

# Studies on Effect of Orange Peel Powder Incorporation on Physical, Nutritional and Sensorial Quality of Cookies

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**Abstract** - Studies were conducted for incorporation of orange peel powder in cookies. The orange peel powder was used in various proportion viz 0, 5, 10, 15 and 20 per cent levels for incorporation in cookies by replacing the maida. The orange peel powder and maida was analyzed for the proximate composition. The cookies were prepared and were analyzed for its physical (diameter, thickness, and spread ratio), chemical (moisture, protein, fat, ash, fiber) and sensorial characteristics (appearance, color, flavor, taste, texture). On the basis of overall sensory attributes, cookies 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 cookies 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 fiber was increased. It was concluded that orange peel powder and refined wheat flour can be substituted up to 10 per cent in refined wheat flour to prepare orange peel powder without adversely affecting quality attributes.

**Keywords:** Citrus fruits, Orange peel powder, Sensory evaluation, and quality attributes.

## 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 1995). 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.*, 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. Cookies 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.

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: cookies and also evaluated for their overall quality characteristics.

## MATERIAL AND METHODS

The research work was carried out at Department of Food Engineering, College of Food Technology, Vasantrao Naik Marathwada Krishi Vidhyapeeth, Parbhani, Maharashtra. The Oranges (Nagpur variety) were procured from the local market of the Nagpur, Maharashtra. Refined wheat flour and other ingredients used in cookies preparation were obtained from the local market of the Parbhani.

### *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 microorganisms (vegetative cells). Drying of peel was carried out in an

oven at 50°C for 24 h to improve shelf life of citrus by-products 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.

**Preparation of cookies**

Cookies were prepared by using the standardized recipe and method given by (Shaikh Ishaque *et al.*, 2016).

Table 1. Standardized Recipe for cookies

Ingredient	Quantity (g)
Wheat flour	100.0
Sugar	35.00
Fat	25.0
Salt	1.0
Baking powder	1.5
Ammonium carbonate	0.5

Blends were prepared by mixing orange peel powder, water and refined wheat flour in different ratios on dry weight basis as per the recipe. These blends were standardized for product’s acceptable physical characteristics as well as better nutritive value in the final product. The dry ingredients i.e. composite flour, baking powder etc. were mixed together with the help of commercial sigma blender for 8 minutes with medium speed. A homogenous paste of fat and sugar was prepared in stainless steel pan. The dry mix and homogenous paste of sugar and fat was mixed thoroughly at high speed in commercial sigma blender to obtain uniformly mixed dough. The prepared dough was rolled in a uniform shape of 6 mm thickness and cut into round shape cookies with the help of cutter. These cookies were baked at 175°C for 15 min. Preparation of Cookies was carried out using wheat flour samples replaced separately with 0, 5, 15 and 20 per cent orange peel powder. The method of preparation of cookies is summarized in flow sheet as follows:

