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Dietary Fiber and Mineral Enriched Carrot Pomace Powder Bread

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Abstract

Carrot pomace(CP) isa by-productof carrotjuiceprocessing industry. It contains largeamounts of dietary fiberand other valuable compounds.Dryingincreasethe shelf life of CP.Consumption of bakery products increasing but that contain negligible fiber and minerals therefore, continuous consumption may lead to major chronic diseases and mineral deficiencies.Bakery products easily modified into therapeutic products. Therefore, the present study was planned to develop bread enriched with fiber and minerals using CP and evaluate its nutritional composition. For that, CP was dried,ground, sieved to 240 (CPP), packed in polythene bag and stored until used. For product optimization Maida was replaced with 2,4,6,8 and 10% CPP in the commercial bread formula and evaluate sensorily (6penalistsX3times) using 9 point hedonic scale. The processing changes include increased proofing temperature and decreased time and vice-a-versa in baking.6% CPP replacement resulted into pour volume & texture. Thus CPP replacement level narrowed down to 1,2,3,4 and 5% for primary selectionand3.5, 4 and 4.5% for final selection using composite scoring test. The 4% CPP replacement scored highest. That is considered as Experimental Bread (EB). A consumer survey showed that 87.5% liked EB. Raw material, control and experimental bread were analysed for various nutrients using standard methods. The carbohydrate, calorie and protein content of CPP found about three fourth, third fifth and half as compared to Maida because of very high content of fiber. EB contains 238% more fiber and 32% more ash while 47% lesser energy then CB.

Keywords: Health food; bread; Carrot pomace; High fiber food; Mineral enrichment

Introduction

Carrot pomace, a by-product of carrot juice processing industry, contains large amounts of valuable compounds including dietary fiber. Thus could be explored in the development of food ingredients and dietary supplements.[1] Bakery products bear negligible fiber therefore its continuous consumption may lead to chronic diseases. Increasing health consciousness and easy modification of bakery products has led to their development as the therapeutic products.[3] Few authors used carrot pomace to develop cookies but hardly used for other bakery products. Therefore, a study was planned to develop the carrot pomace bread on the sensory characteristics. The fiber, mineral and nutritional composition of bread were studied.

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Materials and Methods

Preparation of Carrot Pomace Powder

Carrot pomace produced as by product after juice extraction as a part of experiential learning for the students for commercial purpose was collected

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from the Center of Fruit Processing, Department of Horticulture, B A College of Agriculture, Anand Agricultural University, Anand, Gujarat, India. For juice extraction, carrot (*Daucus carota*) was obtained from the local market, cleaned, peeled, grated, juice extracted in juicer. The pulp left was dried and converted to powder as shown in Fig. 1 and used for further analysis and product development.

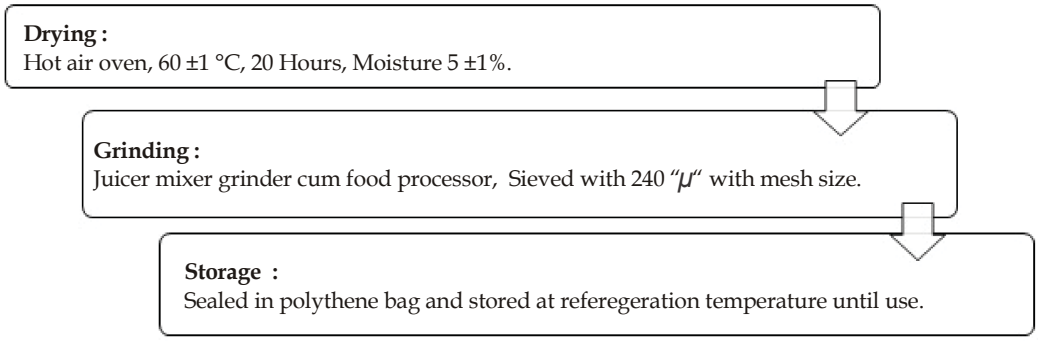

Fig.1:Processflow chartofcarrot pomace drying

Product Development

Bread was developed in the laboratory following scientific method as detailed below.

Recipe Optimization

Good quality raw materials were purchased from the local market, cleaned, packed in airtight PET jar and stored at refrigeration temperature until used. Maida was replaced with 2, 6, 8 and 10% of CPP in the commercial bread formula[4] using no dough time method of bread preparation. Repeated trials with changes in quantity of raw materials (yeast, water and acetic acid) as well as processing conditions (time and temperature for proofing and baking) were carried out to standardize the recipe.

