Development and Evaluation of Cookies Supplemented With Carrot Pomace as a Source of Dietary Fiber and Phytochemicals

1. **Authors; Muhammad Anas Ajmal*,** National Institute of Food Science and Technology, university of Agriculture Faisalabad, anasajmal411@gmail.com

2. **Abdul Rasheed,** Department of Food Science and Technology, The Islamia University of Bahawalpur, rasheed.sandhu2@gmail.com

3. **Dileep Kumar,**Institute of Food Science and Technology, Sindh Agriculture University, Tandojamdklifst.sau@gmail.com

4. **Mahmooda Buriro,** Institute of Food Science and Technology, Sindh Agriculture University, Tandojam, mahmooda_buriro@yahoo.com

5. **Imtiaz Ali Unar,** Institute of Food Science and Technology, Sindh Agriculture University, Tandojam, imtiazali2k13fst10@gmail.com

6. **Syed Qamar Abbas,** National Institute of Food Science and Technology, university of Agriculture Faisalabad, Qamar.Abbas@uaf.edu.pk

7. **Yasmeen Bano,** Department of Food Science and Technology, University of agriculture Faisalabad sub campus Burewala, yasmeen@uaf.edu.pk

8. **Rizwan shukat,** National Institute of Food Science and Technology, university of Agriculture Faisalabad, RIZWANUAF@HOTMAIL.COM

***Correspondence**
anasajmal411@gmail.com

Abstract

The carrot juice processing business generates a significant amount of pomace from carrots as a by-product. It is an abundant source of bioactive chemicals, which have been shown to have potential in the treatment of disease and the avoidance of illness. The incorporation of carrot pomace powder into cookies with the intention of enhancing their antioxidant capacities was the primary purpose of this research. In the current study, 0 percent, 3 percent, 6 percent, 9 percent, and 12 percent of pomace level were used to make composite flour. The effect of these levels on the rheological behavior of dough as well as the physical, chemical, and sensory characteristics of cookies was investigated throughout the entire storage period. According to the findings, pomace has a relatively high concentration of fiber (15.78 percent), a relatively low concentration of moisture (7.26 percent), and a relatively low concentration of ash components (5.32 percent). The presence of the antioxidant (anthocyanins) was found to be 21.02 percent.The cookies made with T4 had the highest water absorption rate (74.30 percent), which was achieved by using a mixture of 88 percent wheat flour and 12 percent pomace in their production. On the other hand, the amount of time needed for dough development rose with the number of pomace levels, and the stability of the dough reduced as the concentration of carrot pomace increased. However, when it was added at a rate of 12 percent, it increased the fiber contents from 1.51 to 2.46 percent, which is a little bit of a negative effect on the color of the cookies when they were made with a high concentration of carrot pomace, which also has a little bit of a negative effect on the color of the cookies. The antioxidant activity of the cookies was shown to be boosted as a result of the carrot pomace, with values ranging from 0.60 to 3.18 percent depending on the amount of pomace used. The antioxidant values suffer from the unfavorable effects of storage, and as a result, they drop from 3.04 percent to 2.71 percent accordingly.In the sensory examination, the amount of 6 percent carrot pomace powder showed a good degree of general acceptability. According to the findings, the integration of carrot pomace powder into cookies dough has the potential to boost the cookies' antioxidant capabilities.

Key words: **Carrot Pomace, Cookies, Dietry Fiber.**
DOI Number: 10.48047/nq.2023.21.6.NQ23023 **NeuroQuantology2023;21(6):194-206**

Introduction

Processing of fresh fruits and vegetables results in the generation of large amounts of various types of waste material. Peels, fragments of seeds, and other leftovers are some examples of these types of waste materials. Before any further processing can take place, the plant wastes will first need to be dried. This is because plant wastes are susceptible to being ruined by bacteria. the valuable nutrients that are contained in agro-industrial waste would be lost if the waste is not handled in an acceptable manner. Peels and pomaces are examples of one of the by-products that can be obtained from the business of fruit and vegetable production. It is possible that the inclusion of peels and pomaces as a health food item in the diet of people would have a number of beneficial effects on their health if a way could be found to do so (Kumar and Kumar., 2011).