Fig. 1 Flow sheet for preparation of cookies

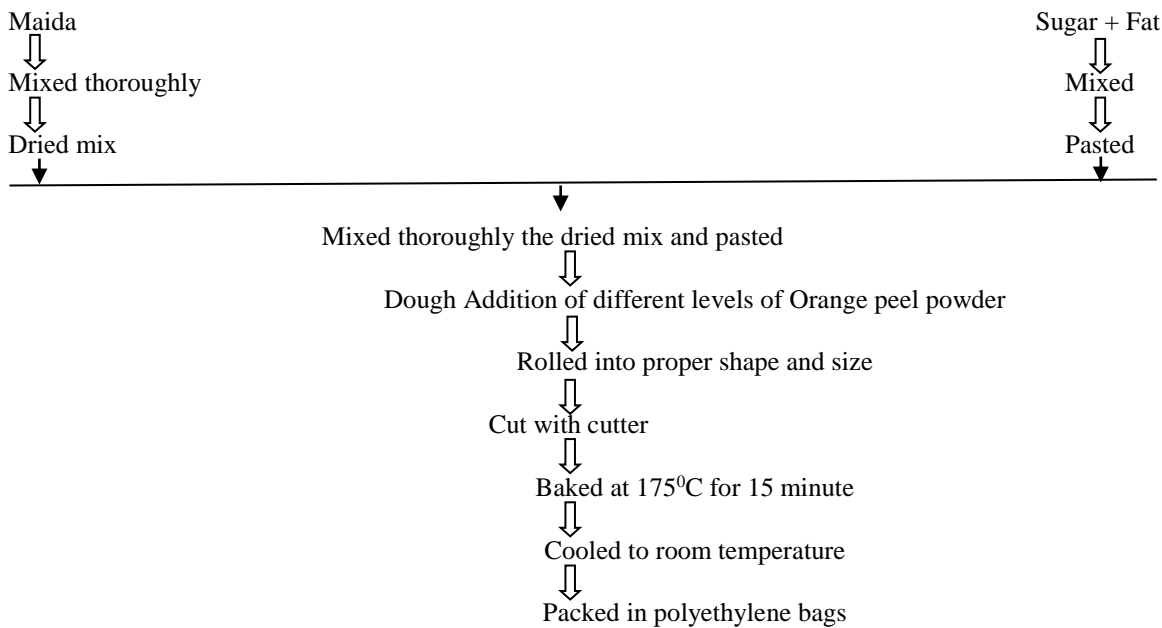


Table 2. Different levels of addition of Orange peel powder in cookies

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:**

The physical properties viz: width, thickness and spread ratio of the prepared cookies were carried out by the process given by the AACC (2000).

**Analytical Methods:**

Proximate composition and dietary fiber 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 cookies:**

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 cookies 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'.

## RESULTS AND DISCUSSION

### Proximate composition of refined wheat flour

Table-3 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

Compositions of refined wheat flour were determined to signify its suitability in preparation of Cookies. The obtained results are summarized in Table 3. 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).

### Proximate Composition of Orange peel powder

Table 4. 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 Fiber	74.14±3.0
7	Indigestible Dietary Fiber	55.47±2.14
8	Digestible Dietary Fiber	19.1±1.1
9	Water holding capacity (g/g)	5.9
10	Oil holding capacity (g/g)	4.0

Proximate composition of orange peel powder presented in table-4 revealed that it contain 9.5 per cent moisture, 5.17 per cent protein, 74.14 per cent total dietary fiber 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).

Table 5. Physical characteristics of orange peel powder supplemented cookies

Sample (%)	Width, W(mm)	Thickness, T(mm)	Spread Ratio (W/T)
Control	58.4	6.53	8.94
5 OPP	56.8	6.72	8.45
10 OPP	55.2	6.8	8.11
15 OPP	53.9	6.71	8.03
20 OPP	52.5	6.61	7.94

OPP: Orange peel powder

Physical characteristics of cookies such as width, thickness and spread ratio are presented in Table 5. The average width of control cookies was 58.4 mm whereas that of substituted cookies varied from 56.8 to 52.5 mm for orange peel powder at 5-20% levels. On the other hand, the average thickness of control cookies was 6.53 mm and for

other supplemented levels, it ranged from 6.71 to 6.61 mm. The changes in width and thickness are reflected in spread ratio which was 8.94 mm for control cookies, and further these values was decreased to 7.94 in orange peel powder cookies.

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

Table 6. Chemical composition of orange peel powder substituted cookies g/100g dry weight basis

Sample (%)	Protein	Fat	Ash	Carbohydrate	TDF	IDF	SDF
Control	9.88	20	0.8	69	2.73	1.75	0.98
5 OPP	8.41	18	1.0	72	7.21	4.9	2.31
10 OPP	7.01	17.1	1.24	73.4	9.00	6.0	3.1
15 OPP	6.71	16.4	1.39	74.8	11.4	6.5	4.92
20 OPP	6.8	15.12	1.42	77.9	13.6	8.4	5.2

TDF: Total dietary fiber IDF: insoluble dietary fiber SDF: soluble dietary fiber

The values (Table-6) 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 cookies total, insoluble and soluble dietary fiber contents increased by increasing the level of Orange peel powder and reached to 13.6, 8.4 and 5.2 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 fibers. The obtained results for the proximate composition and dietary fibers were similar to that of results reported by Nassar *et al.*, (2008) and Kakali Bandyopadhyay *et al.*, (2014).

