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# EVALUATION OF NUTRITIONAL AND PHYSICO-CHEMICAL CHARACTERISTICS OF DIETARY FIBRE ENRICHED WITH CARROT POMACE PASTA

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**ABSTRACT:** Fibre rich pasta were prepared by substituting refined wheat flour with carrot pomace powder (CPP) at 5%, 15%, and 25% and evaluated for its physical properties, chemical composition, textural properties and sensory characteristics. The fat content of the pasta showed no pronounced variation. The hardness of the pasta increased with increase in the level of incorporation of CPP in the flour blends. CPP improved the appearance of pasta by imparting it attractive colour; however the texture score decreased with the increase in the level of supplementation. Pasta with 15% CPP was found to be most acceptable due to attractive appearance; and better taste and flavour.

**INTRODUCTION:** Pasta is having wide spread acceptance in the present food habits. There are some issues related to Health studies on carrot have shown beneficial effects across a wide range of areas including cardiovascular health, eye health, liver health and cancer protection. These studies give us confidence in the ability of carrots to provide support for a wide variety of body systems. However, it is also important to note studies on carrots also have some limitations at this point in the research process. For example, researchers often analyze carrots as part of a larger food group (for example, yellow/orange vegetables) rather than focusing on them specifically. In addition, many of the studies that we have seen on the health benefits of carrots have been conducted using mice and rats rather than people, or depend on analysis of human cell lines in a laboratory setting.

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The ability of carrots to provide cancer-protective benefits has been and continues to be an active area of research on this root vegetable [1]. Of special interest in this area are components of carrot called polyacetylenes. Carrots have the ability to take their fatty acids and convert them into molecules called polyacetylenes. Yield and quality of carrot juice extracted by pressing is varied with the pre-treatment conditions such as pH, temperature and time [2].

These polyacetylenes include molecules like falcarinol and falcarindiol. Polyacetylenes provide carrots with protection from microorganisms, including fungi and bacteria, and they have also shown anti-cancer properties in lab and animal studies. Lymphocytic leukemia and colorectal cancer are two of the cancer types that have been studied in relationship to carrot polyacetylenes. Total dietary fibre is the part of a plant that is resistant to intestinal digestion in human large intestine. The beneficial effects of total dietary fibre on human health and body function are well-documented, thus a high consumption of dietary fibre is associated with a reduced incidence of common disorders and diseases in developed societies [3]. Studies on the benefits of carrots for eye health have not usually focused on carrots themselves, but on carotenoids as a group of nutrients and carotenoid levels in the bloodstream. However, we have seen some small-scale studies in which participants with greater carrot consumption had lower rates of glaucoma than participants with little carrot intake. (The term "glaucoma" refers to a condition involving damage to the optic nerve that is often associated with excessive pressure inside of the eye). Glaucoma-lowering benefits in one study were associated with two weekly servings of carrots. We have also seen several studies on risk of cataracts and intake of carrot extracts [4]. One of these studies identified a specific phytonutrient in carrots-geranyl acetate - as a substance likely to be involved in cataract protection.

Over time, we expect to see more studies on humans and meal plans that include carrots, and we also expect to see a wide range of health benefits that extends across many body systems [5]. Many of these phytoalexins can be removed by peeling carrots prior to processing [6]. Pasta products, largely consumed all over the world were traditionally manufactured from durum wheat semolina, known to be the best raw material suitable for pasta production [7]. The main by-product of carrot is carrot pomace, generated during juice extraction. The peel removed prior to processing (epidermis and lateral roots mainly) and discarded carrots due to inferior quality can be utilized as cattle feed and for the extraction of other important functional components, *i.e.* pectin, organic acids, and biogas. Pulses flour increased the protein, fibre and sugar content of the pasta keeping the fat at optimum level. Fortification increased the cooking time, and stiffness of the samples than control. Fortified pasta was highly acceptable with respect to sensory attributes and cooking time [8].

In carrot juice production up to 50% of the raw material remains as pomace which is mainly disposed as feed or manure [9]. Carrot pomace is a good source of vitamins, dietary fiber and carotenoids, therefore can be utilized as a source of valuable bioactive and functional compounds. Carrots do not supply a significant amount of calories to the human diet, but do supply nutrition in the form of phytochemicals, such as carotenoids, anthocyanins, and other phenolic compounds [10]. Dried carrot pomace powder, which can be stored for a long time, can change the textural attributes of the food products along with nutrient potential. Thus the waste from carrot juice could be utilized as raw material for preparation of gazrella during the off season [11]. The increased intake of antioxidant-rich fruits and vegetables assist in reducing the risks of cancer and cardiovascular diseases. Carrot is a rich source of calcium pectate; an extraordinary pectin fiber that has the cholesterol lowering properties. Carrot (*Daucus carota*) is an important root vegetable, and usually used for juice production, and there is a steady increase in carrot juice consumption [12].