Sensory Evaluation

The breads prepared using the adopted formula were sliced, randomized and presented to the panelists for evaluation of sensory characteristics. The breads were evaluated first for initial acceptability using a 9 point hedonic scale (6 members X 3 replications) on the day of preparation (i.e. day 0). For this, products were served on randomly coded paper plates at room temperature. Panelists were supplied with tap water for cleansing the palate between samples. Product evaluation was carried out under 'day light' illumination and in isolated booths within the laboratory.

Preliminary Screening

The ranks of hedonic rating were converted to scores and analysed statistically. The bread that scored the highest among CPP incorporated bread was selected for further refinement. Replacement rate of newly introduced raw ingredients were narrowed down in such a way that percent replacement of CPP of "selected product" remains some were in the middle.

Primary Selection

On the bases of these results, Maida was replaced with 1 to 5 % (with 1% interval) CPP for primary selection. That was carried out again by sensory evaluation but using a composite scoring test on the day of preparation. The sensory evaluation performa used was developed on the basis of Pyler.[9] A sensory judging panel was constituted with six panelists from among the faculties, staff and students of the School of Baking, Polytechnic in Food Science, College of Food Processing Technology as well as Dairy Science.

The panelists evaluated volume, colour and nature of crust, symmetry of shape and uniformity of bake and shape, texture and grain, crumb colour, taste and aroma and overall acceptability. Bread prepared using the commercial formula (i.e. 0% CPP) served as the control bread (CB) and was used for comparison. The bread that scored the highest among CPP incorporated bread was selected for final selection. Replacement rate of newly introduced raw ingredients were narrowed down in such a way that percent replacement of CPP of "selected product" remains some were in the middle.

Final Selection

For that, trials of bread preparation were carried out by replacing CPP with Maida at 3.5, 4 and 4.5% and evaluated as similar to primary selection. The bread ranked highest overall acceptability considered as the Experiemental Bread (EB) and used for subsequent study.

Consumer Survey

Once after evaluation by experts the consumer survey was carried out through sensory evaluation using five point hedonic scale. Total 200 respondent from among faculty members of Anand Agricultural University were randomly selected. Out of that 113 respondent assigned their selection. The samples were provided almost similar fashion to preliminary screening at a time of meeting.

Nutritional Evaluation

Maida, CPP, CB and EB were analysed for various nutrients namely moisture, protein (macro-Kjeldahl method), fat (soxhlet method), carbohydrate (anthrone method), energy (calculated), fiber (by digestion) and ash (muffle furnace burning) using standard methods.

Data Analysis

The standard SPSS program was run to analyse the data. All the data were tested for significance using the ANOVA / Duncan's test.[11]

Results and Discussions

Present study was planned to develop value added bread using CPP and also to assess its nutritional quality. The results obtained are discussed below.

Recipe Optimization

When Maida was replaced with CPP in the CB formula, quantity of yeast and acetic acid was increased from 1.5 to 1.75 % and 0.04 to 0.05 %, respectively in order to speedup the proofing. For the same purpose proofing temperature was increased from 37°C to 50°C. As a result proofing time was decreased by 10 minutes. The baking was carried out at 220°C for 15 minutes instead of 205°C for 20 minutes.The final formula and process flow chart adopted for bread processing is described in Table 1 and Figure 2, respectively

Preliminary Screening

The bread prepared by replacing 6 % CPP resulted in to pour volume and texture when judged using nine point hedonic scale during preliminary screening. Therefore, it was decided to prepare bread with 1 to 5 % (with 1% interval) CPP replacement level for primary selection.

Primary Selection

Composite scoring test was conducted for the selection of replacement level of CPP. CB containing no CPP scored the highest for all the sensory attributes studied. A decreasing trend in all the sensory attributes was also observed upon increasing the levels of CPP replacement. However, bread prepared using 4% replacement of CPP scored the highest among all the CPP replaced bread. Therefore, it was decided to prepare bread with 3.5, 4 and 4.5% CPP replacement level for final selection.

Final Selection

It can be seen from Table 2 that Volume of the CPP replaced breads scored more than acceptable with no significance difference but were significantly differ with CB. Similar the case with the Colour and nature of the crust as well as Symmetry of shape and uniformity of bake characteristics. The Crumb colour, Texture and grain and Taste and aroma of the CB differ significantly to the 4 and 4.5% CPP replaced breads but found acceptable by the panel of judges. Overall acceptability of bread prepared with 3.5 and 4% CPP replacement were significantly different than CB while bread with 4.5% CPP replacement significantly differ than all the three breads.

