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Valorisation of Orange and Banana Peel: Formulation of Fibre Loaded Biscuits.

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Abstract: The production, processing of agricultural products results in massive generation of waste, which has an environmental impact. In current study on the node of valorisation of the processed waste, orange and banana peel waste are utilized for the production of biscuits. The fortified biscuits were analysed for proximate and sensory analysis. The fibre content of the fortified biscuits increases several folds. From the sensory score the proportion of biscuits with 7.5% and 10% has undesirable quality parameters, whereas up to 5% concentration all the parameters are more desirable. Fortifying biscuits with orange and banana peel powder may be an excellent source of dietary fibre and an enhanced valorisation technique.

Keywords: waste valorisation; fibre biscuits; orange peel; banana peel

Introduction

Agro waste is the term used to describe the enormous amounts of solid waste created during the preparation, processing, and consumption of fruits and vegetables. These wastes can remove vital biomass and nutrients, and if left untreated for a long period create disposal and environmental problems. Agricultural wastes can be transformed into useful products or even raw materials for other industries [1]. The processing of fruits and vegetables results in huge amounts of waste materials such as peels, seeds, and unused flesh generated down the processing chain [2]. These enormously produced agricultural wastes are highly lucrative and offer a wide range of valuable materials. Several research studies have been conducted on utilization of processing waste from apple [3], orange and citrus peel [4, 5], passion fruit [6], banana [7], carrot and beetroot [8]. The processing waste are used as functional ingredient as source of antioxidant and dietary fibre. Dietary fibre incorporation prolong the shelf life of the food products, modify the structural and physical characteristics of product such as texture, water and oil holding capacity as well as viscosity and sensory properties [9]. Furthermore, high intake of dietary fibre has been found to be associated with reduced blood pressure, LDL cholesterol and associated cardiovascular diseases [10]. In recent years, the demand for foods that has low fat content and provide less calories as well as rich in dietary fibre contents is increasing worldwide.

According to World Health Organization data one should consume at least 30 g of fibre per day; however, most people consume less than the recommended amount. Several factors such as rapid industrialization, consumption of ready to eat processed foods, high calorie, fat and sugary foods, unbalanced diet and sedentary life styles may leads to inadequate fibre content. To combat with this issue fibre enriched products is consider being a greater solution. On the node of waste valorisation and addressing fibre inadequacy, the current study was carried out to prepare biscuits fortified with orange and banana peel powder as they provide a good source of dietary fibre.

MATERIAL AND METHODS

Materials: Wheat flour (72% extraction), orange peel powder, banana peel powder, sugar, shortening agent, milk powder, baking powder, salt, eggs, vanilla essence.

Preparation of orange peel powder: Orange peels were collected from the fruit processing unit, cleaned, cut down to smaller sizes and oven dried at $65\pm 5^{\circ}\text{C}$. The dried peel are powdered and stored in airtight container for further analysis.

Preparation of banana peel powder: Banana peels were washed and sliced; peels were steam blanched to inactivate enzyme activity. Blanched peels were dried in a cabinet dryer at $60\pm 5^{\circ}\text{C}$ for 6 to 7 hours. Dried peels are powdered sieved and stored for analysis.

Formulation and Preparation of Biscuits: The orange peel powder (OPP) and banana peel powder (BPP) were added to wheat flour at 0, 2.5, 5, 7.5, 10% and the composition of biscuit were shown in table 1. Biscuit were prepared according to the method described by [11]. The prepared biscuits were baked at 180°C for 15 min in the oven. Baked biscuits were stored in airtight container for further analysis.

Proximate Analysis: Proximate analysis of the OPP and BPP fortified biscuits such as moisture, protein, fat, ash and fibre contents were determined from the procedures as described by Association of Official Analytical Chemist [12]. Moisture content were determined by using gravimetric method, protein by Kjeldahl method, fat by Soxhlet extraction method, ash by dry ashing method and fibre by enzymatic gravimetric method. All the readings were taken in triplicate and the mean value was taken for analysis.

Table 1. Treatment used in formulation of blend of wheat flour, OPP and BPP (%).

