogram, Bangladesh.

Preparation of mixed peel powder (MPP)

Whole banana, apple and carrot were washed with tap water for cleaning and removal of extraneous dirt. Then clean fruits and vegetables were peeled using Peeler and chopped. The slices of peel were dipped into the Potassium metabisulfite solution (0.02%) for 5 minutes to prevent from discoloration. Then they were blanched separately for 5 minutes. Collected peels were then spread on trays and dried in Cabinet Dryer at 60°C for 12 hr.'s. Dried peels were ground separately in grinder to fine powders. Equal amount of each powder were mixed together and packed in polythene bags and stored in air tight food grade plastic containers until used.

Biscuit formulation and preparation

Sweet biscuits were prepared using the traditional creamery method. Biscuits were prepared from blend of whole wheat flour, MPP using the proportions given in table 1. Refined flour/ blends, sugar powder, vegetable oil, milk, common salt, baking powder and water as required for proper consistency were used as the recipe for preparing biscuits. Sugar and fat were creamed in a mixer. To do this, a well-mixed blend of white flour/blends, MPP, milk and baking powder were added along with water containing common salt. The contents were mixed further for 5 minutes to make the dough. Using a wooden rolling pin, the dough was sheeted on a platform to a uniform thickness. Circular star shape biscuits were cut and baked for 15 minutes at 220°C in a baking oven.

Table 1: Formulation of biscuit

Ingredients	Control biscuit	MPP fortified biscuit (5%)
Wheat Flour	200 gm.	190 gm.
MPP	-	10 gm.
Ground sugar	94 gm.	94 gm.
Milk	10 ml	10 ml.
Butter	6.25 gm.	6.25 gm.
Egg	2 no.	2 no.
Salt	1.50 gm.	1.50 gm.
Baking Powder	2 gm.	2 gm.

Then the biscuits were cooled, packed in air-tight boxes and stored at room temperature. Control biscuits were also prepared from refined flour along with other ingredients using the above proportions.

Proximate analysis of MPP and biscuit

MPP and prepared biscuit samples were analyzed for their moisture, ash, crude protein, lipids and crude fiber contents according to the methods described in AOAC, (2007). The moisture content was determined by moisture analyzer. Nitrogen content was estimated by Kjeldahl method and converted to protein by multiplying with the factor 6.25 for MPP and biscuit samples, the lipids were estimated by extracting known weight of samples with petroleum ether as solvent, using a Soxhlet apparatus. Ash content was determined by igniting

the samples in muffled furnace at 550ºC (dull red) until grayish white ash were obtained. Crude fiber was determined by acid-alkali digestion method. All the analyses were carried out in triplicates. Total carbohydrates were calculated by the difference

% carbohydrate = 100-(% moisture + % ash + % crude protein + % fat +% crude fiber)

Determination of mineral contents

Iron (Fe), Calcium (Ca), Potassium (K), Manganese (Mn) and Magnesium (Mg) contents were determined by using atomic absorption spectrophotometer according to AOAC, (2007).

Evaluation of sensory attributes

Sensory evaluation was carried out using a trained panel of ten members consisting equal men and women. Samples of both control and MPP fortified biscuits were presented to each of the panelist and were asked to assess the taste, color, texture, aroma, flavor, sweetness, and overall acceptability using nine point hedonic scale with 1 representing the least score (dislike extremely) and 9 the highest score (like extremely).

Statistical analysis

Obtained data were subjected to one-way analysis of variance (ANOVA) using Minitab Version 18.1 Statistical Software followed by Fisher's LSD test to distinguish statistical differences among them to test the level of significance ($p<0.05$).

RESULTS AND DISCUSSION

Proximate composition of wheat flour and MPP

Table 2 summarized the proximate composition of wheat flour and MPP used in this study. The MPP was characterized by lower moisture, protein, carbohydrate content and higher content of fat, fiber and ash compared to wheat flour. The composition of MPP with respect to its fiber content i.e. sugar, cellulose, hemicelluloses, pectin and roughage appears to have the best proposition for incorporation in the bakery industry for production of high fiber baked foods. The increased ash content may be attributed to high percentage of mineral content present in MPP. These results are in line with the result published by Ebere et al (2015).

