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Research Article

Optimization of Mango Peel Powder with Wheat Flour to Develop High Fiber Biscuit

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Received: October 15, 2018; **Published:** November 13, 2018

Abstract

Objective: The general objective of the study was to optimize the mango peel powder (MMP) with wheat flour to formulate the high fiber biscuit. The specific objectives were to calculate the proximate content of wheat flour, mango peel powder and formulated biscuits; to optimize the mango peel powder content in the formulations by sensory method and to calculate the elevated fiber content in the best formulation.

Materials and Methods: Mango peel was obtained from the ripe mango of 'Dashehari' variety, wheat flour of brand 'Gyan', K. L. DUGAR GROUP and Butter of Amul brand. All were bought from the local market. Similarly, other ingredients for biscuits preparation as sugar (sucrose), salt (Nacl) and skim milk powder of brand everyday were also bought from the local market. Other chemical agents required for the analysis were provided by college, National College of Food Science and Technology, Kathmandu, Nepal. Semi-sweet hard dough biscuit was prepared by blending mango peel powder in wheat flour at 0% (control), 8%, 10% and 12% peel powder as substituting level for wheat flour. Proximate calculation was done as per AOAC (2005), sensory evaluation by Hedonic method as per Rangana [1] where number of participants was calculated for 5% level of significance from the formula ($n = z^2_{a/2} * p * q / e^2$) which was found to be 384. However due to limitation of semi-skilled personnel only 70 individuals participated. Similarly, elevation of fiber content was checked by statistical tools at ($P < 0.05$) triplicate data were analyzed and subjected to the analysis of variance (ANOVA).

Results: Proximate calculation shows mango peel powder contained sufficient amount of crude fiber as 12.91 ± 0.3 (%db) whereas wheat flour contained only 0.51 ± 0.4 (%db). Biscuits of all formulations were made and their proximate were calculated and the variation in the fiber content was observed between the samples at 5% level of significance. Chemical analysis showed that the crude fiber increased from 0.37% (control) to 2.41% (at 12% MMP). Similarly, the formulation with 10% MMP was found to be best after sensory analysis of all the formulations.

Conclusions: The study shows that the utilization of by-product such as mango peel powder by optimizing with wheat flour can contribute to the development of high fiber biscuits with significant health benefits.

Keywords: *Mango Peel Powder; Crude Fiber; Biscuit; By-Product*

Introduction

Baking is one of the oldest arts which has a long history and undoubtedly has a long future [1]. Biscuits are one of the most popular bakery products consumed by all levels of society. The word biscuit derives from panis biscotus which is Latin for twice-cooked bread. The dough pieces were baked and then dried out in another cooler, oven. They were very unattractive being made from more or less flour and

water [3]. Nowadays, the consumers' trends has been towards food with more natural antioxidants, dietary fibers, natural color and flavor, minerals, vitamins and free of synthetic additives, etc [4]. Diets rich in fruits and vegetables are gaining increased importance because of their significant role in reducing the risk of certain types of cancer, cardiovascular diseases and other chronic diseases [5]. Peels are the major by-products obtained during the processing of various fruits and these were shown to be a good source of dietary fibers and other bioactive compounds which possess various beneficial effects on human health [6]. The peel and stone proportions in mango fruit range from 20 to 30% and 10 to 30%, respectively [7]. Animal feeding is the usual application of these wastes, although they can also be used to obtain more valuable products. Juice, wine, vinegar and good quality pectin's have been produced from peels [8,9]. Dietary guidelines advise a diet rich in fruit and vegetables for a healthy lifestyle. At present up to one third of fruit and vegetables in the form of peels, pips and skins can be discarded during preparation and processing, therefore creating a 'waste', while also decreasing the maximum nutritional potential of the fruit or vegetable. Researchers are discovering new alternative uses for such 'waste' as potential value added ingredients. Biscuits are consumed nearly by all level of society this is mainly due to its ready to eat nature, good nutritional quality and availability in different varieties with affordable cost. Although Mango peel powder is bitter in taste, they are good source of fiber than cereal bran and contains large amount of total polyphenol content as well as bioactive compounds and health benefit properties [9]. Therefore, sensory optimized mango peel powders can be used in biscuits products to improve nutritional properties.