Treatment	Wheat flour (g)	Orange peel powder (g)	Banana peel powder (g)	Sugar (g)	Shortening (g)	Egg (g)	Milk powder (g)	Salt (g)	Baking powder (g)	Vanilla essence (drops)
T0	100	0	0	60	20	40	5	1	.5	2
T1	95	2.5	2.5	60	20	40	5	1	.5	2
T2	90	5	5	60	20	40	5	1	.5	2
T3	85	7.5	7.5	60	20	40	5	1	.5	2
T4	80	10	10	60	20	40	5	1	.5	2

T0 – control biscuits with 100% wheat flour and 0% OPP and 0% BPP; T1 – biscuits with 95% wheat flour and 2.5% OPP and 2.5% BPP; T2 – biscuits with 90% wheat flour and 5% OPP and 5% BPP; T3 – biscuits with 85% wheat flour and 7.5% OPP and 7.5% BPP; T4 – biscuits with 80% wheat flour and 10% OPP and 10% BPP.

Sensory analysis: Sensory analysis was carried out based on hedonic rating by twenty trained panellist. The panellists assessed biscuits for its colour, taste, texture, flavour, and overall acceptability. Each sensory attribute was rated on a 9 point hedonic scale: 9-like extremely, 8-like very much, 7-like moderately, 6-like slightly, 5- neither like nor dislike, 4-dislike slightly, 3-dislike moderately, 2-dislike very much and 1-dislike extremely.

Result and Discussion: The proximate analysis of wheat flour, orange peel powder and banana peel powder is reported in table2. The wheat flour has the highest amount of protein (11.27%) and least amount of fibre (0.46%). These results are in consistent with the findings of [13]. The OPP has the lowest protein content (4.97%) and highest amount of fibre (13.97%). Likewise, [14] found that the fibre content of OPP ($14.17\pm 0.36\%$), which is within the founded range. The BPP has more fibre (10.03%) and ash content (9.63%), [15] found that the ash content of BPP is about ($13.42\pm 0.35\%$) and [16] found that ash content of BPP is ($8.8\pm 0.54\%$), the variations in some of these findings might be due to various post harvesting methods, climatic conditions, or due analytical methods used.

Table 2. Proximate analysis of wheat flour, orange peel powder and banana peel powder. .

components	Wheat flour (%)	Orange peel powder (%)	Banana peel powder (%)
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Moisture	11.03 ^a	7.04 ^a	6.32 ^d
Protein	11.27 ^b	4.97 ^d	8.19 ^c
Fat	2.24 ^c	1.89 ^e	4.76 ^e
Fibre	0.46 ^e	13.97 ^b	10.03 ^a
Ash	0.81 ^d	5.50 ^c	9.63 ^b

^aindicates the highest value across the same column; ^{a-e} different letter superscripts in the same column indicate statistical difference of P<0.05.

The proximate analysis of the formulated biscuits was reported in table3. The amount of moisture in all the biscuits was in the range of 3.38% to 6.98%, the linear increase in the moisture content is due to the initial moisture content of all the ingredients used. It has to be noted that a protein content of biscuits decreases with increase in the OPP and BPP concentrations, at T0 protein content (9.15%) and at T4 (6.91%). [17] Reported values for protein content in the biscuits with banana peel powder were similar to the current findings. No such significant effects were observed in the fat content. The fibre and ash content increases with increase in the concentration of OPP and BPP. [18] Discovered a substantial rise in fibre and ash content when BPP is used in formulation of baked products. The highest ash content was observed in T4 (2.73%), while the lowest was in T0 (0.84%). [6, 19, 20] Reported biscuits supplemented with fruits peel powder show higher ash content. The fibre content increases several folds in T4 (4.93%) than in control T0 (0.54%), the enormous increase of ash and fibre content is primarily due to the added OPP and BPP.

Table 3. Proximate analysis of formulated biscuits.

Treatment	Moisture (%)	Protein (%)	Ash (%)	Fat (%)	Fibre (%)
T0	3.38 ^e	9.15 ^a	0.84 ^e	27.85 ^a	0.54 ^e
T1	4.42 ^d	8.93 ^b	1.01 ^d	27.63 ^a	2.24 ^d
T2	5.84 ^c	8.46 ^c	1.97 ^c	27.28 ^b	3.87 ^c
T3	6.21 ^b	7.74 ^d	2.24 ^b	26.93 ^c	4.27 ^b
T4	6.98 ^a	6.91 ^e	2.73 ^a	26.47 ^d	4.93 ^a

^aindicates the highest value across the same column; ^{a-e} different letter superscripts in the same column indicate statistical difference of P<0.05; T0 – control biscuits with 100% wheat flour and 0% OPP and 0% BPP; T1 – biscuits with 95% wheat flour and 2.5% OPP and 2.5% BPP; T2 – biscuits with 90% wheat flour and 5% OPP and 5% BPP; T3 – biscuits with 85% wheat flour and 7.5% OPP and 7.5% BPP; T4 – biscuits with 80% wheat flour and 10% OPP and 10% BPP.

