

Development Of Carrot Pomace And Wheat Flour Based Cookies

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Carrot is the excellent source of β carotene and other vitamins. The carrot is utilized as raw, cooked vegetable, sweet meats or as juice and beverages. Carrot pomace is the by-product of carrot juice extraction process. The carrot pomace was dried in hot air oven at 65°C and then grinded to pass through 2 mm sieve. Dried carrot pomace was added in different proportions (0 –9%) to fine wheat flour, shortening, sugar and water. The formulation was baked at 175 °C for 12 min. in the gas oven with air circulation. The moisture content of cookies was measured using hot air oven method. The hardness was measured using a texture analyzer (TA-XT2) with the cutting probe in compression mode. The colour of both the sides of cookies was measured using a Hunter's lab color analyzer. The sensory characteristics for colour, taste, aroma and texture were analyzed using Hedonic rating test by ten panelists. It was observed that moisture content varied from 4.03 to 4.79% with an average moisture content of 4.41%. The average L, a*, b* values ranged from 51.535 to 61.206, 11.205 to 15.595, 31.65 to 35.27 with average values of 55.3275, 13.84625 and 34.18375 respectively. Maximum change was observed in L* value followed by a* and b* with respect to control sample. The hardness was ranged from 41.047 to 116.1N with an average value of 81.499N. It was further observed that moisture content, hardness and L*, a* values increased with the increase in proportion of carrot pomace in cookies, whereas no pattern of change was observed in b* value with change in proportion of carrot pomace. Sensory score of all the cookies ranged from fair to very good; whereas the cookies with 6% dried carrot pomace proportion got the highest score. The study indicated that the carrot pomace could be incorporated into ready-to-eat bakery cookies up to the level of 6% as a source of vitamins and dietary fiber.*

Keywords: Carrot pomace, Wheat flour, Texture, Colour, Cookies, Sensory.

1. INTRODUCTION

The total vegetables production in the world was estimated as 240.8 million tones during the year 2007 [1]. Mainly vegetables are consumed as raw or processed to different products. The food processing industry produces large quantities of waste coproducts. About 27.94 million tones of food waste from the food processing industry are produced in the EU only every year [2]. Fruit and vegetable wastes are inexpensive, available in large quantities, characterized by a high dietary fiber content resulting with high water binding capacity and relatively low enzyme digestible organic matter [3]. Due to the high dietary fiber content and contrasting dietary fiber properties, the coproducts could be used to change physicochemical properties of diets. A number of researchers have used fruits and

vegetable by-products such as apple, pear, orange, peach, blackcurrant, cherry, artichoke, asparagus, onion, carrot pomace [4-6] as sources of dietary fibre supplements in refined food. Dietary fibre concentrates from vegetables showed a high total dietary fiber content and better insoluble/soluble dietary fiber ratios than cereal brans [4].