It is also observed that all the characteristics were increased initially upon increasing the CPP replacement level in bread preparation and there after decreased. Similar observations for overall acceptability were made by K shitij[5] while developing bun adding CPP. The bread prepared with 4% CPP replacement scored highest in all the characteristics among all CPP replaced breads and found acceptable i.e. scored more than half of the maximum score. However, Kshiti[5] suggested to use 2.5% CPP proportion for the development of buns while Navneet[8] and Shyamlal[10] concluded that CP can be used up to 6% and 8% level respectively, to incorporate into cookies as a source of dietary fiber.

Consumer Survey

Most of the faculty members (87.5%) found the EB acceptable i.e liked excellent, very good and good and was found at with the CB in all the likings. The detail liking of CB and EB are represented as Chart 1.

Nutritional Composition

The carbohydrate, calorie and protein content of CPP found about three fourth, third fifth and half as compared to *Maida* because of very high content of fiber. Proximate composition for *Maida* found more or less similar to reported by Baljeet.[2] Similarly ash content (3.15%) of CPP found almost equivalent (3.2) to reported by Baljeet[2] and protein content (5.51) found nearer to reported by Shyamlal

[10] as well as Ajay[1] i.e. 6.50 and 4-5%, respectively. Similarly fiber content (65.16%) estimated was also nearby reported (72.80%) by Baljeet[2] but quite higher to reported by Shyamlal[10] as well as Ajay[1] i.e.44.75% and 37 to 48%, respectively. These may be due varietal difference.

The fiber content of EB was found three times higher as compared to CB due to addition of CPP containing 65.61% total fiber. Shyamlal.[10] were also observed more than two and half times increase in fiber level in cookies developed by replacing *Maida* with 4% CPP as compared to cookies prepared without replacement of CPP. The energy value were reduced to half in EB as compared to CB. Both the situations have beneficial effect on chronic diseases. The ash content was 1.3 times higher in EB then CB. The results are supported by Shyamlal[10] who observed 1.6 times higher ash in 4% CPP replaced cookies then control. Thus the developed bread might be useful in some mineral deficiencies as nutraceuticals. Nutritional composition of principle raw ingredients as well as commercial and developed breads are depicted in Table 3. However, the percent change in selected nutrients are graphically represented in Chart 2.

Table 1: Formula for control and carrot pomace powder replaced breads

Product Ingredients	**Quantity (baker's percentage)**	
	Control Bread	**CPP Replaced Bread**
	(A)	(C)
Flour	100	96.0
CPP	Nil	4.0
Oil	2.0	2.0
Sugar (powdered)	5.0	5.0
Yeast (Dry)	1.5	1.75
Gluten	1.0	1.0
Salt	2.0	2.0
Water	64	70
Acetic acid	0.04	0.05
Processing conditions	**Temperature**	**Time (minute) /use of**
Weighing	RT	15
↓		
Kneading	RT	20, Spiral mixer
↓		
Scaling	RT	Cutter
↓		
Rounding	RT	Hand
↓		
Intermediate proofing	37° C	10, Proover
↓		
Moulding and Panning	RT	5
↓		
Proofing	37° C(C)	60 Proover
↓	50° C(E)	50 Proover
Baking	205°C(C)	20 Oven
↓	220°C (C)	15 Oven
Cooling	RT	60 Cooling rack
↓		
Slicing and Packing	RT	5, Slicer

Fig. 2:Process fFlow chart for control and experimental bread

Table 2: Sensory (composite) scores of breads prepared by replacing *Maida* with different levels of carrot pomace powder

Characteristic Product	Volume (15)	Crust character$ (5)	Shape and bake@ (10)	Crumb colour (10)	Texture and Grain (30)	Taste and aroma (20)	Overall acceptability (10)
Control #	13.25^{a}± 0.17	4.40^{a} ± 0.05	8.83^{a}± 0.11	8.83^{a}± 0.09	26.75^{a}± 0.25	17.94^{a}± 0.18	8.97^{a}± 0.11
3.5 % CPP	10.33^{b}± 0.29	3.69^{b}± 0.10	7.05^{b}± 0.15	7.00^{c}± 0.19	21.00^{c}± 0.72	13.77^{c} ± 0.35	6.88^{b}± 0.22
4.0 % CPP	11.08^{b}± 0.32	3.77^{b}± 0.07	7.66^{b}± 0.14	7.77^{b}± 0.10	22.66^{b} ± 0.36	14.77^{b}± 0.32	7.33^{b}± 0.14
4.5 % CPP	10.91^{b}± 0.23	3.77^{b}± 0.07	7.66^{b}± 0.16	7.44^{b}± 0.16	22.16^{b} ± 0.35	14.66^{b} ± 0.28	7.22^{c}± 0.12
'F' Value	23.56**	18.41**	27.10**	28.64**	29.51**	38.01**	34.11**
CV%	0.10	0.08	0.08	0.08	0.08	0.08	0.09