Sensory analysis of formulated biscuits: The report of sensory analysis of OPP and BPP fortified biscuits shown in (table 4). The sensory analysis of formulated biscuits were not satisfy able with increase in the concentration of the peel powders, up to 5% concentration of BPP and OPP all the parameters tends to have greater score, beyond 5% desirable characteristics were not obtained. The overall acceptability of the formulated biscuits followed the trend as T2>T1>T3>T4.

Table 4. Sensory analysis of formulated biscuits.

Treatment	Colour	Texture	Taste	Flavour	Overall acceptability
T0	8	7.8	8	7.21	7.75
T1	8.16	8.29	8.19	8.12	8.19
T2	8.55	8.76	9	8.52	8.70
T3	7.44	7.14	7.51	7.75	7.46
T4	7.13	7	6.96	7.11	7.05

T0 – control biscuits with 100% wheat flour and 0% OPP and 0% BPP; T1 – biscuits with 95% wheat flour and 2.5% OPP and 2.5% BPP; T2 – biscuits with 90% wheat flour and 5% OPP and 5% BPP; T3 – biscuits with 85% wheat flour and 7.5% OPP and 7.5% BPP; T4 – biscuits with 80% wheat flour and 10% OPP and 10% BPP.

At T3 and T4 the colour of biscuits darkened, texture becomes crumbled and sandy, grassy and intense orange flavour were noted, which reduces the overall acceptability of the fortified biscuits, further biscuits tasted burned orange and citrus which were predominant in T4 than in T3, [3] observed similar effects in biscuits with citrus peel. The darkening of biscuits may arise due to millard reaction between the sugars in the peel powders. At T1 and T2 the overall acceptability was more and no such intense notes were recorded, the flavour of orange is noted at acceptable level and a natural sweetness was found. The texture was smooth with golden brown colour.

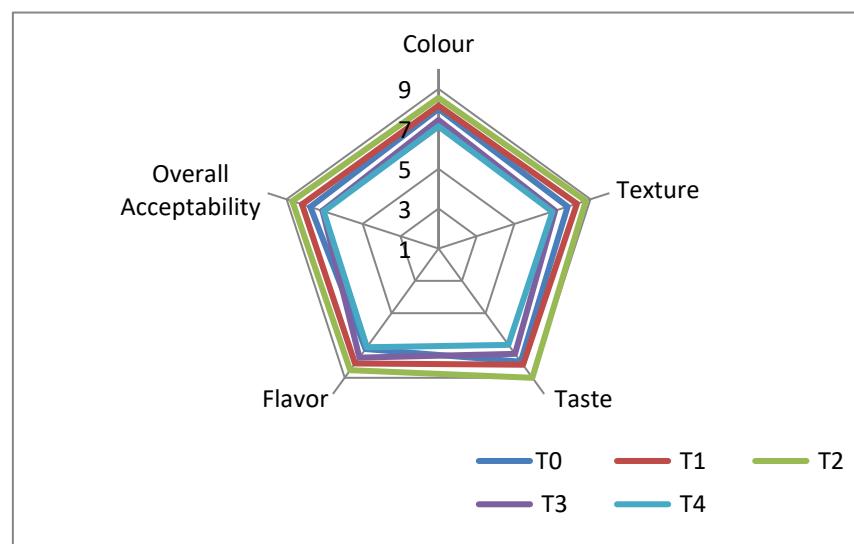


Figure 1. Sensory score of formulated biscuits.

Conclusion

This study highlighted a best technique of valorisation and utilization of fruit processing waste for the preparation of biscuits. Biscuits were fortified with banana and orange peels to boost the nutritional profile of biscuits predominantly the fibre content. The proximate analysis of the biscuits demonstrates that increase in the concentration of both OPP and BPP tend to peaks the fibre content to maximum, whereas the sensory analysis of the biscuits with higher content of the fortificants were not desirable and adversely affects the quality attributes. Up to 5% addition of both OPP and BPP all the sensory attributes were more acceptable. These findings suggest that using the peel wastes are effective and low cost mean of producing fortified bakery products, further more valorisation of banana and orange processing waste alleviates various hazards while serving as the source of nutrients.

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