Asian J. Dairy & Food Res, 36(4) 2017 : 327-331
Print ISSN:0971-4456 / Online ISSN:0976-0563

AGRICULTURAL RESEARCH COMMUNICATION CENTRE
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Physico-chemical and sensory characteristics of carrot pomace powder incorporated fibre rich cookies

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Received: 19-06-2017 Accepted: 23-08-2017 DOI: 10.18805/ajdfr.DR-1268

ABSTRACT
Fibre rich cookies were prepared by substituting refined wheat flour with carrot pomace powder (CPP) at 5%, 10%, 15%, 20% and 25% and evaluated for its physical properties, chemical composition, textural properties and sensory characteristics. The weight and thickness of the cookies increased whereas the diameter, spread ratio and spread factor decreased with the increase in CPP in flour blend. The moisture, crude fibre and ash content increased whereas the protein and carbohydrate content decreased with the increase in CPP in flour blend. The fat content of the cookies showed no pronounced variation. The hardness of the cookies increased with increase in the level of incorporation of CPP in the flour blends. CPP improved the appearance of cookies by imparting it attractive colour; however the texture score decreased with the increase in the level of supplementation. Cookies with 10 % CPP were found to be most acceptable due to attractive appearance; and better taste and flavour.

Key words: Carrot pomace powder, Cookies, Fibre.

INTRODUCTION

Dietary fibre in diet is gaining lot of importance looking at the present scenario where modern lifestyle has resulted in substantial reduction in the intake of roughage in diet leading to many chronic diseases (Sahni, 2017) like constipation, diverticulosis, cardiovascular disease, and cancer (Trowell *et al.*, 1985). Plenty of fruits and vegetables are used for the extraction of their juices and that produces significant amount of pomace as a by-product. Large quantity of waste obtained after juice extraction from fruits and vegetables is an inexpensive source of dietary fibre having water binding capacity and relatively low enzyme digestible organic matter (Serena and Kundsen, 2007).

Mainly the pomace produced from juice processing finds its use in animal feeding. However, it can be used as a good source of fibre for the valorisation of food products. Carrot is an excellent source of calcium pectate; which has cholesterol lowering properties and thus helps in reducing the risk of high blood pressure, stroke, heart disease and some type of cancer (Bakhru, 1993). Carrot pomace is a by-product obtained during carrot juice processing containing high amount of dietary fibre and even up to 80% of carotene (Bohm *et al.*, 1999). Thus, it can be efficiently utilized for value addition to deliver nutritious, tasty and convenient products having optimal phytochemical and fibre content (Sharma *et al.*, 2012).

Baked products have been widely used for incorporating healthy compounds (Ktenioudaki, 2013) and different plant fibre products are added to various baked food products in order to increase their fibre content (Masoodi *et al.*, 2001). Among bakery products cookies are ideal for supplementation due to palatability, compactness, convenience and long shelf life of the product (Wade, 1988); and being liked by all the segments of the consumers. Thus, it is good carrier for providing a fibre rich product.

The present study was carried out to find out the effect of addition of different proportion of carrot pomace powder on physical properties, chemical properties, texture and sensory characteristics of fibre rich cookies.

MATERIALS AND METHODS

Preparation of carrot pomace powder (CPP): Carrots were washed, de-headed and peeled and subjected to juice extraction. After juice extraction pomace was spread on aluminium trays keeping bed thickness of 0.5 cm and was dried at 65°C for 6 hours in cabinet drier. Dry pomace was pulverized using domestic grinder and sifted through sieve of 250 μm particle size and packed in airtight polypropylene jar and stored in cool and dry place. Flow chart for the preparation of carrot pomace powder is presented in figure1.

Preparation of flour blends: Substitution of refined wheat flour with carrot pomace powder was done at different levels *viz.* 5%, 10%, 15%, 20% and 25%.