CPP = Carrot Pomace Powder # Control = 100% Maida (Baker's %),
$ Crust character = Colour and nature of the crust
@ Shape and bake = Symmetry of shape and uniformity of bake
All the replacements are based on baker's percentage
Values are Mean ±SEM scores of a composite scoring test by a panel of 6 judges X 3 replications
Means bearing the same superscript within the column do not differ significantly ($p \leq 0.05$) ** $p \leq 0.01$
Values in parentheses indicate number of maximum score

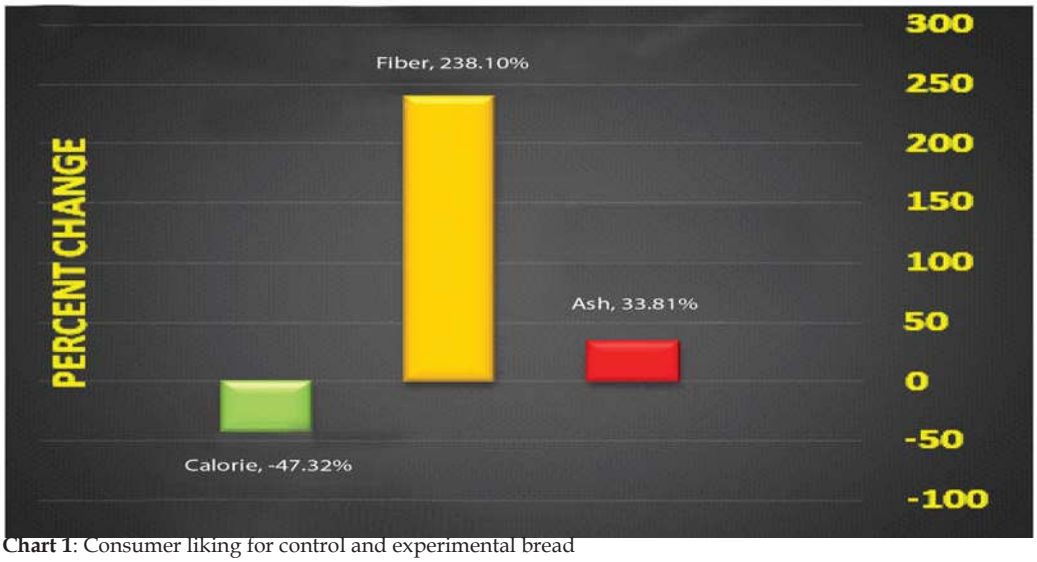

Chart 1: Consumer liking for control and experimental bread

Table 3: Nutritional composition of control and experimental bread

Nutrient	Flour	CPP	Control Bread	Experimental Bread	% Change
Moister (g%)	13.12 ± 0.12	8.10 ± 0.09	36.36 ± 0.25	36.23± 0.31	- 0.36± 0.09
Protein (g%)	11.28± 0.15	5.51± 0.04	11.37± 0.11	11.32± 0.15	- 0.44± 0.06
Fat (g%)	1.57± 0.01	2.12± 0.02	3.81± 0.02	3.90± 0.10	2.36± 0.10
Carbohydrate (g%)	85.39± 1.10	24.06± 0.54	83.13± 0.63	80.38± 0.82	3.31± 0.07
Calorie (K. Cal.)	400.82± 10.10	156.33± 4.82	494.96± 9.35	260.75± 4.50	- 47.32± 0.10
Fiber (g%)	1.08± 0.10	65.16± 1.80	1.05± 0.01	3.55± 0.12	238.10± 6.85
Ash (g%)	0.68± 0.01	3.15± 0.02	0.64± 0.05	0.85± 0.10	32.81± 0.08

