

Effect of orange peel powder incorporation on physical, nutritional and sensorial quality of biscuits

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Studies were conducted for incorporation of orange peel powder in biscuits. The orange peel powder was used in various proportion viz., 0, 5, 10, 15 and 20 per cent levels for incorporation in biscuits by replacing the maida. The orange peel powder and maida was analyzed for the proximate composition. The biscuits were prepared and were analyzed for its physical (diameter, thickness, and spread ratio), chemical (moisture, protein, fat, ash, fibre) and sensorial characteristics (appearance, colour, flavour, taste, texture). On the basis of overall sensory attributes, biscuits prepared with 10 per cent of orange peel powder were recorded higher acceptability as compared to other samples. It was also found that the spread ratio of the biscuits was decreased as the per cent of orange peel powder was increased. The increase in powder concentration, the protein, and fat content was decreased while the dietary fibre was increased. It was concluded that orange peel powder and refined wheat flour can be substituted upto 10 per cent in refined wheat flour to prepare orange peel powder without adversely affecting quality attributes.

Key Words : Peel powder, Sensorial characteristics, Spread ratio, Dietary fibres, Quality attributes

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INTRODUCTION

Orange is a fruit of the citrus species *Citrus sinensis* in the family Rutaceae. Important orange varieties cultivated in India are Nagpur Santra, Coorg Santra, Khasi Santra, Mudkhed, Shringar, Butwal, Dancy, Kara (Abohar). Brazil, America, China, India, Mexico, Spain and Egypt are the countries having significant production of oranges. Brazil is the world's leading orange producer, with an output of 36 million tons (2013); similar in total to the next three countries combined (the United States,

China and India). With approximately 16 million tons produced in 2013, the United States is the second largest producer. Other countries with significant production of oranges are China, India, Mexico, Spain and Egypt. Citrus is grown in more than 26 states in the country. The important states producing major citrus fruits in the country are Punjab, Rajasthan and Maharashtra (FAO Statistics, 2013). Citrus peel, remaining after juice extraction, is the primary waste fraction amounting to almost 50 per cent of the fruit mass (Braddock, 1999). It is note-worthy to clarify that citrus peel: the waste by-product of the citrus factories is reckoned as a valuable functional food. So, citrus peels may provide a health benefit beyond the traditional nutrients they contain, as well as prevent diet-related diseases, e.g. metabolic syndrome, type II diabetes, coronary heart disease, obesity, hypertension, certain types of cancer, gastrointestinal diseases and osteoporosis (Block *et al.*,

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1992) Citrus by-products, if utilized fully, could be major sources of phenolic compounds. The peels, in particular, are an abundant source of natural flavonoids, and contain higher amount of phenolics compared to the edible portions (Gorinstein *et al.*, 2001). The contents of total phenolics in peels of lemons, oranges, and grapefruit were 15 per cent higher than those in the peeled fruits. Flavonoids in citrus are a major class of secondary metabolites. The peel contains the highest amount of flavonoids than other parts and those flavonoids present in citrus fruits belong to six peculiar classes according to their structure. They are flavones, flavanones, flavonols, isoflavones, anthocyanidins and flavanols (Senevirathne *et al.*, 2009).

Baking industry is considered to be one of the major segments of food processing in India. Baked products have popularities in the people because of their availability, ready to eat convenience and reasonably good shelf-life. Biscuits are different from other baked products like bread and cakes because of their low moisture content which ensures less chance of microbial spoilage to provide a longer shelf-life, making large scale production and distribution possible.

Biscuits are the most popularly consumed bakery items in the world. Some of the reasons for such wide popularity are their ready to eat nature, affordable cost, good nutritional quality, availability in different tastes and longer shelf-life (Gandhi *et al.*, 2001). The physico-chemical properties of the mango peel fibre rich powder make it a suitable by-product to be used in the preparation of a low calorie and high fibre food products, such as bakery products (Hassan *et al.*, 2011).

In view of the impact and economy of waste the present research investigation was carried out to utilize the orange peel powder in value added food products *viz.*, biscuits and also evaluated for their overall quality characteristics.