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Preparation of cookies: Cookies were prepared using creamery method for making biscuit dough. The ingredients (g) used in preparation of cookies were flour blends 100, fat 45, sugar 60, baking powder 1.5, sodium bicarbonate 1.5, ammonium bicarbonate 1.5 and water as per requirement for making dough. Dough was rolled in sheet of 0.5 cm thickness and cut into circular shape with dye. The pieces were placed in the baking tray smeared with fat and baked at 160°C for 20 min. The cookies were allowed to cool, packed and stored at ambient temperature.

Physical properties: The weight, diameter, thickness, spread ratio and spread factor of cookies were calculated as per AACC (1976) methods. Top grain was visually assessed as a function of number of cracks formed over the surface of the cookies.

Chemical composition: Moisture, crude fat, protein (using the factor 6.25 × N), ash and crude fibre content of different samples of cookies were determined as per standard methods (AACC, 2000). Total carbohydrate was obtained by difference.

Textural properties: Stable Micro System *TAXT2 plus* Texture Analyzer was used for texture profile analysis (TPA) of cookies. The test was configured so that the hardness calculated at the time of the test by determining the load and displacement at predetermined points on the TPA curve. S-5 probe with 20 mm/sec. of pre-test and post-test speeds; and 75% compression were selected for TPA analysis. The maximum force required to break the cookies was noted as hardness.

Sensory Characteristics: The sensory characteristics of cookies were evaluated for its different sensory attributes using ten semi trained panellists. Panellists were given control sample and the experimental samples along with cookies with 25 % oat flour at the time of evaluation. Sensory attributes like colour and appearance, texture, taste, flavour and overall acceptability were evaluated using 9 point hedonic rating (Ranganna, 2011).

Statistical analysis: The data obtained was analyzed statistically to determine statistical significance of treatments. Completely Randomized Design (CRD) was used to test the significance of results (Panse and Sukhatme, 1984).

RESULTS AND DISCUSSION

The effect of incorporation of carrot pomace powder at various levels on physical properties of the cookies is presented in Table 1. Weight of the cookies increased progressively from 19.230 g to 19.511 g with increase in the level of supplementation of CPP. Increase in the weight could be due to water binding capacity of CPP. Increase in the weight of cake with the increase in the incorporation level of carrot pomace was reported by Sharoba *et al.* (2013).

The increased proportion of CPP in flour blend resulted in poor spreading of cookies and progressive decrease in the diameter, spread ratio and spread factor; and increase in the thickness of the cookies. Poor spreading resulted from high viscosity of dough due to absorption of water by CPP; since hydrophilic components of a cookie formula were flour and sugar and addition of CPP lowered water absorption by sugar that increments syrup and cause spreading of cookies (Slade and Levine, 1994). Similar results were reported by Mridula (2011); and Sahni and Shere (2016) for cookies incorporated with carrot powder and beetroot pomace powder respectively.