Material and Methods

A ripe Mango fruit of 'Dashehari' variety was bought from Kalimati Tarkari Bazar, Kalimati. Wheat flour of brand 'Gyan' (K.L. DUGAR GROUP) was bought from the local market. The flour was packed in a plastic bag and stored in room temperature. Butter of 'Amul' brand was brought from the local market and was stored at refrigerated condition. Sugar and Skimmed milk powder of brand everyday was brought from the local market. Sugar was grounded in powder for biscuit preparation. Salt, sodium bicarbonate, ammonium bicarbonate and lecithin with the necessary equipments were made available by the college pilot-plant, National College of Food Science and Technology.

Mangos of 'Dashehari' variety were collected at harvest maturity. The whole peel was washed with clean water and peel was peeled out by Stainless Steel Knife. Then it was cut in small pieces; peel was spread in trays and dried by the Cabinet drier (55 ± 5)°C for 18 hours and checked till the moisture was below 10%. The moisture was found to be 9.1%. The dried peel was powdered using a mill and sieved through 40 mesh size. Semi sweet type of biscuit was formulated in the different ratio of wheat flour to Mango peel powder as: 100:0, 92:8, 90:10 and 92:12. The recipe and preparation methodology is followed from Manley [3] which is given below.

Ingredients	Amount (g)
Flour	200
Pulverized Sugar	38
Ghee	26
SMP	3
Salt	2
Sodium bicarbonate	0.8
Ammonium bicarbonate	3
Lecithin	0.5
Water (mL)	50

Table 1: *Biscuit recipes.*

The method of preparation of biscuit was carried out as given below.

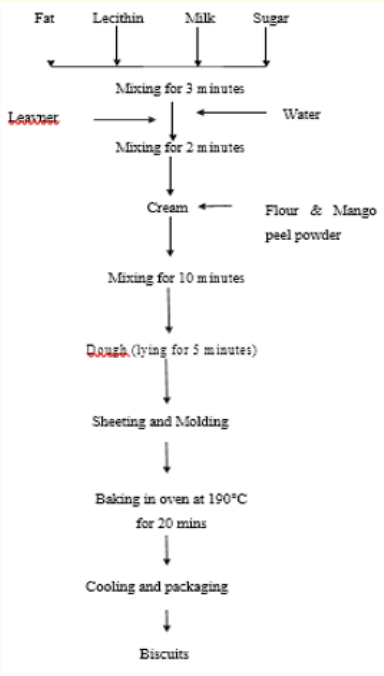

Figure 1*: Flow chart of biscuit preparation.*

The biscuits were tested for physical properties like thickness, diameter, bulk density and crispiness. Then the biscuits were analyzed by sensory method [1]. Sensory evaluation was made by the 9-point hedonic method where samples of all variations were presented to the 70 semi-skilled personnel. All the people who participated were undergraduate students, lab technicians and faculty members. They ate the biscuits and based on their preferences they gave the score form 1 - 9 on every parameter of biscuits mentioned in the manuscript, 1 being extremely-dislike and 9 being extremely-like. After all the scores were collected, they were put through the statistical test known as Analysis of Variance (ANOVA). There was significantly difference ($p > 0.05$) between the panelists score. The samples of biscuits were then analyzed for the physicochemical property by AOAC [10]. The formulations were tested for sensory quality like color, appearance, taste, smell, texture, crispiness and overall acceptability. Triplicate data were analyzed and subjected to the analysis of variance (ANOVA) using the statistical analysis system using the Microsoft office excel 2007. Significant levels were defined as probabilities of 0.05 or 5% level of significant.

Results and Discussion

Proximate composition of flour as well as biscuit was carried out. The best products among the three variations were determined by carrying out sensory evaluation and the detailed nutrition value of all the formulations.

Result of analysis shows that the peel has high ash, crude fat and crude fiber content 3.917, 2.136 and 12.91% respectively as compared to wheat flour, on the other hand, the peels had low protein content 4.267% and carbohydrate content 75.876%, as compared to the high protein being 10.91% and carbohydrate content 87.16% respectively. Similar type of result was also reported by Gopalan., et al. [11] on peel of two different types of mango varieties while the result for the proximate composition of wheat flour lies within the range given by MoA Nepal.