METHODOLOGY

The research work was carried out at Department of Food Engineering, College of Food Technology, Vasantarao Naik Marathwada Krishi Vidhyapeeth, Parbhani, Maharashtra. The oranges (Nagpur variety) were procured from the local market of the Nagpur, Maharashtra. Commercial soft wheat flour (72% extraction), bakery fat, powdered sugar and skimmed milk powder were purchased from the local market. Food grade dextrose, sodium chloride, sodium bicarbonate and

ammonium bicarbonate were used in biscuit processing.

Preparation of orange peel powder :

Orange peel was obtained after peeling and further washed with tap water and scalded in a water bath to remove possible potential pathogenic micro-organisms (vegetative cells). Drying of peel was carried out in an oven at 50°C for 24 h to improve shelf-life of citrus byproducts without addition of any chemical preservative. A grinder mill and sieves are used to obtain a powder having particle size of less than 0.2mm.

Table A : Standardized recipe for biscuit

Ingredient quantity	(g)
Wheat flour	200.0
Sugar	60.00
Fat	50.0
Salt	2.0
Ammonium bicarbonate	3
Sodium carbonate	0.8
Dextrose	4
Skim milk powder	4
Water	40-42 ml

Biscuit processing :

Biscuits were prepared using the standardized recipe and method given by (Ashoush and Gadallah, 2011).

Biscuits samples were processed from doughs containing 5, 10, 15 and 20 per cent of Orange peel powder (orange peel powder) (Table B) as substituting levels for wheat flour according to the method described by Leelavathi and Rao (1993). The formula used was as follows: 200 g wheat flour, 60 g sugar, 50 g shortening, 2 g sodium chloride, 0.8 g sodium bicarbonate, 3 g ammonium bicarbonate, 4 g dextrose, 4 g skimmed milk powder and 40 - 42 ml water (Table A). The ground powder sugar and fat were creamed in a Hobart mixer (N-50) with a flat beater for 3 min at 61 rpm (speed 1). Sodium bicarbonate, sodium chloride and ammonium bicarbonate were dissolved in water and added. Skimmed milk powder was made into suspension with water and transferred to the cream. The contents were mixed for 6 min at 125 rpm (speed 2) to obtain a homogenized and creamy texture. Sieved flour was added to the cream and mixed for 2 min at 61 rpm (speed 1). The dough pieces were sheeted to a thickness of 3.5 mm, cut using a circular mould (51 mm diameter) and baked at 205°C

for 8-9 min (Fig. A). After baking, biscuits were left to cool at room temperature and were wrapped tightly with polypropylene pouches and kept until further analysis.

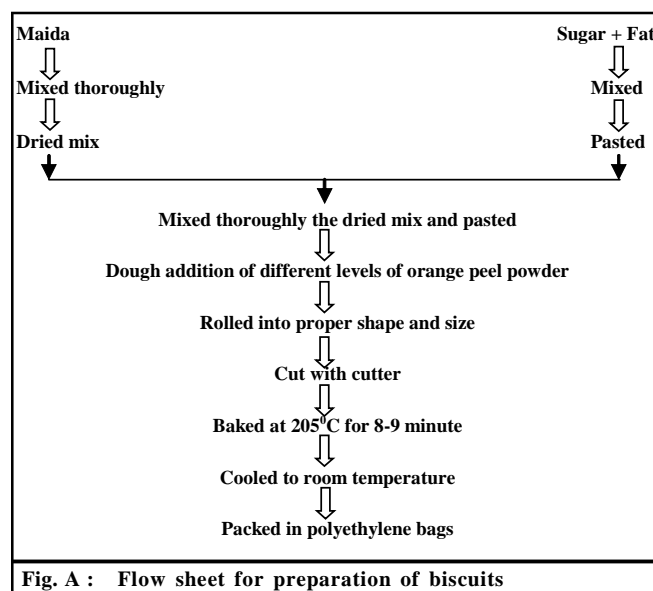


Fig. A : Flow sheet for preparation of biscuits

Sample	Fortification levels of orange peel powder
OPP5	Orange peel powder 5%
OPP10	Orange peel powder 10%
OPP15	Orange peel powder 15%
OPP20	Orange peel powder 20%

OPP: Orange peel powder

Physical properties:

Diameter (W) of biscuits was measured by laying six biscuits edge-to-edge with the help of a scale. The same set of biscuits was rotated 90° and the diameter was re-measured. Average values were reported in millimeter. Thickness (T) of biscuits was measured by stacking six biscuits on top of one another and taking the average in millimeter. The spread ratio was calculated by dividing diameter (W) by thickness (T).