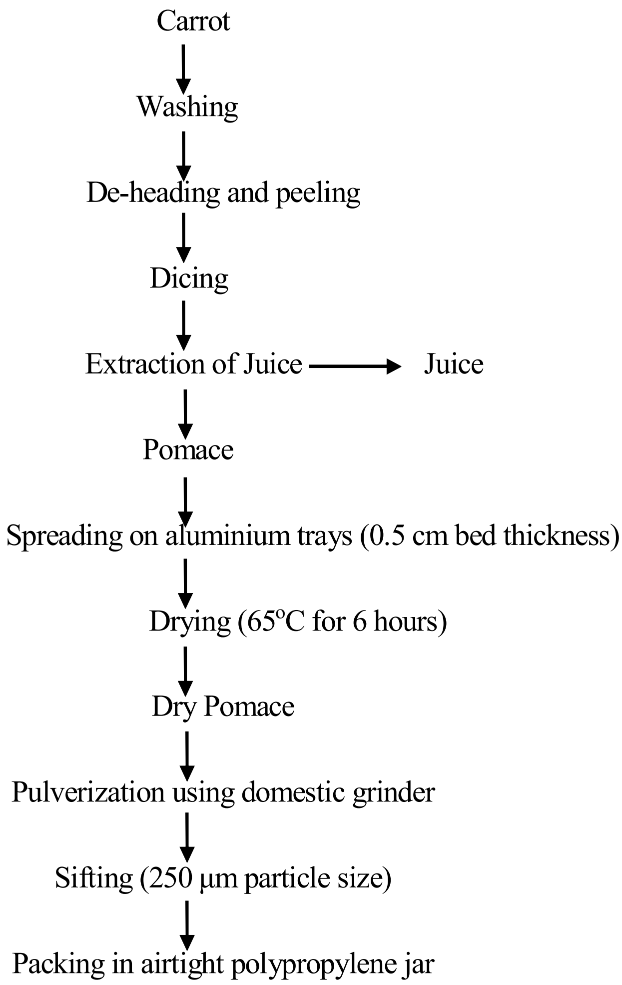


Fig 1: Preparation of carrot pomace powder

Sensory scores of the cookies incorporated with carrot pomace powder are presented in Table 2. The table clearly indicates that colour and appearance of the cookies improved with the addition of carrot pomace powder up to 20 % followed by decrease in sensory score of cookies. CPP imparted attractive colour to the cookies. Texture score of the cookies gradually decreased with the increase in the levels of CPP due to increased hardness and decrease in the crispness of the cookies.

Table 1: Physical properties of cookies incorporated with carrot pomace powder

Sample	Weight (g)	Diameter (mm)	Thickness (mm)	Spread ratio	Spread factor (%)	Top grain Development
C_C	19.230	60.48	14.85	4.07	100	Normal
C_1	19.263	57.34	16.73	3.42	84.02	Most
C_2	19.330	53.83	17.04	3.15	77.39	Most
C_3	19.412	52.42	17.78	2.94	72.23	Rare
C_4	19.474	50.83	18.49	2.74	67.32	Rare
C_5	19.511	49.06	18.69	2.62	64.37	Negligible
SE±	0.011	0.049	0.032	-	-	-
CD at 5%	0.033	0.150	0.096	-	-	-

*Each value is average of three determinations

C_C- 0% CPP C_3-15 % CPP

C_1-5% CPP C_4-20% CPP

C_2-10% CPP C_5-25% CPP

Addition of CPP improved the taste of cookies by imparting it typical carrot taste. Cookies maintained acceptable taste even up to 25 % addition. CPP improved the flavour of cookies due to development of peculiar carrot flavour. Increased intensity of orange colour of crumbs and significant influence on taste and odour of wheat rolls with CPP was reported by Kohajdova *et al.* (2012). Overall acceptability scores of the cookies increased upto 10 % CPP followed by decrease in the score.

In comparison to cookies with 25 % oat flour, cookies with 25 % CPP showed markedly decreased sensory scores. However, colour and appearance of cookies with CPP was found to be better than oat cookies.

The textural characteristics of cookies were measured using Stable Micro System *TAXT2* plus Texture Analyzer and results are presented in Table 3. The hardness of the cookies increased with increase in the level of incorporation of CPP in the flour blends which can be attributed to incomplete development of protein matrix and starch granules due to adhering of fibre particles to them (Hernández-Ortega *et al.*, 2013). The minimum value of hardness (10.232 Kg) was observed in control sample with 0 % CPP and maximum (19.447 Kg) was observed in cookies with 25 % CPP.

Very high values of hardness were obtained for the cookies with higher level of incorporation of pomace powder. This could be attributed to relatively higher water content of incorporated doughs (Ajila *et al.*, 2008). Doughs with higher water content results in formation of gluten network resulting in harder cookies (Gaines, 1990; Labuschagne *et al.*, 1996; Smith, 1972). It is evident from graphs (figure 2) that there was decrease in the number of peaks before peak positive force with the increase in the level of incorporation of carrot pomace powder representing decrease in the crunchiness. Similar progression was observed by Sahni and Shere (2016) for cookies incorporated with beetroot pomace powder.