Parameters	Wheat Flour	Mango Peel Powder
Moisture (%wb)	11.14 ± 0.5	9.10 ± 0.02
Crude protein (%db)	10.91 ± 0.44	4.26 ± 0.28
Crude Fiber (%db)	0.51 ± 0.43	12.91 ± 0.03
Crude Fat (%db)	1.01 ± 0.91	2.13 ± 0.01
Total Ash (%db)	0.56 ± 0.08	3.91 ± 0.04
Carbohydrate (%db)	87.16 ± 0.87	75.87 ± 0.91

Table 2: *Proximate composition of wheat and mango peel powder.*

**: All data are the mean* ± s*tandard deviation of its triplicates.*

Sample	A	B	C	D	LSD
Moisture (% wb)	2.62 ± 0.93a	2.60 ± 0.15a	2.45 ± 0.33a	2.36 ± 0.25a	0.52
Protein (%db)	9.35 ± 0.15a	9.06 ± 0.82a	8.55 ± 0.70a	8.02 ± 0.96a	1.37
Crude Fat (%db)	9.61 ± 0.29a	10.92 ± 0.56b	11.57 ± 0.49bc	11.86 ± 0.50c	0.89
Total Ash (%db)	0.55 ± 0.15a	1.02 ± 0.34b	1.53 ± 0.45bc	1.90 ± 0.31bc	0.63
Crude Fiber (%db)	0.37 ± 0.14a	1.05 ± 0.41b	1.85 ± 0.36c	2.41 ± 0.40d	0.66
Carbohydrate (%db)	78.28 ± 0.56a	74.56 ± 0.66b	73.86 ± 0.81bc	72.81 ± 0.54c	1.23

Table 3: *proximate analysis of result of control and trial biscuit product.*

**: The figure in the parentheses in sample column refers to mean value* ± s*tandard deviation.*

***: Similar superscript in similar row shows not significant different at 5% level of significance.*

The data in the table indicates that there was significant different in protein, fat, ash, fiber, carbohydrate between control biscuit and the formulated biscuits ($p > 0.05$). It shows that the chemical composition of biscuit was affected by the addition of mango peel powder. The same result were found in the report given by Ayo., *et al.* [12] where soybean-acha flour composite biscuit had high amount of protein, fat, ash and fiber. The moisture content of control biscuit was 2.62 ± 9.33% and it decreases with the addition of mango peel powder i.e. from 2.60 ± 0.15% to 2.36 ± 0.25%. The obtained data lies within the range as described by DFTQC, (2012) which is 6%. There is slight decrease in moisture due to increase in crude fiber content. Mustafa.,*et al*. [13] reported decrease of moisture content in bakery products with increase in crude fiber content. Meanwhile a slight decrease could be traced in protein content. The result on Statistical test showed the protein content was decreased with the increase level of MPP addition. There was also slight decrease in carbohydrate content in formulated biscuits as compared to control biscuit. This may be due to low protein and carbohydrate content in peel powder according to Sudha., *et al.* [14], bakery products are varied by addition of value added ingredients. There is slightly increase in fat content of biscuits. Higher oil retention improves mouth feel of biscuit. The ash content was also found to be significantly different ($p > 0.05$) with the control biscuit. The ash content was increased in the formulated biscuit which may be due to the presence of abundant amount of minerals in mango peel powder. This result agrees with the result given by Shrestha and Noomhorm [15]. The crude fiber content of formulated biscuits was found to be progressively increased with the increase in mango peel powder. All the value of MPP added biscuit were found to be significantly different with control biscuit at ($p > 0.05$). Bakery products are varied by addition of value added ingredients. Among the added ingredients, dietary fiber has gained tremendous attention. The crude fiber has direct relation with gastro intestinal disorders

so that optimum consumption helps to reduce this problem [16]. The LSD stands for Least Significance Difference or Least Significant Difference between the means at the required level of probability. Significance of determination is the difference between two mean values is compared to the LSD value. If the difference is greater than the LSD value, then the means are significantly different.

Parameter	A	B	C	D	LSD
Diameter (mm)	48.3 ± 0.02	47.3 ± 0.07	46.1 ± 0.09	43.8 ± 0.02	
Thickness (mm)	6.4 ± 0.11	6.47 ± 0.09	6.52 ± 0.13	6.58 ± 0.10	
Spread ratio (W/T)	7.546^{a}	7.3106^{b}	7.07^{c}	6.58^{d}	0.11

Table 4: *Physical analysis of Control and Mango Peel Biscuits*

**: The values are the mean of 7 samples and the values are in standard deviation.*

Physical characteristic of biscuits such as diameter, thickness and spread ratio were affected significantly with increasing levels of mango peel flour. Results indicate that, the addition of mango byproduct adversely affected the diameter of biscuits. Table 4 shows that diameter and spread ratio were decreased with increasing level of mango peel while thickness was increased. Similar type of study was carried out by Bilgicli., *et al.* [17] and Sharma and Chauhan [18] where the expansion of diameter was effected by crude fiber content

Sensory evaluation of trial compositions were carried out to find out the best proportion of ingredients. The products developed were evaluated on the basis of color, flavor, texture, crispness, taste, and overall acceptance.

