DEVELOPMENT AND QUALITY ANALYSIS OF PEANUT FLOUR AND BANANA PEEL POWDER FORTIFIED BISCUIT

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ABSTRACT: The present research entitled "Development and Quality Analysis of Peanut Flour and Banana Peel Powder Fortified Biscuit" was planned with the aim to utilize and explore the properties of peanut flour and banana peel which is a waste product obtained from banana processing industry and possess good nutritional value, functional properties, dietary fiber, antioxidant, antimicrobial property and also low in caloric value but not yet used for value addition. Increasing awareness of consumers regarding health and nutrition has led to experimentations for modification and development of bakery products to prepare value added health foods. By keeping this in the mind a research study was conducted to prepare and evaluate the quality characteristics of protein rich fortified biscuits. To prepare the composite flour defatted peanut flour has been incorporated with wheat florin different proportion and then it was fortified with banana peel powder. Prepared biscuits were subjected to physiochemical and sensoryanalysis to evaluate the suitability of the biscuits for consumption.

To evaluate its social-economic feasibility, cost of production of biscuit also calculated. Nutritional analysis revealed that the moisture (3.04-6.82), ash (0.72-2.54), fiber(0.14-5.25), fat content(14.29-16.54) and protein(11.30-12.90), were increased whereas carbohydrates contents(70.31-55.95)decreased due to increasing the level of incorporation.It was observed that the diameter and spread ratio decreases whereas thickness increases with increasing the level of incorporation. Nine points hedonic scale ranking method was used to evaluate the sensory characteristics of prepared functional biscuits. Generally, the mean scores for all the assessed organoleptic characteristics were decreased with increasing incorporation.

Microbial analysis (SPC, Y/ M count and Coliform count) was done on all control and treatments after fifteen days and thirty days of preparation. Coli form count was found nil where as SPC and yeast & mold count increases with supplementation after thirty days, but they are within acceptance range.

KEYWORDS: Fortified Biscuit, Peanut Flour, Banana Peel Powder

I. INTRODUCTION

Banana (Musa spp.) is among the leading fruit crops in the economic value in the world. It rank's fifth in the world trade **(Guylene et al., 2008)**. Banana peels have various health benefits to excellent nutritional status, and it treats the intestinal lesion, diarrhoea, dysentery, ulcerative colitis, nephritis, gout, cardiac disease, hypertension, and diabetes **(Imam and Akter, 2011)**. Banana peels are rich in phenolic compounds as they are a good source of antioxidants, which protect against heart disease and cancer **(Schieber et al., 2003).** Banana peel wastes from industrial processes represent about 40% of fresh bananas **(Anhwange et al., 2009)**. Re use of banana processing waste, such as peel, could improve the yield of raw materials and subsequently minimize the large waste disposal problems faced by the food industry **(Mariela et al., 2014)**. Therefore, the economic and technological feasible alternative will be to produce flours from banana peels to make newproducts such as noodles or to partially incorporate these flours in wheat flour in order to improve the nutritive value of confectionaries such as cookies.This by-product constitutes an environmental problem because it contains large quantities of nitrogen and phosphorus and its high-water content makes it susceptible to modification by microorganisms **(Aruna et al., 2015).**

Groundnut, also known as peanut and taxonomically classified as *Arachis hypogaea*, is a legume crop grown mainly for its edible seeds. It is widely grown in the tropics and subtropics, as it is important to both small and large commercialproducers **(USDA, 2016).** Groundnut has the highest oil content of all food crops and second only to soybean in term of protein content (20–30%) among the food legumes **(Laufenberg et al., 2003).**Groundnuts are low in saturated fat and cholesterol, and as result, could beneficial in reducing the risk of heart disease **(Moretzsohn, et al., 2013).** Determined the bakery product like bread, cookies and biscuits are widely consumed on the source of nutrients including calories throughout the world **Englyst et al., (1982)**. Reported and determined the physical analysis of flour that is moisture, protein, ash and fat **Rangana(1986).**