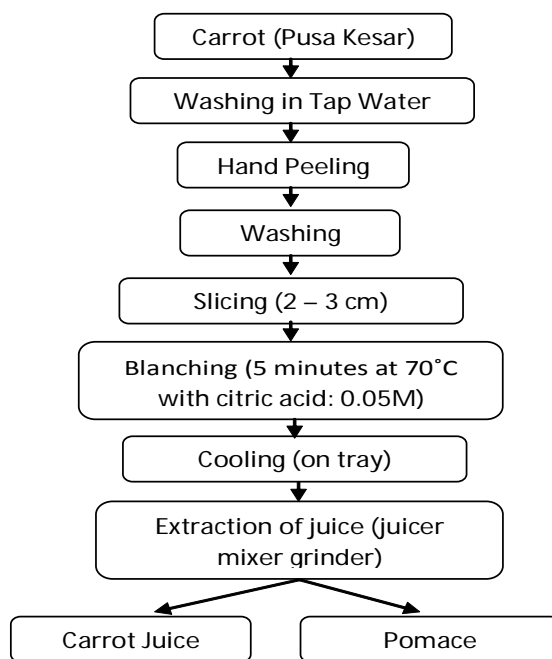
The carrot (*Daucus carota*) is a root vegetable. Carrot is also an excellent source of calcium pectate; an extraordinary pectin fiber that has the cholesterol lowering properties. It has a property to reduce the risk of high blood pressure, stroke, heart disease and some type of cancer [7]. The carrot is mainly consumed as raw, converted to juice drink, used as salads, cooked as vegetable dish, used to make sweet dishes. Fruit and vegetable juices have become important in recent years due to overall increase in natural juice consumption as an alternative to the traditional caffeine containing beverages such as coffee, tea, or carbonated soft drinks [8]. Carrot juice has particularly high content of pro-vitamin A (β carotene) and is also high in B complex vitamins and many minerals including calcium, copper, magnesium, potassium, phosphorus, iron and folic acid. Carrot pomace is a by-product obtained during carrot juice processing. The juice yield in carrots is only 60-70%, and even up to 80% of carotene may be lost with left over carrot pomace [9]. It also has good residual amount of all the vitamins, minerals and dietary fiber. So far the left over pomace, received after juice extraction of carrots, does not find proper utilization. Moreover, vegetable pomace has become a source of environmental problem. The pomace is quite perishable as it contains about $88 \pm 2\%$ of moisture. Drying or dehydration is the useful means to increase the shelf life of perishable food for further use. However, dried carrot pomace has β carotene and ascorbic acid in the range of 9.87 to 11.57 mg and 13.53 to 22.95 mg per 100 g respectively [10].

Bakery product cookies are fast and convenient food based on wheat. There are many varieties of bakery products depending upon the local demand like rusk, cookie, whole flour bread, brown bread, bread fortified with vitamins and minerals, milk bread and bread for diabetic patients. Its consumption is more in cities and towns where industrial working group population is more. Bread and Cookie consumption is increasing day by day and these are being increasingly used for various feeding programs for children managed by voluntary agencies and State Departments of Health. Cookies, which constitute an important item of bakery industry have now become a common item of consumption among all classes of people with tea or coffee, Different variety of cookies are used as one of the tasty and nutritious snacks. Cookies are more popular as a convenient food.

The objective of this study was to incorporate carrot by-products as a source of dietary fiber into wheat flour based cookies. However, the range of process variable was too wide. Reference researches indicate that no published work research on the incorporation of carrot pomace with wheat flour is available.

2. MATERIALS AND METHODOLOGY

Commercial variety (Pusa Kesar) was procured from local market, Meerut, Uttar Pradesh, India. These were washed in running tap water number of times to remove extraneous material. Trashes were removed with a plane stainless steel knife and trimming was also done. A juice mixer grinder cum food processor (Make: Supremo DLX, Maharaja appliance limited, New Delhi, India) was used to extract carrot juice using the following method in Fig. 1 [11]. The pomace was collected for further studies.

Process flow chart of carrot juice extraction**Fig. 1**

A hot air oven (Make: Osaw Industrial Products Pvt. Ltd., Haryana, India) was used for drying carrot pomace, which could regulate drying air temperature upto 250°C with $\pm 2^\circ\text{C}$ accuracy. The dryer consisted of a preheating and heating chamber with thermostat based control unit, an electrical fan, and measurement sensors. The samples were spread over the trays and the temperature of the dryer was set to 60°C. The drying procedure continued till the moisture content of the sample was reduced to about $5 \pm 1\%$ (wet basis). The grinding was performed using the same food processor with grinder attachment. The material was ground to pass through the sieve of 2 mm size. The pomace was stored in sealed polythene bag for further use.

2.1 SAMPLE PREPARATION

Ingredient formulations for extrusion products are given in Table 1. Fine wheat flour was replaced with carrot pomace at levels of 0%, 3%, 6% and 9%. The ingredients were mixed in the same food processor with mixer attachment. The moisture was added by sprinkling distilled water in dry ingredients. All the ingredients were again mixed in the same food processor for 10 minute based on preliminary study.

