RESEARCH PAPER — FOOD SCIENCE RESEARCH JOURNAL

e ISSN-2230-9403 ■ Visit us : *www.researchjournal.co.in*
Volume 8 | Issue 2 | October, 2017 | 266-270
DOI : 10.15740/HAS/FSRJ/8.2/266-270

Studies on exploration of orange pomace powder on physical, sensorial and nutritional quality of biscuits

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Processing of fruit and vegetable produces large quantity of waste particularly citrus processing produces waste in the form of peel, seeds and pomace which can be the major source of phytochemicals and dietary fibres. The objective of the research was to utilize the orange pomace in the form of powder in biscuits. The orange pomace 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 pomace powder and maida were analyzed for the proximate composition. The biscuits were prepared and 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 pomace powder were recorded higher acceptability as compared to other samples. The spread ratio of the biscuits also decreased as the per cent of orange pomace powder was increased with the increase in powder concentration the protein, fat content was gradually, decreasing and the dietary fibre. Orange pomace powder can be substituted upto 10 per cent in wheat flour to prepare orange pomace powder biscuits without adversely affecting overall quality attributes.

Key Words : Pomace powder, Sensorial characteristics, Quality attributes

How to cite this article : Zaker, M.A., Sawate, A.R., Sadawarte, S.K., Patil, B.M. and Kshirsagar, R.B. (2017). Studies on exploration of orange pomace powder on physical, sensorial and nutritional quality of biscuits. *Food Sci. Res. J.*, **8**(2): 266-270, **DOI : 10.15740/HAS/FSRJ/8.2/266-270**.

INTRODUCTION

Citrus is an ancient crop, with records of human cultivation extending back to at least 2100 B.C. (Moore, 2001). Citrus cultivation dates back to many centuries. This cultivation is said to be started in China as early as 2200 BC. South China and Assam are the origin of many citrus fruits. The citrus fruits include lime, lemons and oranges. Limes, lemons and citrus reticulate are indigenous to Assam (Bhattacharya and Dutta, 1949). Among the major orange producing countries of the world, Brazil is the country at the first position with production aread of 729583 in HA and total production on MT of 18012560. America is at the second position in terms of area and production with 250582 HA and 8166480 Mt in production. China occupies the third position with total area of 475000 in HA and 6500000 MT in production. India is at the fourth position with total production and productivity of Orange of 334939 of HA and 3886198 in MT. The other countries having good area and production capacity includes Mexico, Spain and Egypt (NHB, 2015). The all India area, production and productivity of orange increased. In 2011-12 the total area (in HA) was 329.1 and 3128.5 MT was the production while productivity in MT/HA was 9.5. While in the year 2012-13 total area (in HA) was 311.2 and 2906.3 MT was the production while productivity in MT/HA was 9.3. Compared to the

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previous year in the year 2013-14 the productivity and other things got increased with the total area (in HA) was 330.0 and 343.14 MT was the production while productivity in MT/HA was 10.4 (NHB, 2015). Leading orange producing states in India are Punjab and Madhya Pardesha with 30 and 26 per cent. Maharashtra is at the third position im producing the oranges with 22 per cent followed by Rajasthan and Assam with 7 and 5 per cent, respectively (NHB, 2015).

The net impact by the revolution in agriculture is the fast development of food processing industries all over the world. Food industrialization has generated a large quantity of the food products, provides employment to large number of people and uplifted the economic status, at the same time; it generated waste in huge quantities causing the environmental pollution, by products from the agriculture and food processing industries can become one of the most serious sources of pollution (Blasi *et al.*, 1997). The processing industry creates a large amount of waste by-product in the form of peel, seeds, rag (the membranes between the citrus segments) and pulp (juice sacs), representing 50-60 per cent of the whole fruit being discarded after juicing (Siles *et al.*, 2010). 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 (Vijayakumar *et al.*, 2013).

This study was designed to evaluate the chemical composition, water and oil holding capacity of orange pomace powder and the effect of their incorporation different levels (0-20%) on the chemical, physical, and sensory evaluation of wheat biscuits.

METHODOLOGY

The research work was carried out at Department of Food Engineering, College of Food Technology, Vasantarao Naik Marathwada Krishi Vidyapeeth Parbhani-Maharashtra, in the year 2016. The oranges (var. Nagpur) were procured from the local market of the Nagpur, Maharashtra. Wheat flour and other ingredients used in biscuits preparation were purchased from the local market of the Parbhani.

Preparation of orange pomace powder :

Orange pomace were obtained after extraction of juice from the orange fruit and obtained pomace was dried in an oven at 50^0C for 24 h to improve citrus by-products shelf-life without addition of any chemical preservative. A grinder mill and sieves were used to obtain a powder particle size of less than 0.2 mm.

Biscuit processing :

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

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

Biscuits samples were processed from dough's 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.