Analytical methods:

Proximate composition and dietary fibre were estimated by the methods given by AOAC (1999).

Water and oil holding capacity:

The water and oil holding capacity was measured by the method given by Nassar *et al.* (2008).

Organoleptic quality of biscuits:

The sensory evaluation was done on point hedonic scale as per the method given by Hooda and Jood (2005). The sensory evaluation of prepared herbal biscuits was carried out by a 25 member trained panel comprising of postgraduate students and academic staff members of faculty who had plenty previous experience in sensory evaluation of bakery products. The panel members were requested to measure the terms identifying sensory characteristics and in use of the score. Judgments were made through rating products on a 9 point Hedonic Scale with corresponding descriptive terms ranging from 9 'like extremely' to 1 'dislike extremely'.

OBSERVATIONS AND ASSESSMENT

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Proximate composition of refined wheat flour:

Compositions of refined wheat flour were determined to signify its suitability in preparation of Biscuits. The obtained results are summarized in Table 1. The refined wheat flour contained 11.87 per cent of crude protein while 8.72 per cent of gluten content was observed. The other results with respect to moisture, fat, ash and total carbohydrate were found to be 13.20, 1.38, 0.53 and 68.17 per cent, respectively. The obtained results for the proximate composition and gluten content of wheat flour were similar to that of results reported by other scientist Gopalan *et al.* (2004).

Table 1 : Proximate composition of refined wheat flour (g/100g DW)

Sr. No.	Parameter (%)	Refined wheat flour
1.	Moisture	13.20
2.	Protein	11.87
3.	Crude fat	1.38
4.	Total ash	0.53
5.	Total carbohydrate	68.17
6.	Gluten content	8.72

*Each value is average of 3 determinations

Proximate composition of orange peel powder :

Proximate composition of orange peel powder presented in Table 2 revealed that it contain 9.5 per cent moisture, 5.17 per cent protein, 74.14 per cent total dietary fibre and 4.41 per cent fat, these results are comparable

with findings reported by Humaira *et al.* (2013). The results of the water and oil holding capacity are found comparable with findings reported by Nassar *et al.* (2008).

Physical characteristics of biscuits such as diameter, thickness and spread ratio are presented in Table 3. The effect of replacing 5, 10, 15 and 20 per cent of wheat flour with orange peel powder was studied and the data. The results showed that all selected orange peel powder treatments caused significant increase in biscuit diameter as compared with 50.33 mm for control except 20 per cent of orange peel powder. The highest diameter (53.24 mm) was found by addition of 5 per cent of orange peel powder. Incorporation of 20 per cent orange peel powder in biscuit given less diameter value (50.16 mm) without significant difference with control. It was also clear that using orange peel powder upto 10 per cent in biscuit preparations resulted in significant increase in thickness when compared with 8.16 mm for control. The higher thickness (9.61 mm) was recorded by orange peel powder at 10 per cent. The decrease in diameter and thickness of biscuits with addition of 20 per cent orange peel powder may be due to dilution of gluten. This observation is agreement with those obtained by Ajila *et al.* (2008).

Table 2 : Proximate composition of orange peel powder (g/100g DW)

Sr. No.	Parameter (%)	Orange peel powder
1.	Moisture	9.5±0.05
2.	Protein	5.17±0.40
3.	Crude fat	4.41±0.15
4.	Total ash	2.53±0.12
5.	Sugar	9.20±0.22
6.	Total dietary fibre	74.14±3.0
7.	Indigestible dietary fibre	55.47±2.14
8.	Digestible fibre	19.1±1.1
9.	Water holding capacity (g/g)	5.9
10.	Oil holding capacity (g/g)	4.0

Concerning to spread ratio, it was observed that replacing of 20 per cent wheat flour by orange peel powder recorded the highest value 6.27 which had no significant difference with control. Results also showed that no significant difference was found in spread ratio between biscuit containing 10 and 15 per cent orange peel powder.