The effect of incorporation of carrot pomace powder at various levels on chemical properties of the cookies is presented in Table 4. The moisture content of cookies increased linearly with increased level of replacement of CPP in flour blend. The increase in moisture content was due to water holding capacity of CPP causing resultant increase in the water content of dough (Kohajdova *et al.*, 2012).

The fat content of the cookies showed no pronounced variation due to low fat content of refined wheat flour and CPP. Crude fibre and ash content of the cookies increased linearly with the increase in the CPP content in

Table 2: Sensory evaluation of cookies incorporated with carrot pomace powder

Sample	Colour and appearance	Texture	Taste	Flavour	Overall acceptability
C_C	8.3	8.4	7.9	7.9	8.0
C_1	8.7	8.2	8.1	7.9	8.2
C_2	8.9	8.0	8.3	8.2	8.3
C_3	8.9	7.1	7.6	7.0	7.2
C_4	8.9	6.8	7.2	6.7	7.0
C_5	7.2	6.2	6.9	6.2	6.2
O_5	8.5	8.5	8.3	8.1	8.0
SE±	0.033	0.042	0.056	0.053	0.062
CD at 5%	0.094	0.120	0.160	0.152	0.178

* Each value is average of 10 determinations

C_C- 0% CPP C_4-20% CPP

C_1-5% CPP C_5-25% CPP

C_2-10% CPP O_5- 25 % Oat flour

C_3-15 % CPP

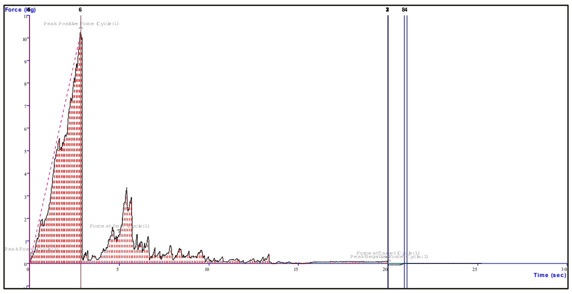
Table 3: Textural properties of cookies incorporated with carrot pomace powder

Sample	Hardness (Kg)
C_C	10.232
C_1	12.892
C_2	14.071
C_3	15.750
C_4	18.310
C_5	19.447

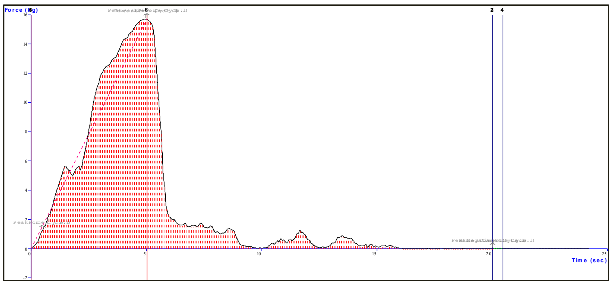
C_C- 0% CPP C_3-15 % CPP

C_1-5% CPP C_4-20% CPP

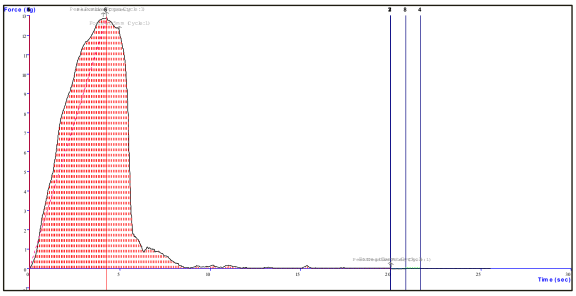
C_2-10% CPP C_5-25% CPP



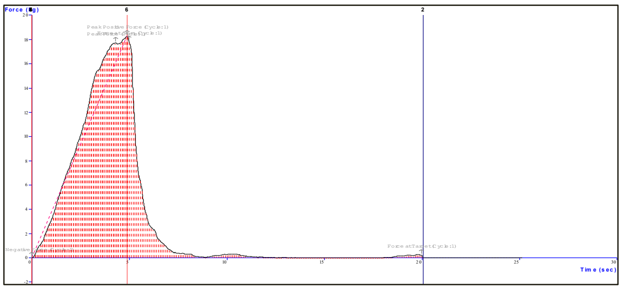
2.1 Representative TPA graph of Control Sample (0 % Incorporation)