Table 1 Composition of Carrot pomace cookies

S.No.	Ingredients	Controlled (0%)	3% carrot Pomace	6% carrot Pomace	9% carrot Pomace
1.	Maida(fine wheat flour)	500g	485g	470g	455g
2.	Carrot pomace	Nil	15g	30g	45g
3.	Vanaspati	100g	100g	100g	100g
4.	salt	5g	5g	5g	5g
5.	Sugar	100g	100g	100g	100g
6.	Water	400g	400g	400g	400g

2.2 BAKING OF CARROT COOKIES

The dough was rolled in the form of sheet and cut in to suitable size, mould them square, round and oval pieces. The formulation was baked at 175 °C for 12 min in the gas oven with air circulation and then kept in desiccators for moisture stabilization and allowed to be cooled. The cooled samples were packed in polybags till the evaluation of responses and sensory analysis.

2.3 EVALUATION OF RESPONSES

2.3.1 MOISTURE CONTENT

The moisture content of all the extrudates will be measured by using a hot air oven method [12]. The mass of the empty moisture box was noted in the starting. The wet sample were filled in the boxes, weighed and kept in hot air oven at 100°C for 24 h. The samples were taken out and gain weighed after cooling in desiccators.

$$\text{Moisture Content} = \frac{(\text{Mass of wet sample} - \text{Mass of dry sample})}{\text{Mass of wet sample}} \times 100 \quad \text{--(1)}$$

2.3.2 COLOUR ANALYSIS

The colour of both sides of cookies was measured using a Hunter's Lab colour analyzer. In the Hunter's lab colourimeter, the colour of a sample is denoted by the three dimensions, L*, a* and b*. The L*, a* and b* readings were then recorded in the software provided in a attached PC. The L* value gives a measure of the lightness of the product colour from 100 for perfect white to 0 for black, as the eye would evaluate it. The redness/greenness and yellowness/ blueness are denoted by the a* and b* values, respectively. The colour of the samples was measured after putting the samples in front of smallest aperture.

2.3.3 HARDNESS

Mechanical properties of the extrudates were determined by crushing method using a TA–XT2 texture analyzer (Stable Micro Systems Ltd., Godalming, UK) equipped with a 500 kg load cell. Whole cookie was cut with a probe cutting probe at a crosshead speed 5 mm/s to 3 mm of 90% of width of the cookie. The compression generated a curve with the force over distance. The highest first peak value was recorded as this value indicated the first rupture of cookie at one point and this value of force was taken as a measurement for hardness.

2.3.4 SENSORY CHARACTERISTICS

Sensory analysis was conducted for all the samples. Twelve panelists were asked to assess the expanded snacks and mark on a Hedonic Rating Test (1 – Dislike extremely, 5 – Neither like nor dislike and 9 – Like extremely) in accordance with their opinion for taste, texture, color and overall acceptability.

3. RESULT AND DISCUSSION

3.1 MOISTURE CONTENT

It was observed that moisture content varied from 4.03 to 4.79% with an average moisture content of 4.41%. It was also observed that the moisture content cookies increased with the increase in pomace level, which may however result in storage life. This may be due to carrot pomace characteristics in the cookies.

3.2 COLOUR ANALYSIS

The average L^* , a^* , b^* values ranged from 51.535 to 61.206, 11.205 to 15.595, 31.65 to 35.27 with average values of 55.3275, 13.84625 and 34.18375 respectively. Maximum change was observed in L^* value followed by a^* and b^* with respect to control sample as shown in Fig. 2.