Chemical composition of orange peel powder substituted biscuits g/100g dry weight basis :

The values (Table 4) shows that protein, fat and

carbohydrate contents decreased with increasing orange peel powder concentration, this is due to replacing the refined wheat flour and vegetable fat which are major source of the protein and fat. On the other side, for biscuits total, insoluble and soluble dietary fibre contents increased by increasing the level of Orange peel powder and reached to 12.04, 8.3 and 6.0 per cent at level 20 per cent for orange peel, respectively, as from the proximate composition of the orange peel powder it is clear that peel powder is a major source of the dietary fibres. The obtained results for the proximate composition and dietary fibres were similar to that of results reported by Nassar *et al.* (2008) and Kakali *et al.* (2014).

Table 3 : Physical characteristics of orange peel powder supplemented biscuits

Sample (%)	Diameter, D (mm)	Thickness, T (mm)	Spread ratio (W/T)
Control	50.33	8.16	6.18
5 OPP	53.24	9.15	5.64
10 OPP	53.23	9.61	5.82
15 OPP	51.5	8.51	5.94
20 OPP	50.16	8.01	6.27

OPP: Orange peel powder

Sensory evaluation:

Sensory evaluation of biscuits prepared with different levels of orange peel powder as compared to the control biscuits is depicted in Table 5. The data revealed that incorporation of orange peel powder has marked improvement in colour, appearance and textural profile of prepared biscuits upto concentration of 10 per cent while further increase in concentration results in drastic reduction in appearance, colour, flavour, and texture as well as taste characteristics. With respect to appearance, it was observed that incorporated of orange peel powder resulted in grainy appearance of biscuits which were preferred by panellist members upto 10 per cent while in case of 20 per cent incorporated biscuits, excessive grainy appearance secured lower values. The colour characteristics of biscuits showed to be darker with increase in concentration of peel powder which enhanced consumer appeal upto 10 per cent of incorporation. Similar trend to that of flavour scores was observed in case of colour values of incorporated biscuits. Textural profile plays an important role in justifying the overall acceptability of biscuits, In case of peel powder incorporated biscuits, slight improvement in crispiness of biscuits were observed in samples upto 10 per cent of peel powder, secured better

Table 4 : Chemical composition of orange peel powder substituted biscuits g/100g dry weight basis

Sample (%)	Protein	Fat	Ash	Carbohydrate	TDF	IDF	SDF
Control	9.80	20	0.8	69	2.41	1.65	0.99
5 OPP	8.32	18.10	1.0	71	7.01	4.8	2.39
10 OPP	7.20	17.21	1.21	73.4	9.03	6.1	3.17
15 OPP	6.54	16.20	1.30	74.9	11.1	6.9	4.98
20 OPP	6.31	15.32	1.32	77.4	12.04	8.3	6.0

TDF: Total dietary fibre IDF: Insoluble dietary fibre SDF: Soluble dietary fibre

Table 5 : Sensory evaluation of biscuits

Sample code	Sensory attributes					
	Colour	Appearance	Texture	Taste	Flavour	Overall acceptability
Control	8.2	8.53	8.31	8.48	8.42	8.58
OPP5	7.20	7.17	8.19	8.13	8.10	8.07
OPP10	7.37	7.28	8.31	8.25	8.23	8.20
OPP15	6.39	6.98	7.82	7.52	7.86	7.10
OPP20	4.97	4.71	4.99	5.82	6.08	6.68
Mean	6.82	6.931	7.52	7.63	7.745	7.734
S.E. _±	0.549	0.615	0.640	0.482	0.429	0.341
C.D. (P=0.05)	0.182	0.206	0.214	0.161	0.143	0.115

*Each value represents the average of ten determinations

scores however in case of biscuits containing 20 per cent of peel powder, the panelists reported dryness of mouth secured least scores. It was found that biscuits containing 10 per cent of peel powder found to secure maximum score (8.2) followed by OPP5 (8.07) and control (8.58) while least overall acceptability was observed in OPP20 sample containing 20 per cent of peel powder. On the basis of overall acceptability of biscuits, it can be concluded that incorporation of orange peel powder in preparing biscuits upto the level of 10 per cent is superior to all other sample and also in control sample. Hence, 10 per cent peel powder incorporation in preparation of biscuits could be overall acceptable with respect to sensorial quality characteristics.

Conclusion :

It can be concluded that incorporation of orange peel upto the level of 10 per cent in formulating biscuits preparations enhanced the nutritional value particularly with respect to dietary fibre, physical quality and overall acceptability of biscuits.

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