Demonstrated dietary fiber extraction from Waste Pomegranate Seed (WPS) which is rich in conjugated fatty acids, high quality proteins and dietary fibers **(Young, 2001**

II. MATERIAL AND METHODS

Raw Materials: Raw banana was procured from local market of Prayagraj, India and thoroughly cleaned with potassium permanganate solution to remove any kind of infections and then washed with tap water to remove soil and dust particles. Washed banana was peeled and the peels were dehydrated. Other raw materials are given below:

Raw Banana: The raw materials were selected by visual appearance of fresh and bright colored, fully ripened fruits obtained from local market of Prayagraj. The fruits were washed with clean water so as the remove the dirt, other disease-causing organism or the adhering pesticides.

Peanut flour : Peanut was procured from local market. They are roasted and grinded into fine powder.

0.255 N Sulphuric acids : To make 0.255 N of sulphuric acid, exactly dissolve 1.38 ml of 98% sulphuric acid and make the final volume 200ml with distilled water.

0.313 N Sodium Hydroxide : To make 0.313 N of NaOH solutions, exactly dissolve 159.74ml of 0.1 N NaOH solutions and make the volume 500ml by using distilled water.

Neutral Solvent : Neural solvent was prepared by using 12 ml of Acetic acid: chloroform completely dissolving on warming hot plate and adds the same amount of KOH till it by checking its colour is not change by adding phenolphthalein indicator.

Phenolphthalein Indicator : Phenolphthalein Indicator was prepared by dissolving exactly 0.5 g of phenolphthalein powder in 50% of ethanol (50 ml of ethanol + 50 ml of distilled water).

Starch Indicator : Starch indicator was prepared by dissolving 1gm of starch into 10 ml distilled water, and shake well it, pour it in 90 ml of boiling distilled water and boil it for 1 min.

Baking powder : Baking powder was purchased from local market of Prayagraj. It was used as a leavening agent. Baking powder is the combination of sodium bicarbonate and an acid salt when moisture heating. Baking powder lightens the product and make easy digest. It acts as buffer between soda and acid prevent reaction when expose to air by absorbing moisture.

Wheat Flour : Wheat purchased from local market of Prayagraj and was prepared as flour by grinding. Sieving process with 40, 60 mesh sizes used to sieve the end product. Adding wheat bran to pan cakes, biscuits or even cookies is a great way to bulk up the nutritional value (dietary fiber) of a food. Besides these, certain essential minerals are also present in the bran.

Table: 1: Creamery method described by Whitley (1970)

Ingredients	Quantity
Wheat flour	64 g
Sugar (powdered)	18g
Vegetable oil/shortening	16 g
Skim milk powder	1.0 g
Glucose	1.0 g
Ammonium bicarbonate	0.5 g
Common salt	0.4 g
Baking Powder	0.3 g
Sodium bicarbonate	0.2 g
Vanilla	0.025 g
Water	As per required consistency

Table 2: Experimental plan for biscuit development

Wheat flour %	Peanut flour%	Banana peel powder%
100	0	0
92	0	8
84	8	8
76	16	8
68	24	8
60	32	8
52	40	8