## MATERIAL AND METHOD:

**Procurements of Raw Material:** Carrot pomace powder (CPP), grinded and sundried and wheat flour (*Triticum aestivam*) was procured from local market.

**Evaluation of Physicochemical Properties of Raw Material:** The content of protein was determined as per (IS: 7219:1973): Kjeldhal method, protein content was obtained by using the conversion factor of 6.25, crude fibre was determined by (IS: 11062) and carbohydrate content by difference method, ash and fat content were determined according to AOAC 2000 methods.

**Sample Preparation:** Four Samples (C, C1, C2, and C3) were prepared using sample C as control containing only refined wheat flour (100%), while sample C1, C2 and C3 were prepared using different concentration of refined wheat flour and carrot pomace powder. Proximate composition and concentration of different raw materials taken in the preparation of control (C) and other samples (C1-C3) is shown in **Table 1**. All the samples were passed separately through sieve no. 10 thrice to improve the mixing. Prepared samples were stored in an air tight polyethylene bag in cool and dry place for further study.

**TABLE 1: CHEMICAL COMPOSITION OF RAW MATERIALS**

| Ingredient | Sample | | | |
|---|---|---|---|---|
| | C | C1 | C2 | C3 |
| Refind wheat flour | 1000 | 950 | 850 | 750 |
| CPP | - | 50 | 150 | 250 |

**Pasta Preparation:** Different samples of pasta (C, C1, C2 and C3) were prepared using different concentrations of refined wheat flour and Carrot pomace powder in the ratio of 100:00; 95:05; 85:15, 75:25 respectively. In each case, an amount of 1000 g of the respective composition was taken for the preparation of pasta. Refined wheat flour and carrot pomace powder were mixed with optimum amount of water in the mixing chamber of pasta extruder (Le Monferrina Masoreo Arturo and C.S.N.C., Italy) for 10 min to distribute the water uniformly. The moist flour aggregate was extruded through pasta extruder fitted with an adjustable die. The speed of revolving sharp blade cutter in the front of the die was adjusted so that the length of the pasta finished at 2 cm for each sample. Drying of final pasta sample was carried out in hot air oven at 75 ºC for 3 h. The dried product was packed in polyethylene bags. The main objective of the drying was to reduce the moisture content of the sample to about 8-10%.

Final dried products of various samples were packed in high density polyethylene bags. The resultant dried products were then used for further study such as cooking time, chemical composition, viscosity, texture and sensory analysis.

**Evaluation and Optimization of Pasta Samples:** The developed pasta products were analyzed for their different quality parameters. The cooking quality of samples was determined by the minimum cooking time as per AACC 2000. Rapid visco analyzer (RVA) was used to determine the pasting properties of raw material of pasta products. The texture of the product was determined with the help of stable micro system texture analyzer TA-XT2i. It was used in cutting mode to record the required force to cut the pasta sample. Sensory evaluation was carried out as per 9 point hedonic scale with the degree of liking: 1 = extremely dislike, to 9 = extremely like. Each pasta sample was cooked separately in a stainless steel pan, in the each case 100 g pasta sample was taken and cooked in 500 ml of water. The pasta was added in to the boiling water and was boiled for the time already determined. Boiled pasta was then drained, fried in a pre standardized method by using oil, mustard, onion and tomato with salt and used for sensory evaluation. A ten member panel of panellists evaluated the cooked samples of pasta and marked their observations in the sensory card. Each of the samples was randomly numbered using a three-digit code. Pasta was evaluated for colour, texture, aroma, taste and overall acceptability.

**Statistical Analysis:** The results are expressed as Mean ± SD (standard deviation). The statistical significance was analyzed using One-way Analysis of Variance (ANOVA) followed by Dunnett Multiple Comparisons Test by employing statistical software, Differences between groups were considered significant at $P<0.05$ level.