The consumption of foods that are rich in dietary fiber and antioxidants has been increasingly popular over the course of the past several decades. In addition, the significance of these food components has led to the development of a sizeable market for goods and components that are rich in fiber and antioxidants. This market is expected to continue to increase in the coming years. Intake of dietary fiber as well as phytochemicals such as polyphenols, carotenoids, tocopherols, and ascorbic acid has been linked to the maintenance of health as well as protection against diseases such as cancer, cardiovascular diseases, and a wide variety of other degenerative conditions. Intake of dietary fiber has also been linked to the improvement of overall health. (Ahmad *et al.*, 2016).

The carrot, which is also referred to as *Daucus carota*, is the root vegetable that is commonly used to make carrot juice. It is the largest root vegetable. The carrot is the sixth most consumed of the 22 important vegetables worldwide, and it ranks sixth in terms of consumption on a per capita basis. It is the source of magnesium, carotenoids, pectin, and other antioxidants, as well as vitamins B and K, as well as other minerals. The pomace of carrot is a residue obtained after processing of carrot juice. On industrial level carrot juice yield 70 %

while 81.5 % of carotene is wasted as residue of carrot pomace. There are a variety of necessary vitamins that can be found in carrots, such as thiamine, riboflavin, and the B vitamin complex. In addition, carrots are an excellent source of the antioxidant beta-carotene, in addition to other nutrients such as iron, calcium, and magnesium.

Due to the nature of its activities, the food processing industry is responsible for the production of a sizeable amount of waste. The organic and inorganic wastes that are created by fruits and vegetables have a value that is relatively low in comparison to their amount, and a significant quantity is collected. This is because the wastes are produced in such enormous quantities (Kumar and Kumar., 2011). They have a considerable capacity for holding water due to the high fiber content, and as a result, they reduce the amount of enzyme digestible and organic components that are present. Because it has a higher fiber content, the by-products can be used to alter the physicochemical properties of the diet. In order for researchers to evaluate the quantity of fiber that is included in a variety of fruits and vegetables, such as apples, pears, oranges, peaches, blackcurrants, cherries, artichokes, asparagus, onions, and carrots, they analyze the waste that is produced by these foods (Kausar at el., 2018).

Carrots are an excellent source of calcium pectate due to their high content. It has been demonstrated that the essential pectin fiber known as calcium pectate might bring about a drop in cholesterol levels. Calcium pectate has the ability to reduce one's chance of acquiring a variety of malignancies, in addition to the risk of having high blood pressure, strokes, and heart problems. The pomace that is left over after extracting the juice from a carrot is where around 80 percent of the carotene is found(Singh *at el*., 2011).Bread's nutritional value is improved by the addition of dietary fiber, but this addition frequently has the effect of changing the rheological properties of dough as well as the quality and sensory properties of cookies. Fruits, vegetables, nuts, and seeds are all good sources of dietary fiber that you can consume. When compared to the product that was obtained in the control cookies by not incorporating fiber, the product that was obtained in the experimental cookies by including dietary fiber resulted in distinct properties being possessed by the dough.

According to Zlatica*et al*. (2012) the most major obstacle that is posed by the inclusion of dietary fiber into baking is that it results in loaves that have dramatically altered textures and a lower volume. This is the conclusion that can be drawn from the findings of the study.Bakery products range in variety and include items such as cakes, cookies (cookies and crackers), bread which contains the main ingredient wheat flour as it provides structure and bulk to the bread. On a daily basis, bakery products are consumed worldwide inhuge quantities and have a significant importance in the nourishment of human. The main aim of research was

- To develop cookies fortified with carrot pomace
- Evaluation of the physiochemical and sensory characteristics of carrot pomace added cookies

Materials and Methods

3.1 Preparation of carrot pomace powder

Powder was prepared by grinding carrot pomace in a small laboratory grinder according to the process outlined by Kumar and Kumar (2011). The pomace was dried in a dryer. The finished powder was then placed in plastic bags that were hermetically sealed, ready for further use.