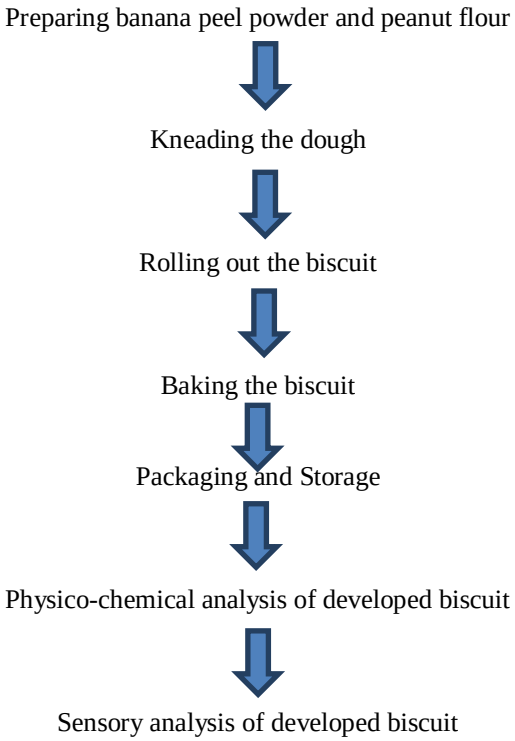

Fig 1: Development of peanut flour and banana peel powder fortified Biscuit

III. RESULTS

The experiment of the research work **"Development and quality analysis of peanut flour and banana peel powder fortified biscuit"** andhas been evaluated by studying their physical, chemical, and sensory characteristics of biscuits. The cost of high fiber and high protein biscuits was also calculated. The data obtained were analyzed statistically to determine the level of significance of variation in observation caused by the changes in blends and the biscuits formulations. Different standardization trials were conducted to develop most acceptable protein and fiber rich functional biscuit by substituting defatted peanut flour and banana peel powder at different levels.Biscuits were prepared using creamery method for making biscuit dough. The ingredients used in biscuits were peanut flour, banana peel powder, sugar, shortening, sodium chloride, sodium bicarbonate, ammonium bicarbonate. Seven flours were prepared by mixing 0%, 0%, 8%,16%, 24%, 32%,40% of defatted peanut flour,0%, 8%, 8%,8%, 8%, 8%, 8% of banana peel powder each with 100%, 92%, 75%,84%, 76%, 68%, 60%, 52% wheat flour respectively.The dough was sheeted to a thickness of 3.5mm with the help of flat rolling board. The sheeted dough was cut into fine circular shape using a wooden cutter. The cut dough was transfer to greased baking tray. The biscuits were baked in an electric oven maintained 200°C for 7-8min.The biscuit were cooled for about 30 min, packed into LDPE bags for further analysis.

Fig 4.2: Control biscuit (T_0) and fortified biscuit (T_1,T_2,T_3,T_4,T_5,T_6)

Physical Analysis of Biscuit : Physical analysis of biscuit is important as an objective judgment of quality. Physical analysis of biscuit is important as an objective judgment of quality. The result of the physical analysis of the functional biscuit is shown in Table 3 which shows width & spread factor of functional biscuit decreases with increasing level of substitution whereas thickness increases with increasing the concentration. The result obtained agreed with result reported by **Banusha and Vasantharuba, 2014.**

The diameter of biscuit decreases from 49.1 to 46.4 with increasing in the level of substitution; this may be due to the high fiber content of composite flour than control flour. Dietary fiber additions, in general had pronounced effects in dough properties yielding higher water absorption, mixing tolerance, tenacity & smaller extensibility in comparison with those obtained without fiber addition **(Ghoshal2020; Elleuch et al., 2011).** The thickness of biscuit prepared from different treatment ranged from 7.6 to 9.5. The result elucidated that T_6 has maximum thickness 9.5 while minimum thickness was observed in control treatment T_0 (7.6). The results of present study are quite close to the observations reported earlier by numerous researchers. He found in his study that thickness of biscuits increases with proportionate increase of defatted rice bran and with supplementation of wheat flour with defatted and non-defatted soy flour reduced loaf volume and specific volume drastically **Shah and Masoodi, 1994.**There was a decreasing trend in the spread ratio of biscuits with the proportionate increase of supplementation. The spread factor of biscuits prepared from different treatments ranged from 64.60 to 48.84. The maximum value (64.60) for spread ratio was observed in T_0 (biscuits with 0% fortification) whereas minimum (48.84) in biscuit prepared from 40% supplementation of peanut flour and 8% banana peel powder. Greater spread ratios are desirable and indicate a better biscuit quality (**Sharmaet al., 1998).**