Physical properties:

Diameter (W) of biscuits was measured by laying

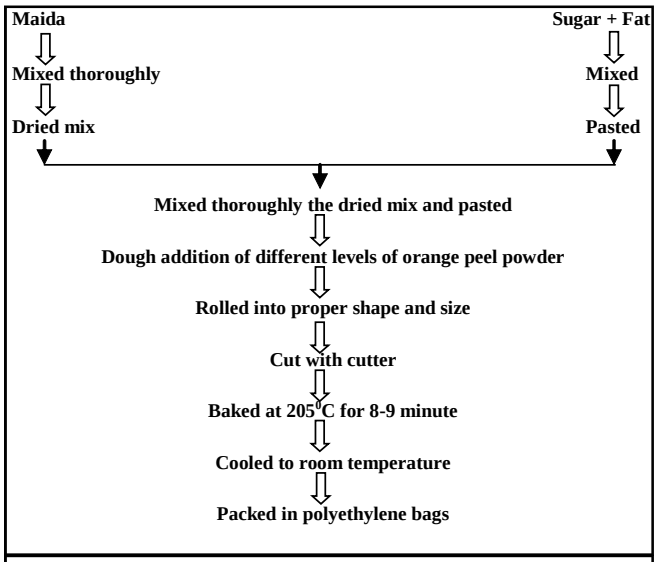

Fig. A : Flow sheet for preparation of biscuits

Table B : Different levels of addition of orange peel powder in 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

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 pomace powder:

Proximate composition of orange pomace powder presented in Table 2 revealed that it contain 8.91 per cent moisture, 6.18 per cent protein, 60.33 per cent total dietary fibre and 5.51 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 width, thickness and spread ratio are presented in Table 3. The

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

Sr. No.	Parameter (%)	Orange pomace powder
1.	Moisture	8.91±0.05
2.	Protein	6.18±0.21
3.	Crude fat	2.51±0.15
4.	Total dietary fibre	60.33±0.15
5.	Indigestible dietary fibre	49.66±2.10
6.	Digestible dietary fibre	11.78±0.59
7.	Water holding capacity g/g	3.9
8.	Oil holding capacity g/g	2.2

average width of control biscuits was 58.9 mm whereas that of substituted biscuits varied from 57.5 to 50.9 mm for orange pomace powder at 5-20 per cent levels. On the other hand, the average thickness of control biscuits was 6.10 mm and for other supplemented levels, it ranged from 6.35 to 7.31mm. The changes in width and thickness are reflected in spread ratio which was 9.5 for control biscuits, these values were decreased from 9.1 to 7.10 in orange pomace powder biscuits. These results are comparable with findings reported by Humaira *et al.* (2013).

Chemical composition of pomace powder incorporated biscuits g/100g dry weight basis :

The data in Table 4 shows that protein, fat decreased with increasing orange pomace powder this is because we are replacing refined wheat flour and vegetable fat which are source of protein and fat, with the orange pomace powder whereas ash, carbohydrate and total dietary fibre as well as soluble and insoluble dietary fibre increased with increasing orange pomace powder and reached to 12.07 at level 20 per cent for orange pomace, respectively. This is because pomace powder is rich in dietary fibre which can be seen from the proximate composition of the pomace powder. Dietary fibres play a major role in maintaining the healthy gastrointestinal tract, and also play a role in diabetic. These results are comparable with findings reported by Humaira *et al.* (2013).

Table 3 : Physical characteristics of orange pomace powder supplemented biscuits

Sample (%)	Width, W (mm)	Thickness, T (mm)	Spread ratio (W/T)
Control	58.9	6.10	9.5
5 OPP	57.5	6.35	9.1
10 OPP	55.3	6.80	8.01
15 OPP	52.8	6.89	7.57
20 OPP	50.9	7.31	7.10

OPP: Orange pomace powder

Table 4 : Chemical composition of pomace powder incorporated biscuits g/100g dry weight basis

Sample (%)	Moisture	Protein	Fat	Ash	Carbohydrate	TDF	IDF	SDF
Control	3.48	10.10	19.8	0.7	69	2.70	1.70	1.0
5 OPP	4.29	9.10	19	1.10	72	7.18	5.4	1.78
10 OPP	5.01	7.98	17.0	1.29	73.98	9.98	6.36	3.62
15 OPP	5.41	6.78	16.74	1.34	74.87	11.00	6.97	4.10
20 OPP	6.00	6.25	15.01	1.30	77.01	12.07	7.4	4.66

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	Mouth feel	Flavour	Overall acceptability
Control	8.0	8.0	8.0	8.0	8.0	8.0	8.0
OPP5	8.1	7.5	8.1	6.8	6.2	6.2	7.10
OPP10	8.0	8.0	8.0	7.5	8.0	7.5	7.60
OPP15	7.2	7.2	5.6	6.9	6.0	6.0	6.50
OPP20	5.3	4.6	5.0	5.1	4.5	4.9	5.00
S.E.±	0.166	0.0924	0.1314	0.120	0.1139	0.126	0.0742
C.D. (P=0.05)	0.522	0.2909	0.4133	0.377	0.358	0.397	0.233

*Each value represents the average of ten determinations

Sensory evaluation:

Sensory evaluation of biscuits containing different levels of orange pomace powder as compared to the control biscuits is shown in Table 5. The data revealed that incorporation of orange pomace 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. The overall acceptability of biscuits was determined by taking average of all the values pertaining to appearance, colour, flavour, texture and taste. It was found that sample containing 10 per cent of pomace powder found to secure maximum score (7.6) followed by OPP5 (7.1) and control (8.0) while least overall acceptability was observed in sample containing 20 per cent of powder. On the basis of overall acceptability of biscuits, it could be concluded that incorporation of orange pomace powder in preparing biscuits upto the level of 10 per cent is superior to all other treatments and control sample and hence, 10 per cent pomace powder incorporation in preparation of biscuits could considered optimum with respect to sensorial quality characteristics.

Conclusion :

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

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Received : *26.05.2017;* **Revised:** *11.08.2017;* **Accepted :** *26.08.2017*