3.2 Preparation of wheat flour

In order to achieve a moisture level of 14 percent, wheat flour had to be dried out. After that, four fractions of flour were prepared in a lab size mill (the Quadrumate Senior Mill).Then straight grade flour was taken for further studies.

3.3 Treatment Plan for the replacement of wheat flour with carrot pomace powder(CPP)

Treatment	Flour (%)	CPP (%)
T_0	100	0
T_1	97	3
T_2	94	6
T_3	91	9
T_4	88	12

3.4 Rheological characteristics

On a farinograph (brabender type 10107, Duisburg OHG) a farinograph test was performed to investigate the effect of substituting wheat flour with various levels of carrot pomace powder on dough rheology in accordance with AACC (2000) method no, 54-21.02. The burette was used to add water while the flour was being mixed to achieve a dough stability of 500BU, and the farinogram created was used to determine the described parameters. Water absorption, arrival and departure times, development times, dough stability, and a mixing tolerance index were among the parameters examined.

Preparation of cookies

To make cookies with various amounts of wheat flour and pomace powder according to AACC's (2000) method 10-50D, but with a few adjustments. The essential components were 500g of a flour mix, 300 g of shortening, 250 g of ground sucrose, two beaten whole eggs, and 7 g of baking powder. Adding shortening and sugar to the creamed mixture in 10 minutes was the first step in the process. After that, eggs were added and the mixture was kneaded for a few minutes. After that, a composite flour and leavening agent was added. Adding the salt came after the mixture had been properly mixed for 5-6 minutes. It was then time for moulding and baking at 180 degrees Celsius for 10 to 12 minutes. The cookies were allowed to cool to room temperature before being placed in high density polythene bags and kept there for 30 days at room temperature without a change in quality.

3.5 Analysis of developed cookies

3.5.1 Moisture content

The cookies were baked in an oven at 105°C until they attained a consistent weight, at which point their moisture content was measured. For the purpose of determining the amount of moisture, method no. 44-01 from the AACC (2000) was utilized and the following expression was used:

$$\text{Moisture (\%)} = \frac{\text{Wt. of original sample} - \text{wt.of dried sample}}{\text{wt.of original sample}} \times 100$$

3.5.2 Fiber content

Following digestion with 1.25 percent H2SO4 and 1.25 percent NaOH solution, the crude fiber content was determined. Fibertech instruments were used to determine the sample's fiber content. The residual was computed and burned at 550°C in a muffle furnace until a white residue was left behind. AACC, (2000) technique no. 32-10 was used to compute the fiber %. After burning the samples, the following formula was used to compute the crude fiber percentage:

$$\text{Crude fiber (\%)} = \frac{\text{Wt.of residue left} - \text{Wt.of ash}}{\text{Weight of sample}} \times 100$$

3.5.3Ash content

The ash content, expressed as a percentage of the total inorganic matter, was determined with the use of AACC's (2000) method no. 08-01. We used an oven-dried five-gram sample of cookies and burned them on the burner in a muffle furnace at temperatures ranging from 550 to 600 degrees Celsius for five to six hours until a greyish ash formed.To determine ash content, a formula was used as follows:

Ash (%) = $\frac{\text{Weight of ash}}{\text{Weight of sample}} \times 100$

3.5.4 Protein content

Protein content will be determined by using AACC. (2000). Method No. 46-11A. Accurately weigh 0.5-2.0g finely ground sample and put it in digestion tube. Add 5g of digestion mixture & 30ml concentrated H_2SO, in sample tube.Place rack of digestion tubes on digestion block. Cover it with exhaust system and turn on. Switch on the digestion assembly and heat for 3-4hrs. till 1-2ml of transparent or light green solution remain in flask. Remove and cool, but do not allow crystallization. Make the volume of the sample to 100-250ml with distilled water. 6. Take 10ml of the diluted sample and 40% NaOH solution for further distillation. Add 4% boric acid in conical flask along with methyl red indicator and collect the ammonialiberated from the distilled sample.Titrate distillate with standard NaOH solution to neutrality. Run blank determination using all ingredients except sample.