Table 3: Effect of different treatments on mean score for physical analysis of biscuit

Treatments	Diameter (mm)	Thickness(mm)	Spread Ratio
T_0	49.1	7.6	64.60
T_1	48.9	7.9	61.89
T_2	48.2	8.4	57.38
T_3	47.8	8.9	53.70
T_4	47.3	9.15	51.69
T_5	46.8	9.35	50.05
T_6	46.4	9.5	48.84

Chemical Analysis of Biscuit : The chemical analysis of the biscuits has been presented in Table 4 indicated that all the biscuits contained favorable proportion of protein and fiber. Mean score for moisture content is presented in table 4. On evaluation of result it was found that there was an increasing trend in the moisture content of biscuit with the supplementation from 3.04% to 6.82% this could be due to the high water binding capacity. The highest moisture content found in T_6 (6.82%) followed by T_5 (6.56%) and the lowest moisture was observed in T_0 (3.04%). Ash content indicated an estimate of the total mineral content in a given quantity of food substance. Mean score for ash content of different treatment has been shown in Table 4, revealed the lowest ash content was observed in T_0 (0.72%) whereas the maximum ash content was observed in T_6 (2.54%)

followed by T_5 (2.50%). Results show the linear variation of ash content with increasing the supplementation of peanut flour and banana peel powder. The linear variation of ash content with increasing supplementation may be attributed due the high mineral content of peanut and banana powder. Based on ANOVA, all the factors were found to have significant effect.The maximum fat content was observed in T_6 (16.54%) while the lowest fat content was observed in T_0 (14.29%). Based on ANOVA, all the factors were found to have significant effect.
The result depicts the protein content of biscuit increases with supplementation of peanut flour from 11.3 to 12.90. This could be due to high protein value of peanut flour. Our results are in agreement of many finding like **Awan et al., 1991,** also reported increase in protein content of the bread with the addition of soy flour. The maximum fiber content was observed in T_6 (5.25%) followed by T_5 (5.21%). The fiber content in biscuit attributed may be due to the high fiber content of banana peel powder and peanut flour. The dietary fiber play significant role in the prevention of several diseases such as CVD, diverticulosis, constipation, irritable colon, cancer and diabetes **(Shrestha and Noomhom 2002, Elleuch et al., 2011).** Based on ANOVA, all the factors were found to have significant effect. The total carbohydrate content of biscuits has been found to decrease linearly with increase in supplementation. The variations are due to lower carbohydrate content of defatted peanut flour and banana peel powder. Based on ANOVA, all the factors were found to have significant effect.

Table 4: Effect of different treatments on mean score for chemical analysis of developed biscuit

Treatment	Moisture (%)	Ash (%)	Fat (%)	Protein (%)	Fiber (%)	Carbohydrate (%)	Acidity	pH
T_0	3.04	0.72	14.29	11.3	0.14	70.31	1.5	6.98
T_1	5.87	2.16	15.15	12.09	4.91	59.82	2.1	8.24
T_2	6.35	2.19	15.19	12.21	4.97	59.09	2.8	8.07
T_3	6.67	2.28	15.22	12.37	5.1	58.36	2.4	8.11
T_4	6.93	2.36	15.28	12.54	5.17	57.72	3.7	7.86
T_5	6.56	2.50	16.27	12.71	5.21	56.75	4.4	7.52
T_6	6.82	2.54	16.54	12.90	5.25	55.95	3.32	7.94

Microbiological Analysis of Biscuit (Secondary data due to Covid-19) : Biscuit & most of bakery product are not considered as high-risk food products because of baking at high temperature (160°C-250°C) during preparation and their lower water activity(0.2-0.3) not permit the growth of most of microbes. But some bacteria are resistant to high baking temperature like spores of Bacillus subtilis are heat resistant. If these bacteria are present in raw ingredients, e.g., flour, sugar then yeast grow in biscuit too.