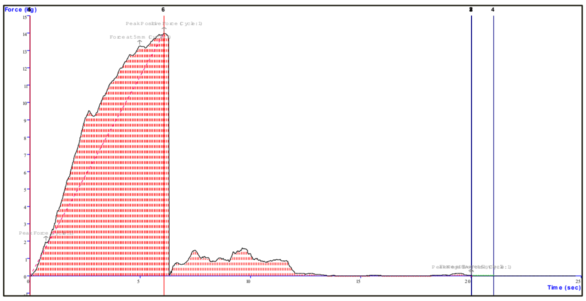
2.4 Representative TPA graph of C_3 (15 % CPP)



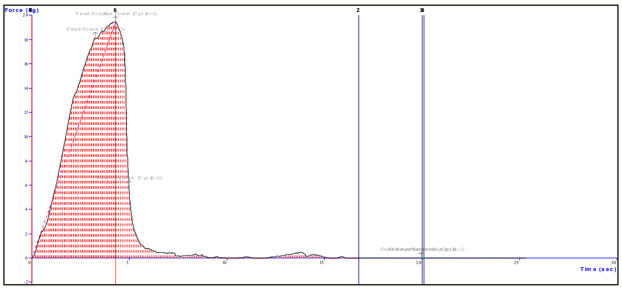
2.2 Representative TPA graph of C_1 (5 % CPP)



2.5 Representative TPA graph of C_4 (20 % CPP)



2.3 Representative TPA graph of C_2 (10 % CPP)



2.6 Representative TPA graph of C_5 (25 % CPP)

Fig 2: Representative graphs of Texture Profile Analysis (TPA) of Cookies

Table 4: Chemical composition of cookies incorporated with carrot pomace powder

Sample	Moisture(%)	Fat(%)	Crude Fibre (%)	Ash(%)	Protein(%)	Carbohydrates(%)
C_C	1.58	23.72	0.40	1.00	5.46	67.84
C_1	1.76	23.76	1.44	1.24	5.25	66.10
C_2	2.08	23.82	2.18	1.32	5.03	65.57
C_3	2.50	23.88	2.88	1.44	4.92	64.38
C_4	2.66	23.92	3.54	1.58	4.81	63.49
C_5	2.78	23.98	4.26	1.68	4.70	62.60
SE±	0.032	0.023	0.029	0.027	0.038	0.042
CD at 5%	0.099	0.069	0.118	0.083	0.116	0.128

*Each value is average of three determinations

C_C- 0% CPP C_3-15 % CPP
C_1-5% CPP C_4-20% CPP
C_2-10% CPP C_5-25% CPP

the cookies. The crude fibre content increased at different levels of replacement (0% - 25 %) ranging from 0.40 % - 4.26 %. Marked increase in fibre and ash content was due to high crude fibre and ash content of CPP.

Protein and carbohydrate content of the cookies decreased linearly with the increase in CPP in the cookies. Since refined wheat flour was having higher protein than CPP, replacement of refined wheat flour by CPP resulted in low protein content in the cookies.

CONCLUSION

Carrot pomace is a valuable by-product obtained from juice processing which can be utilized for valorisation of food products. Incorporation of CPP decreased the spread of the cookies. Incorporation of CPP significantly improved the fibre content of cookies; however, it had detrimental effect on the textural quality of the cookies due to increased hardness. CPP improved the appearance of cookies by imparting it attractive colour. Incorporation of 10 % CPP in cookies was found to be most acceptable. Overall acceptability of the cookies with 10 % CPP was improved due to attractive appearance and better taste and flavour. Thus, CPP can be a source for the fibre enrichment of the cookies.

ACKNOWLEDGMENT

Author is grateful to Indian Council of Agricultural Research, New Delhi for the award of Junior Research Fellowship.

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