## RESULTS AND DISCUSSIONS:

**Evaluation of Chemical Composition of Raw Material:** The composition of the raw material is depicted in **Table 2**.

**TABLE 2: CHEMICAL COMPOSITION OF RAW MATERIALS**

| Raw material | Carbohydrate | Protein | Fat | Fibre | Ash |
|---|---|---|---|---|---|
| Refined wheat flour | 71.62 ± 0.01 | 10.67 ± 0.6 | 1.15 ± 0.08 | 0.45 ± 1.0 | 2.6 ± 0.02 |
| Carrot pomace powder | 67.78 ± 0.82 | 0.68 ± 0.05 | 1.42 ± 0.14 | 11.40 ± 0.52 | 7.13 ± .69 |

**Nutritional Composition of Prepared Pasta Samples:** The protein content of C, C1, C2 and C3 pasta samples were found to be 8.70, 8.46, 8.40, and 8.10 respectively. Fortification of pasta with different level of carrot pomace powder (CPP) slightly decreases the protein and fat content of the final products. While fibre content of prepared carrot pomace pasta increases in comparison to control pasta, the result agreed with other researchers. The nutritional composition of prepared pasta samples is shown in **Table 3**.

**TABLE 3: NUTRITIONAL COMPOSITION OF PREPARED PASTA SAMPLES**

| Sample | Carbohydrate | Protein | Fat | Fibre | Ash |
|---|---|---|---|---|---|
| C | 71.00 ± 0.56 | 10.70 ± 0.22 | 1.14 ± 0.01 | 0.45 ± 0.01 | 2.52 ± 0.05 |
| C1 | 70.10 ± 0.51 | 10.46 ± 0.88 | 1.13 ± 0.02 | 0.99 ± 0.05 | 3.41 ± 0.12 |
| C2 | 69.50 ± 0.42 | 10.10 ± 0.06 | 1.12 ± 0.06 | 2.05 ± 0.02 | 4.08 ± 0.03 |
| C3 | 68.67 ± 0.38 | 9.70 ± 0.62 | 1.10 ± 0.03 | 3.55 ± 0.06 | 4.95 ± 0.06 |

Note: All value are represented as Mean ± S.E.M. (standard error mean), n=6; data were analyzed by one-way ANOVA (Analysis of variance) employing Dunnett Multiple Comparisons Test using Graph Pad, Instate 3 software. Where C= Control sample, C1= 5% carrot poamace powder sample, C2= 15% carrot pomace powder sample, C3= 25% carrot pomace powder sample.

**Cooking Time:** Cooking time of pasta sample was significantly decreased as compare to the control sample, in each case 50g of each sample was taken and cooked separately for the evaluation of cooking time. The result is shown in **Table 4**.

**TABLE 4: COOKING TIME OF PREPARED PASTA SAMPLE**

| Sample | Cooking time (minute) |
|---|---|
| C | 5.10 ± 0.5 |
| C1 | 5.07 ± 0.15 |
| C2 | 4.48 ± 0.10 |
| C3 | 4.25 ± 0.11 |

Note: All value are represented as Mean ± S.E.M. (standard error mean), n=6; data were analyzed by one-way ANOVA (Analysis of variance) employing Dunnett Multiple Comparisons Test using Graph Pad, Instate 3 software, *P<0.05.

**Visco-elastic Properties:** Rapid visco analyzer (RVA, Starch Master of Perten, Sweden) was used to determine the pasting properties of raw material of pasta products. The peak viscosity (maximum viscosity of the sample during the heating and holding phase of the procedure) as well as the final viscosity (viscosity reading at the end of the test profile) was recorded for all samples. Sample is cooked at 95 ºC then cooled to 65 ºC, and its viscosity measured, using a RVA. The paste temperature of 65 ºC is used to rapidly stabilize viscosity and minimize retro gradation.

**TABLE 5: VISCOSITY VALUE OF DIFFERENT SAMPLES**

| Sample | Peak viscosity | Hold viscosity | Final viscosity |
|---|---|---|---|
| C | 2512.65±508.92 | 2659.00±572.504 | 2251.62±452.76 |
| C1 | 2651.32±358.60 | 1658.65±176.20 | 3118.32±221.42 |
| C2 | 2802.33±237.35 | 1627.32±165.72 | 3118.32±221.42 |
| C3 | 3083.00±2102.52 | 2531.30±125.96 | 3213.28±206.76 |

It was found that there was significant difference in the peak viscosity and hold viscosity among different samples (P<0.05). Note: All value are represented as Mean ± S.E.M. (standard error mean), n=6; data were analyzed by one-way ANOVA (Analysis of variance) employing Dunnett Multiple Comparisons Test using Graph Pad, Instate 3 software, *P<0.01

**Texture Analysis:** The texture of the samples was analyzed and it was found that the force (in g) required to cut the pasta sample was decreasing with increasing amount of carrot pomace powder. The results of the analysis are presented in the **Table 6**. The cutting force of C, C1, C2 and C3 were 2510.02 ± 0.40, 2496.00 ± 1.05, 2230.82 ± 1.56, 1983.00 ± 0.85, respectively. The increase in the percentage of carrot pomace powder is resulting in the softer texture of the product.