Microbial growth limits the shelf life of bakery products & causes economic loss for both manufacturers and consumer. The results of microbial analysis of the biscuit samples are presented in Table 5.The microbial analysis carried out after 15 and 30 days of production. Standard plate count of functional biscuit fortified with peanut flour and banana peel powder after 15 days & after 30 days has been presented in table 5, which shows there is gradual increase in the total viable count (SPC) ranges from 3.1 x 10^3 to 24.4 x 10^3 cfu/g. The growth of yeast & mold require water activity between 0.6-0.85 whereas biscuit have water activity approximately 0.2-0.3. But sometime during handling and storage biscuit absorb moisture from atmosphere and favor the growth of yeast & mold. The result found within satisfactory acceptable range & also yeast and mold count increases with supplementation. Coliform are often referred to as indicator organism but in themselves they are not pathogenic, however their present in the environment can indicate that condition are favorable for pathogens to be present. In our study it was found that after 30 days of production coliform count was below 1.1x10^2cfu/g, reflects the hygienic condition were maintained during processing and handling of biscuit.

Table 5: Effect of different treatments on mean score for microbiological analysis of developed biscuit

Treatments	Standard Plate count (cfu/g)		Yeast and Mold count (cfu/g)		Coliform count (cfu/g)	
	15 days	30 days	15 days	30 days	15 days	30 days
T_0	3.1 x 10^3	4.34 x 10^3	4.1 x 10^2	4.67 x 10^2	Nil	Nil
T_1	6.1 x 10^3	7.34 x 10^3	5.9 x 10^2	8.1 x 10^2	Nil	Nil
T_2	8.7 x 10^3	11.1 x 10^3	7.4 x 10^2	9.34 x 10^2	Nil	Spread
T_3	9.9 x 10^3	12.32x 10^3	8.67 x 10^2	10.67x 10^2	Nil	Nil
T_4	12.5 x 10^3	13.7 x 10^3	11.7 x 10^2	12.67x 10^2	Nil	Nil
T_5	14.34x 10^3	16.67x 10^3	13.34x 10^2	16.67 x10^2	Nil	Spread
T_6	20.1 x 10^3	24.4 x 10^3	14.67 x10^2	17.9 x10^2	Nil	>1.1 x 10^2

Color is very important parameter not only in judging that biscuit were properly baked but also provides information about the formulation and quality of the product. Mean quality score of the color of the biscuits has been shown in Table 6. The mean score of color had been decline from 8.1 to 6.9. With increasing level of substitution, the color of biscuit turned from light brown to dark brown, leading to lower acceptance

(Leelavathi and Haridas, 1993). : Taste is the primary factor which determines the acceptability of any product, which has the highest impact on market success of product. The mean score of color had been decline from 7.9 to 6.9. It was observed that after the substitution of peanut flour the mean of taste of constant.Flavor is the main criterion that makes the product to be liked or disliked. Flavor is a combination of a few senses: Taste (gustatory), smell (olfactory), touch (tactile) and temperature (thermal) stimuli make up flavor whereas taste is a sensation of tongue only. The mean flavor scores presented in Table 6 indicated that the biscuit prepared from T_3 significantly got highest score (8.2) for flavor.The texture of the biscuit reveals the external appearance of the biscuit whether smooth or rough. Mean score of texture decreases from 8.3 to 5.8. With increasing the level of peanut flour, mean score for the texture decreases may be due to the protein and fiber content of composite flour increases, which affect the texture. Similar result was found **Mulet, 1987.**Overall acceptability was determined on the basis of quality scores obtained from the evaluation of color, taste, flavor, texture and crispness of the biscuits. The mean overall acceptability scores of more than 7.5 for biscuit sample indicated the commercial scope for manufacturing good quality high protein functional biscuits. Highest scores for overall acceptability of supplemented biscuits were recorded at 16% of peanut flour and 8% of banana peel powder substitution as compared to other treatments.