Calculate the percent N content by the following formula and determine % protein by multiplying with factor (6.25).

% Nitrogen = $\frac{\text{vol of 0.1N H2SO4X0.0014X vol.of dillution (250ml)}}{\text{Vol.of distillate takenx weight of sample}} \times 100$

Crude protein (%) = Nitrogen (%) x 6.25

3.5.5 Fat content

Precisely measure 10 mL of sulfuric acid which was constantly filled the butyrometer. Took 2.5g of cookies powder sample which was set in a 35% butyrometer and 1mL of isoamyl liquor and water were added to quantify fat estimations precisely. Then stoppered the butyrometer and flipped the butyrometer multiple times so that all the contents of cookies were processed and totally blended in with other contents. The butyrometer was then centrifuged for 10 minutes and the fat was perused straightforwardly from the scale. Every determination was made 3 times to get mean value.

3.5.6 Antioxidant activity

The DPPH radical scavenging activity of the extracts was evaluated using a methodology that was adapted from that developed by Blois (1958). A sample of 1 gram was extracted using 10 ml of 80 percent methanol for a period of two hours. Following the addition of two ml of the DPPH solution to fifty ml of the methanolic extract, a solution containing four mg of DPPH per one hundred ml of methanol was produced. The following stage involved vigorously shaking the mixture and then leaving it to sit at room temperature and in the absence of light for a few minutes. After that, the absorbance was measured at a wavelength of 515 nm.The experiment was performed three times to ensure accuracy. The amount of scavenging was estimated to be.

Reduction of absorbance (%) = [(AB-AA)/AB]× 100

Where:

AB = absorbance of blank sample (t = 0 min).

AA= absorbance of tested extract solution (t= 15 min).

3.6 Sensory evaluation

NIFSAT panels, each consisting of ten members who have received specialized training, were asked to evaluate the flavor of cookies containing varied concentrations of carrot pomace powder. It was requested of the panelists that they give a rating for each sensory quality using the control treatment as the benchmark for the assessment. After being stored for a variety of lengths of time, cookies were evaluated using a 9-point hedonic scale that was developed by Meilgaard et al., (2007). This scale was used to assess the cookies' color, texture, taste, flavor, and general acceptability.

3.7 Statistical analysis

The Tuckey test (P<0.05) was used to compare treatment means, while the analysis of variance procedures was used to examine the overall significance of the treatments (Steel et al., 1997). The CRD (Completely Randomized design) was used in every study.

Results

4.1 Effect of carrot pomace powder and storage on moisture content of cookies (%)

TREATMENT	0 DAY	15 DAY	30 DAY
T0	1.62±0.001^{o}	1.65±0.003^{n}	1.71±0.001^{m}
T1	1.78±0.003^{l}	1.82±0.001^{k}	1.87±0.001^{j}
T2	1.91±0.001^{i}	1.98±0.002^{h}	2.43±0.001^{e}
T3	2.15±0.015^{g}	2.71±0.004^{d}	3.32±0.005^{b}
T4	2.38±0.019^{f}	2.92±0.012^{c}	3.52±0.009^{a}

4.2 Effect of carrot pomace powder and storage on fiber content of cookies (%)

TREATMENT	0 DAY	15 DAY	30 DAY
T0	1.51±0.001^{j}	1.51 ±0.003^{j}	1.508±0.003^{k}
T1	1.785±0.003^{h}	1.783±0.001^{i}	1.783±0.002^{i}
T2	1.936±0.001^{f}	1.936±0.002^{f}	1.935±0.001^{g}
T3	2.256±0.015^{d}	2.254±0.004^{e}	2.254±0.005^{e}
T4	2.465±0.019^{a}	2.463±0.012^{b}	2.262±0.015^{c}