Table 2: Proximate compositions of wheat flour and Mixed Peel Powder (MPP)

Variables	Moisture (%)	Fat (%)	Protein (%)	Fiber (%)	Ash (%)	CHO (%)
Wheat Flour	12.01±0.02	1.10±0.04	11.03±0.47	1.10±0.02	0.77±0.05	74.00±0.23
MPP	0.62±0.32	3.63±0.07	6.20±0.37	41.00±0.21	10.95±0.06	36.6±0.31

Proximate composition of the biscuits

The incorporation of flour from fruits and vegetable residue in bakery products improve dietary fiber and functional properties (Ajila et al., 2008). Moisture content of the control biscuit was found to be 10.85% while incorporation of MPP decreased the moisture content to 7.51%. Lower moisture content will prolong the storage time of MPP fortified biscuit and contributes to the textural quality and the inhibition of chemical and biochemical reactions. Furthermore, fortification of biscuit with MPP resulted to significant increase in protein, fat and ash content while carbohydrate content was significantly decreased as compared to control biscuit. The increase in fat content may be due to the high fat content of the peel powder. MPP fortified biscuit was found to have increased fiber (Table 3). These results were supported by Ktenioudaki et al. (2012). Previously Vergara-Valencia et al. (2007) also indicated that incorporation of mango dietary fiber obtained from whole fruit improves nutritional properties of cookies and biscuits.

Table 3: Proximate compositions of biscuit samples

Variables	Moisture (%)	Fat (%)	Protein (%)	Fiber (%)	Ash (%)	CHO (%)
Control Biscuit	10.85±0.06	1.10±0.54	11.30±0.32	0.87±0.09	0.87±0.05	75.01±0.06
MPP Fortified Biscuit	7.51±0.02	4.74±0.67	14.45±0.36	3.00±0.21	1.98±0.12	68.47±0.09

Table 4: Mineral contents of wheat flour and Mixed Peel Powder (MPP)

Variables	Fe (mg/kg)	Mn (mg/kg)	Mg (mg/100g)	K (mg/100g)	Ca (mg/100g)
Wheat Flour	23.77±0.02	7.10±0.09	113.40±0.07	117.30±0.12	17.00±0.19
MPP	52.34±0.06	46.15±0.05	193.20±0.09	420±0.15	18.63±0.32

Table 5: Mineral contents of biscuit samples

Variables	Fe (mg/kg)	Mn (mg/kg)	Mg (mg/100g)	K (mg/100g)	Ca (mg/100g)
Control biscuit	8.39±0.13	2.67±0.11	1.88±0.18	86.26±0.24	9.84±0.15
MPP fortified biscuit	8.53±0.10	4.00±0.13	1.76±0.12	199.19±0.21	10.43±0.19

Mineral contents of wheat flour and MPP

MPP contains higher amount of minerals (Fe, K, Mn, Mg and Ca) compared to wheat flour (Table 4). The obtained results were similar to those reported by Gorinstein et al. (2001). However variety, maturation stage, soil conditions, fertilization, irrigation and temperature may impart a significant role in the mineral contents of fruits and vegetables (Kadam et al., 2011).

Mineral contents of biscuits

Fortification of biscuit with MPP demonstrated significant increase in the mineral contents (Fe, Ca, K, Mn) except Mg compared to control biscuit (Table 5). Gomes et al. (2016) observed that ash in bread made from banana peel flour was higher than those in their counterparts from wheat flour. Thus, biscuits made with MPP are nutritionally beneficial to consumers compared to control made from wheat flour alone. Similar results have been noted by Olaoye et al. (2016).

Sensory characteristics of MPP fortified biscuits

The sensory evaluation was carried out as per 9 point Hedonic scale. It was observed that among the two samples, MPP fortified biscuits had the highest overall acceptability compared to the control biscuit (Figure 1). Newly fortified biscuit ranked higher in all sensory attributes except color because addition of MPP resulted in darker color of biscuits. This finding is confirmed by the report published by Preedy et al. (2015) where peel powder provided natural sweetness, texture and flavor to the fortified biscuits.

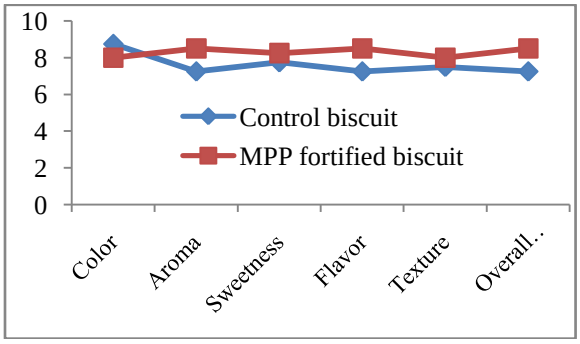

Figure 1: Sensory property of biscuit samples

CONCLUSION

The study has shown the feasibility of harnessing the peel of fruits and vegetables, typical waste product in processing plant for edible use. A novel biscuit product, fortified with banana, apple and carrot peel powder was successfully produced. The addition of MPP improved the crude fiber contents in the newly developed biscuits. Thus, the

compatibility of MPP for substitution of wheat flour coupled with the consumer acceptability of sensory characteristics provides new insight for further research on the use of discarded peels as a value-added food ingredient for bakery products or other selected functional foods.