Sample A = 0% peel powder in wheat flour, Sample B = 8% peel powder in wheat flour, Sample C = 10% peel powder in wheat flour. Sample D = 12% peel powder in wheat flour.

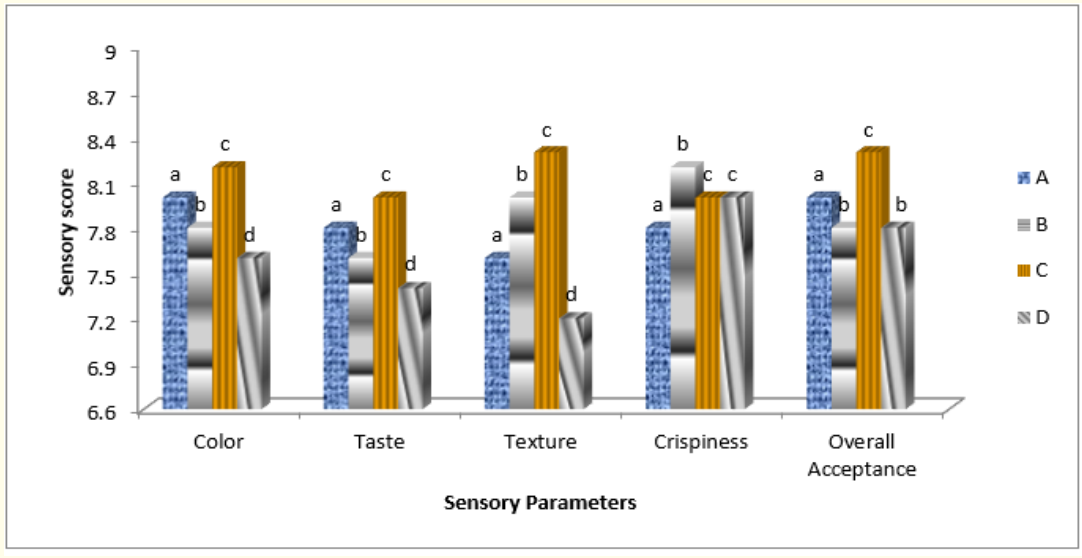

Figure 2: *Sensory evaluation of different sample of biscuits.*

Summary of Sensory analysis of trial compositions: There was significantly difference ($p > 0.05$) between the panelists score. The order of superiority in term of color, taste, crispiness, texture and overall acceptance of the products with varying proportion of ingredients can be summarized below:

- Color: Sample C > Sample A > Sample B > Sample D
- Taste: Sample C > Sample B > Sample A > Sample D
- Texture: Sample B > Sample A > Sample C > Sample D
- Crispness: Sample A > Sample C > Sample B > Sample D
- Overall acceptance: Sample C > Sample B > Sample D > Sample A

In figure 2, "c" is mentioned twice for crispiness because there was no significant difference the sample C and D and hence "c" is mentioned twice meaning they both are significantly different from sample A and B but not with each other, and "b" is mentioned twice for overall acceptance due to same reason. Here, sample A is significantly different from all other samples, sample B is significantly different from all other except sample D, sample C is the significantly different from all other with maximum overall acceptance and lastly, sample D is significantly different from all other samples except sample B.

Conclusion

Biscuits were prepared by using wheat flour to mango peel powder in the ratio if 100:0, 92:08, 90:10 and 88:12 and ratio 90:10 i.e. sample C was found to be best in terms of sensory. However, the crude fiber content was seen maximum in sample D but since all formulations have significantly higher fiber content than the control sample so, sample C was found to be best formulations after both sensory and physicochemical analysis. Hence, the study shows that the utilization of by-product such as mango peel powder by optimizing with wheat flour can contribute to the development of high fiber biscuits with significant health benefits.

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Volume 13 Issue 12 December 2018