Sensory Evaluation:

Sensory evaluation of cookies prepared with different levels of orange peel powder as compared to the control cookies is depicted in Table 7. The data revealed that incorporation of orange peel powder has marked improvement in colour, appearance and textural profile of prepared cookies up to concentration of 10 per cent while further increase in concentration results in drastic reduction in appearance, color, 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 cookies which were preferred by panellist members up to 10 per cent while in case of 20 per cent incorporated cookies, excessive grainy appearance secured lower values. The colour characteristics of cookies showed to be darker with increase in concentration of peel powder which enhanced consumer appeal up to 10 per cent of incorporation. Similar trend to that of flavour scores was observed in case of colour values of incorporated cookies. Textural profile plays an important role in justifying the overall acceptability of cookies, In case of peel powder incorporated cookies, slight improvement in crispiness of cookies were observed in samples up to 10 per cent of peel powder, secured better scores however in case of cookies containing 20 per cent of peel powder, the panelists reported dryness of mouth secured least scores. It was found that cookies containing 10 per cent of peel powder found to secure maximum score (8.22) followed by OPP5 (8.09) and control (8.5) while least overall acceptability was observed in OPP20 sample containing 20 per cent of peel powder. On the basis of overall acceptability of cookies, it can be concluded that incorporation of orange peel powder in preparing cookies up to 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 cookies could be overall acceptable with respect to sensorial quality characteristics.

Table 7. Sensory evaluation of cookies

Sample Code	Sensory attributes					
	Colour	Appearance	Texture	Taste	Flavor	Overall acceptability
Control	8.2	8.53	8.31	8.48	8.42	8.5
OPP5	7.20	7.17	8.19	8.13	8.10	8.09
OPP10	7.37	7.28	8.31	8.25	8.23	8.22
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. at 5%	0.182	0.206	0.214	0.161	0.143	0.115

\*Each value represents the average of ten determinations

## CONCLUSION

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

## REFERENCES

- [1] AACC. 2000. Official Methods of Analysis of AACC International, American association of cereal chemists. Washington D.C.
- [2] AOAC. 1999. Official Method of Analysis, Association of Official Analytical Chemists. Washington D.C.
- [3] Block G, Patterson B and Subar A. (1992). "Fruit, vegetables and cancer prevention: a review of the epidemiological evidence". *Nutrition Cancer*. **18**: pp.1-29.
- [4] Braddock R J. 1999. "Handbook of Citrus By-Products and Processing Technology". John Wiley and Sons, Cambridge University Press.
- [5] Food and Agriculture Organization. 2013. "Citrus Fruit: Fresh and Processed Annual Statistics". Available from :<http://www.ars.usda.gov>.
- [6] Gopalan C, Rama Sastri B V and Balasubramanian S C. 2004. "Nutritive Value of Indian Foods". National Institute of Nutrition Press, Indian Council of Medical Research.
- [7] Gorinstein S O, Martín-Belloso, Park Y S and Trakhtenberg. (2001). "Comparision of some biochemical characterstics of different citrus fruits". *Food Chemistry*. **74**: pp.309–315.
- [8] Hooda S and Jood S. 2005. "Organoleptic and nutritional evaluation of wheat biscuits supplemented with untreated and treated fenugreek flour". *Food Chemistry*. **90**: pp. 427- 435.
- [9] Humaira gazalli, Altaf Malik, Henna Jala and Ambreen M. 2013. "Proximate composition of Carrot pomace powder and Apple Pomace powder". *International journal of Food nutrition and safety*. Modern science press. **3**(1): pp.25-28.
- [10] Kakali Bandyopadhyay, Chaitali C and Sagarika B. 2014. "Fortification of Mango Peel and Kernel Powder in Cookies Formulation". *Journal of Academia and Industrial Research* **5** (2):pp. 661-668.
- [11] Nassar A G, AbdEl-Hamied A A and Naggar. 2008. "Effect of Citrus by-Products Flour Incorporation on chemical, rheological and Organoleptic Characteristics of Biscuits". *World Journal of Agricultural Sciences* **4** (5): pp. 612-616.
- [12] Senevirathne M, Jeon Y J and Kim S H. 2009. "Antibacterial effect of citrus press cakes dried by high speed and far-infraradiation drying methods". *Journal of Food Engineering*. **92**: pp.157-163.
- [13] Shaikh Ishaque, Sawate A R, Kshirsagar R B and Zaker M A. 2016. "Studies on exploration of Chia (*Salvia Hispanica L.*) flour and its oil in cookies". *Multilogic in Science*. **6** :pp.128- 134.