ACKNOWLEDGEMENTS

The authors are grateful to the phytochemistry research division, Bangladesh Council of Scientific and Industrial Research, Chattogram, Bangladesh for the support to complete this research work under their R&D project.

CONFLICT OF INTEREST

The authors declare no conflict of interests.

REFERENCES

Ajila CM, Leelavathi K and Rao UJSP (2008). Improvement of dietary fiber content and antioxidant properties in soft dough biscuits with the incorporation of mango peel powder. Journal of Cereal Science, 48: 319-326.

Anderson WJ, Baird P, Davis HR, Ferreri S, Knudtson M, Koraym A, Waters V and Williams LC (2009). Health benefits of dietary fiber. Nutrition Reviews, 67(4): 188-205.

AOAC (2007). Official Methods of Analysis of the Association of Analytical Chemists, 18th Edition., Gaithersburg, USA.

Ebere CO, Emelike NJT and Kiin-Kabari DB (2015). Physico-Chemical and Sensory Properties of Cookies Prepared from Wheat Flour and Cashew-Apple Residue as a Source of Fibre. Asian Journal of Agriculture and Food Sciences, 03(02): 213-218.

Figuerola F, Hurtado ML, Estevez AM, Chiffelle I and Asenjo F (2005). Fiber concentrates from apple pomace and citrus peel as potential fiber sources for food enrichment. Journal of Food Chemistry, 91: 395-401.

Gorinstein S, Martin-Belloso O, Park Y, Haruenkit R, Lojek A and Ciz M (2001). Comparison of some biochemical characteristics of different citrus fruits. Journal of Food Chemistry, 74: 309-315.

Gomes AAB, Ferreira ME and Pimentel TC (2016). Bread with flour obtained from green banana with its peel as partial substitute for wheat flour: Physical, chemical and microbiological characteristics and acceptance. International Food Research Journal, 23(5): 2214-2222.

Gupta R (2006). Incorporation of dried apple pomace pulp powder in bread. Journal of Dairying, Foods and Home Sciences, 25: 200–205.

Jauharah AMZ, Rosli WIW and Robert DZ (2014). Physicochemical and Sensorial Evaluation of Biscuit and Muffin Incorporated with Young Corn Powder. Sains Malaysiana, 43(1): 45–52.

Kohajdová Z, Karovičová Jand Šimková S (2009).Use of apple fiber in bakery products. Acta Fytotechnicaet Zootechnica, 12: 286–291.

Kodagoda KHGK and Marapana RAUJ (2017). Utilization of fruit processing by-products for industrial applications: A review. International Journal of Food Science and Nutrition, 2(6): 24-30.

Ktenioudaki A, Chaurin V, Reis SF and Gallagher E (2012). Brewer's spent grain as a functional ingredient for breadsticks. International Journal of Food Science and Technology, 47(8): 1765-1771.

Kadam MD, RaiRD, Patil TR and Wilson R (2011). Quality of fresh and stored foam mat dried Mandarin powder. International Journal of Food Science and Technology, 46(4):793 – 799.

Labesi MD and Tzia C (2009). Effect of the Addition of Different Dietary Fiber and Edible Cereal Bran Sources on the Baking and Sensory Characteristics of Cupcakes. Journal of Food and Bioprocess Technology, 4: 710–722.

Olaoye OA and Uzunma R (2016). Quality evaluation of cookies produced from mixed flours of wheat and five varieties of african yam beans (*Sphenostylissteno carpa*). Annals: Food Science and Technology, 17(2): 439-445.

Preedy VR, Watso RR and Patel VB (2015). Flour and breads and their fortification in health and disease prevention.UK: Academic Press, London, p. 125.

Vergara-Valencia N and Granados-Pérez E (2007). Fibre concentrate from mango fruit: Characterization, associated antioxidant capacity and application as a bakery product ingredient. Journal of Food Science and Technology, 40 (4): 722-729.