Table 6: Effect of different treatments on mean score for sensory analysis of developed biscuit

TREATMENT	COLOUR	TASTE	FLAVOUR	TEXTURE	APPEARANCE	OVERALL ACCEPTABILITY
T_0	7.8	7.9	7.4	8.0	7.8	7.7
T_1	7.6	8.0	8.0	7.6	7.8	7.9
T_2	7.0	6.9	7.0	7.3	7.1	7.1
T_3	8.1	8.0	8.2	8.3	8.1	8.3
T_4	7.7	8.0	7.9	7.1	7.3	7.7
T_5	7.7	8.0	7.9	7.3	7.1	7.8
T_6	6.9	7.0	7.4	5.8	6.5	6.7

Cost, as evidence by price, which is determined by economic factor inputs, will always be the most important factor in deciding what foods are produced and consumed in the world. Since the world, in general, is "poor", the less costly foods are likely to be in great demand. This is not to say that consumer desires cheaper foods, but rather he is, in general, forced to use them. Even today, over half of the total world's economic effort goes into the food production. In all probability, such a study would show more than 60 per cent of the total effort of man is involved in feeding himself **(Hungate and Sherman, 1979).**The biscuit T_3 prepared by replacing wheat flour with peanut flour and banana peel powder at level of 76% and then fortified it with 16% of peanut flour and 8% of banana peel powder were found superior in respect to sensory qualities of biscuits. Therefore, the cost of production of biscuit T_3 was worked out based on current market price of the ingredients used and addition of processing and packaging cost at 20% of the raw material cost.The number of biscuits obtained from the hundred grams of flour was eight. The cost of production of biscuit/ piece was found to be Rs.2.33 which was comparatively less than the cost of commercial market biscuit as mentioned in Table 7. Thus, the present investigation was found socio-economically feasible.

Table 7: Cost of production of developed biscuit

Ingredients	Materials Required (gm)	Rate (Rs.)	Estimated cost/ Ingredient requirement (Rs.)
Sugar	20	50	1
Oil	16	150	2.4
Milk Powder	1.5	490	0.735
Baking Powder	1.5	300	0.45
Baking soda	1	300	0.3
Glucose	1	165	0.165
Salt	0.4	20	0.008
Wheat flour	49	40	1.96
Peanut flour	10	750	7.5

Banana peel powder	5	200	1
Total cost			15.518
Processing and Packaging Charges @ 20%			3.1036
Net Cost			18.6216
No. of biscuit from 100gm composite flour are 8			
Cost/piece			2.33

IV. CONCLUSION

The experiment entitled "Development and Quality Analysis of Peanut Flour and Banana Peel Powder Fortified Biscuit" was conducted in the research laboratory of Vaugh Institute of Agricultural Engineering and Technology, Sam Higginbottom University of Agriculture, Technology and Sciences, to attain the desired objectives of the study. Studies were conducted to enhance the nutrients in biscuit by incorporation of peanut flour and banana peel powder. The fortified biscuit can be made with substitution of 40% peanut flour and 8% banana peel powder without adversely affecting the sensory characteristic of biscuit. On the basis of overall acceptability of biscuits, among the different treatment combinations of functional biscuit it could be concluded that treatment T3 fortified with 16% peanut flour and 8% banana peel powder was best combination. This functional biscuit is nutritionally more superior to that of whole wheat flour biscuit and can be used as a vehicle for protein fortification and other nutritional improvement as biscuit is widely accepted bakery product in India. The chemical properties of different treatments of products varied to the great extent and microbial quality was found satisfactory upto 30 days under room temperature. The cost of prepared biscuit was less than commercial biscuit. It is suggested that peanut flour and banana peel powder must be used in baking industry to provide value added products to consumer in reasonable price, so his may become a boon for further development of bakery products using low cost, nutritious ingredients. Therefore, it is concluded that it is best to peanut flour and banana peel powder in preparation of functional biscuit.

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