Variation of colour (L^* , a^* and b^* values) with addition of carrot pomace

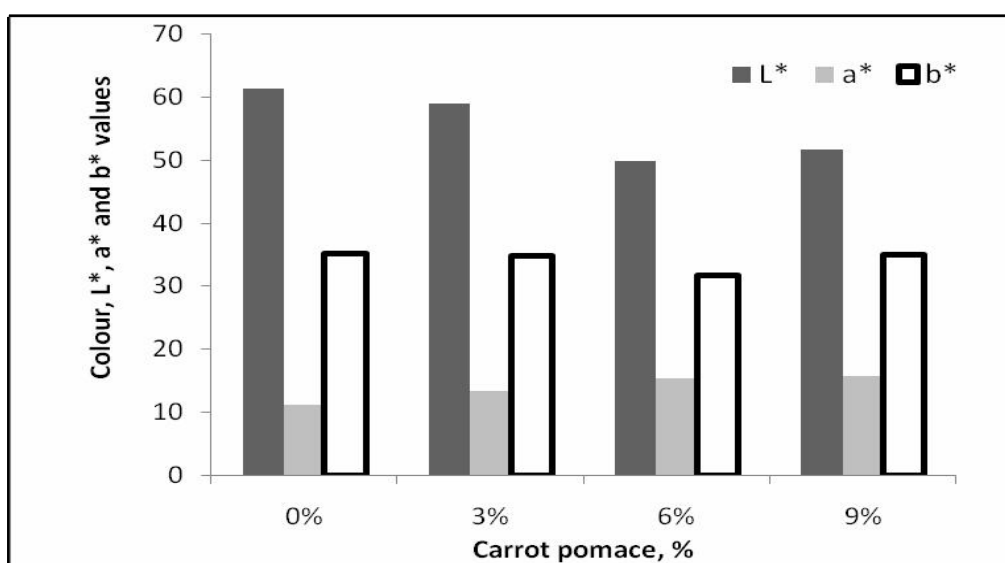


Fig. 2

It can be observed from Table 2 that F values for L^* and a^* were 42.41 and 16.18 against critical F value of 6.59, showing that the changes in L^* and a^* were significant ($P < 0.05$), however F value for b^* was 3.76, signifying that the changes in b^* was not significant. Since L^* value was reducing, signifying that the colour becomes darker as the pomace level increased in the cookie, which may be due to comparatively darker colour of carrot pomace. Increase in a^* signifies the increase in redness, which is evident from the color of carrot pomace. Similar change in L^* and a^* values due to presence of carrot pomace in extrudates also have been reported by Kumar et al [13, 14].

Table 2 ANOVA for color analyzer

Source of Variation	SS	df	MS	F	P-value	F crit
L^* value						
Between Groups	185.1955	3	61.73182	42.41352	0.001724	6.591382

Source of Variation	SS	df	MS	F	P-value	F crit
Within Groups	5.8219	4	1.455475			
Total	191.0174	7				
a* value						
Between Groups	24.41844	3	8.139479	16.1871	0.010579	6.591382
Within Groups	2.01135	4	0.502838			
Total	26.42979	7				
b* Value						
Between Groups	17.40714	3	5.802379	3.763594	0.116506	6.591382
Within Groups	6.16685	4	1.541713			
Total	23.57399	7				

Significant level = 0.05

3.3 HARDNESS

The hardness was ranged from 41.047 to 116.1N with an average value of 81.499N as given in Table 3. The F value of 530.88 against F critical 6.59, indicates that the change is significant ($P < 0.05$). The hardness increased with the in pomace percentage, whereas the hardness decreased at the higher level of pomace. The increase in hardness may be attributed to fibrous pomace, which may be decreased at 9% due to higher moisture content in the cookies.

Table 3 ANOVA for hardness

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	5888.943	3	1932.742	530.8837	1.18E-05	6.591382
Within Groups	1.735155	4	3.640614			
Total	5890.678	7				

Significant level = 0.05

3.4 SENSORY CHARACTERISTICS

Sensory score of all the cookies ranged from fair to very good; whereas the cookies with 6% dried carrot pomace proportion got the highest score. The study indicated that the carrot pomace could be incorporated into ready-to-eat bakery cookies up to the level of 6% as a source of vitamins and dietary fiber.

4. CONCLUSION

It was observed that the average score for sensory was from fair to very good. This signifies that carrot pomace may be used as a source of dietary fiber and vitamin in wheat flour based cookies. The average L^* , a^* , b^* values ranged from 51.535 to 61.206, 11.205 to 15.595, 31.65 to 35.27. The hardness was ranged from 41.047 to 116.1N. The optimized product from sensory analysis was obtained at 6% of flour proportion of carrot pomace. The final recommendation from the study is to use 42.5% wheat flour, 2.7% carrot pomace, 9% vanaspati, 0.5% salt, 9% sugar and 36.2% water for the development of carrot pomace and wheat flour based cookies.

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