**TABLE 6: CUTTING FORCE (G) OF THE PASTA SAMPLES**

| Sample | Carrot pomace powder |
|---|---|
| C | 2510.15 ± 0.02 |
| C1 | 2496.16 ± 1.05 |
| C2 | 2230.82 ± 1.56 |
| C3 | 1983.00 ± 0.85 |

Note: All value are represented as Mean ± S.E.M. (standard error mean), n=6; data were analyzed by one-way ANOVA (Analysis of variance) employing Dunnett Multiple Comparisons Test using Graph Pad, Instate 3 software, *P<0.01

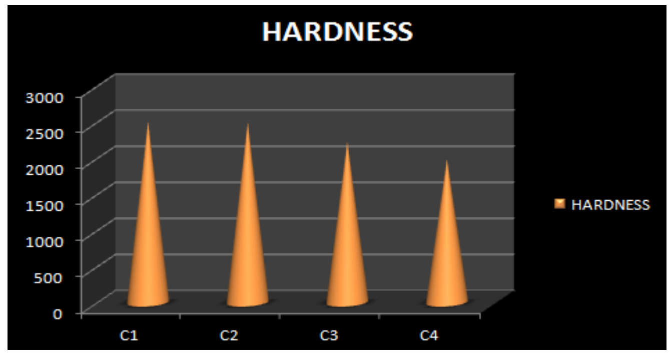


**FIG. 1: GRAPHICAL REPRESENTATION OF HARDNESS OF DIFFERENT PASTA SAMPLE**

**Sensory Characteristics:** Sensory evaluation of the products was carried out by using 9 point hedonic scale sensory test. The colour score of C, C1, C2 and C3 samples was 7.85 ± 0.52, 8.06 ± 0.62, 8.35 ± 0.81, 8.05 ± 0.92, respectively. It was observed that the colour of C2 was found best among all samples. The flavour score of C, C1, C2 and C3 samples was 7.58 ± 0.82, 8.00 ± 0.86, 8.25 ± 0.63, 7.40 ± 0.82, respectively. The score of C2 was found best in sensory evaluation. The texture, taste and overall acceptability score of C2 was 8.50 ± 1.02, 7.82 ± 0.92, and 7.38 ± 0.48, respectively. There was improvement in colour and texture of the product. The taste might have some change with increasing concentration of carrot pomace pasta. The product with 15 percent carrot pomace pasta was found better in comparison to other combinations.

**TABLE 7: SENSORY SCORES OF PREPARED PASTA SAMPLES**

| Sample | Sensory parameters | | | | |
|---|---|---|---|---|---|
| | Colour | Flavour | Texture | Taste | Overall acceptability |
| C | 7.85 ± 0.52 | 7.58 ± 0.82 | 7.10 ± 0.91 | 6.86 ± 0.68 | 6.50 ± 0.72 |
| C1 | 8.06 ± 0.62 | 8.0 ± 0.86 | 8.25 ± 0.90 | 7.45 ± 1.13 | 7.10 ± 0.40 |
| C2 | 8.35 ± 0.81 | 8.25 ± 0.63 | 8.50 ± 1.02 | 7.82 ± 0.92 | 7.38 ± 0.48 |
| C3 | 8.05 ± 0.92 | 7.40 ± 0.82 | 8.10 ± 0.72 | 7.10 ± 0.71 | 8.62 ± 0.51 |

**CONTROL SAMPLE** **SAMPLE C1** **SAMPLE C2** **SAMPLE C3**

**CONCLUSION:** The pasta was prepared with different proportions of carrot pomace powder. The results showed that with increase in carrot pomace concentration the fibre content increased and the cooking time decreased and the softness of pasta increased more than the control sample. It was found that the final viscosity of the sample was increasing with increase of carrot pomace powder. Fortified pasta was highly acceptable with respect to sensory attribute and cooking time.

On the basis of physico-chemical and nutritional properties, cooking time analysis of viscosity and sensory qualities pasta certain 85% refine wheat flour and 15% carrot pomace powder sample C2 resulted in better quality having more and high overall acceptability. Carrot pomace powder prevents different diseases (diabetes, asthma, arthritis and heart diseases *etc*.). If we include carrot pomace powder pasta in daily life style, it may prevent many diseases.

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**CONFLICT OF INTEREST:** The authors declare no conflict of interest.

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