CPP = Carrot Pomace Powder

Values are Mean ±SEM of 3 replications,

All the data except moisture is reported on dry weight bases

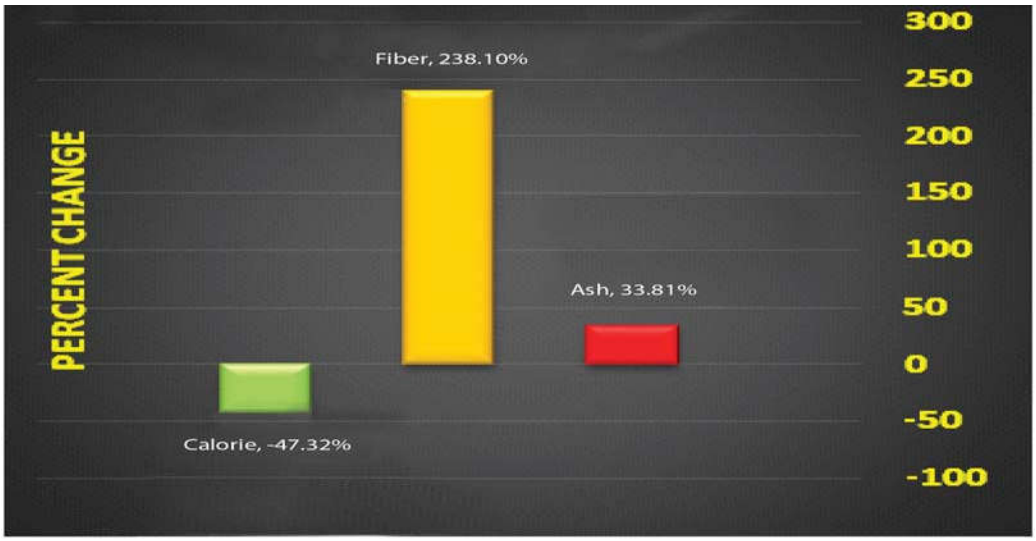

Chart 2: Percent change in selected nutrientsof experimental over control bread.

Conclusion

An acceptable quality high fiber bread by replacing maximum 4% *Maida* with CPP could be prepared by the optimized formula and procedure. It contains 238% more fiber and 33% more minerals while 47% less energy as compared to CB. Thus it may be useful in the dietary management of patient suffering from diabetes, hypercholestremia, constipation etc. chronic diseases as well as might be useful as nutraceuticals in some mineral deficiencies.

Future Scope

Like bread other bakery products such as biscuits, cookies, cakes and pastries could be modified to make it more fibrous, that may be useful for life style diseases.

References

1. Ajay Kumar Maurya, Rajendra Kumar Pandey, Dipti Rai, et al. Waste Product of Fruits and Vegetables Processing as a Source of Dietary Fibre: A Review. Trendsin Biosciences 2015; 8(19): 5129–5140.
2. Baljeet, SY, Ritika BY, Reena K. Effect of incorporation of carrot pomace powder and germinated chickpea flour on the quality characteristics of biscuits. Int Food Res J 2014;21(1): 217–222
3. Kamaliya K, Rema Subhash. Clinical evaluation of wheat bran bread for dietary management of diabetics through glycemic index. Int J of Food, Nut and Diet 2016; 4(1):5–10.
4. Kamaliya MK, Kamaliya KB. Baking Science and Industries, 1st edn. Anand, India: MK Kamaliya; 2001 pp 474–586.

5. Kshitij Kumar, Navneet Kumar. Development of vitaminand dietaryfibreenrichedcarrotpomaceandwheatflourbasedbuns. JPAST 2012; 2(1):107–115.
6. KumarN,KumarK.Development ofCarrotPomaceandWheatFlourBasedCookies.JPAST 2011; 1(1):5–11.
7. Larmond E. Laboratory Methods for Sensory Evaluation of Foods. Ottawa, Canada: Department of Agriculture; 1977 Publication No. 1637 pp 74.
8. Navneet Kumar, Kshitij Kumar. Development of carrot pomace and wheat flour basedv cookies. JPAST2011; 1(1) :5-11.
9. Pyler EJ. Baking Science and Technology, 3rd edn. Kansna, Missouri: Sosland Publishing Co.; 1988 pp 903–904.
10. Shyamala Bellur, Nagarajaiah, Jamuna Prakash. Nutritional composition, acceptability, and shelf stability of carrot pomace-incorporated cookies with special reference to total and β-carotene retention. Cogent Food and Agriculture: Food Science and Technology2015, 1: 1039886, 1–10.
11. Steel RGD, Torrie JH. Principles and procedures of statistics, New York: Mcgraw Hill Publication; 1980 pp 25–27.