4.3 Effect of carrot pomace powder and storage on ash content of cookies (%)

TREATMENT	0 DAY	15 DAY	30 DAY
T0	0.905±0.005^{i}	0.903±0.001^{j}	0.903±0.003^{j}
T1	1.308±0.007^{g}	1.307±0.001^{gh}	1.306±0.002^{h}
T2	1.752±0.002^{f}	1.751±0.002^{f}	1.751±0.001^{f}
T3	2.223±0.025^{c}	2.222±0.002^{d}	2.220±0.015e
T4	2.722±0.001^{a}	2.71±0.002^{ab}	2.70±0.002^{b}

4.4 Effect of carrot pomace powder and storage on protein content of cookies (%)

TREATMENT	0 DAY	15 DAY	30 DAY
T0	5.415±0.001[a]	5.4±0.003[a]	5.395±0.001[a]
T1	5.32±0.003[b]	5.315±0.001[c]	5.315±0.001[c]
T2	5.24±0.001[d]	5.24±0.002d[e]	5.238±0.001[e]
T3	5.01±0.015[f]	4.98±0.004[g]	4.98±0.005[g]
T4	4.90±0.019[h]	4.08 ±0.012[i]	4.08±0.009[i]

4.5 Effect of carrot pomace powder and storage on fat content of cookies (%)

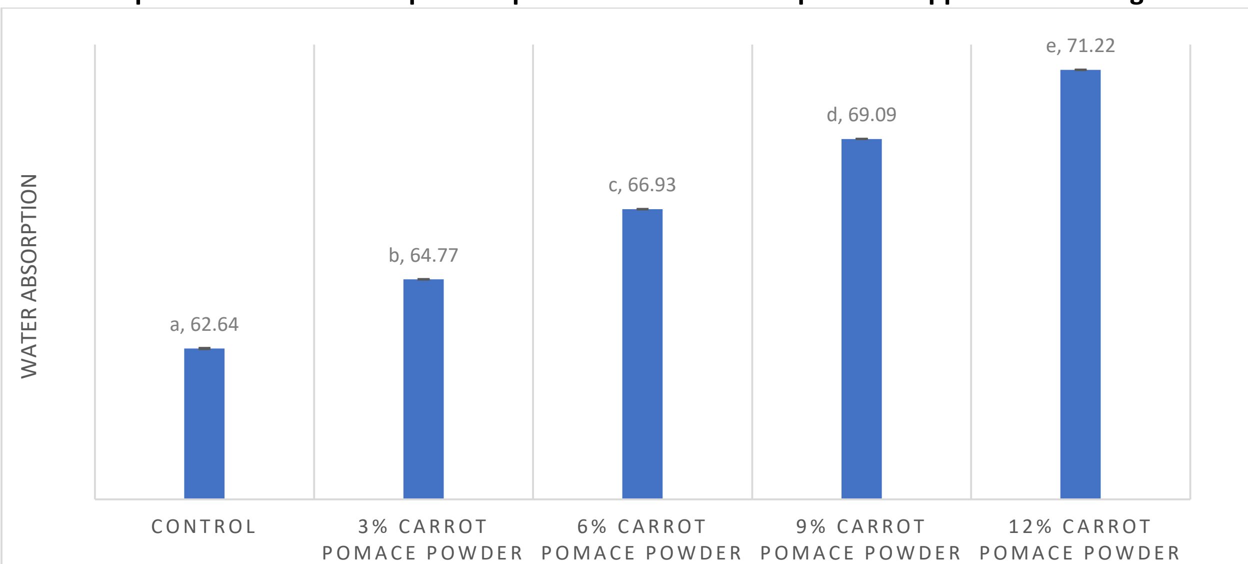
TREATMENT	0 DAY	15 DAY	30 DAY
T0	23.25±0.001[k]	23.24 ±0.003[l]	23.25±0.001[m]
T1	23.32±0.003[i]	23.32±0.001i	23.31±0.001[j]
T2	23.45±0.001[f]	23.44 ±0.002[g]	23.43±0.001[h]
T3	23.51±0.015[c]	23.49±0.004[d]	23.48±0.005[e]
T4	23.55±0.019[a]	23.54±0.012[b]	23.54±0.009[b]

4.6 Effect of carrot pomace and storage on antioxidant activity (%) of cookies

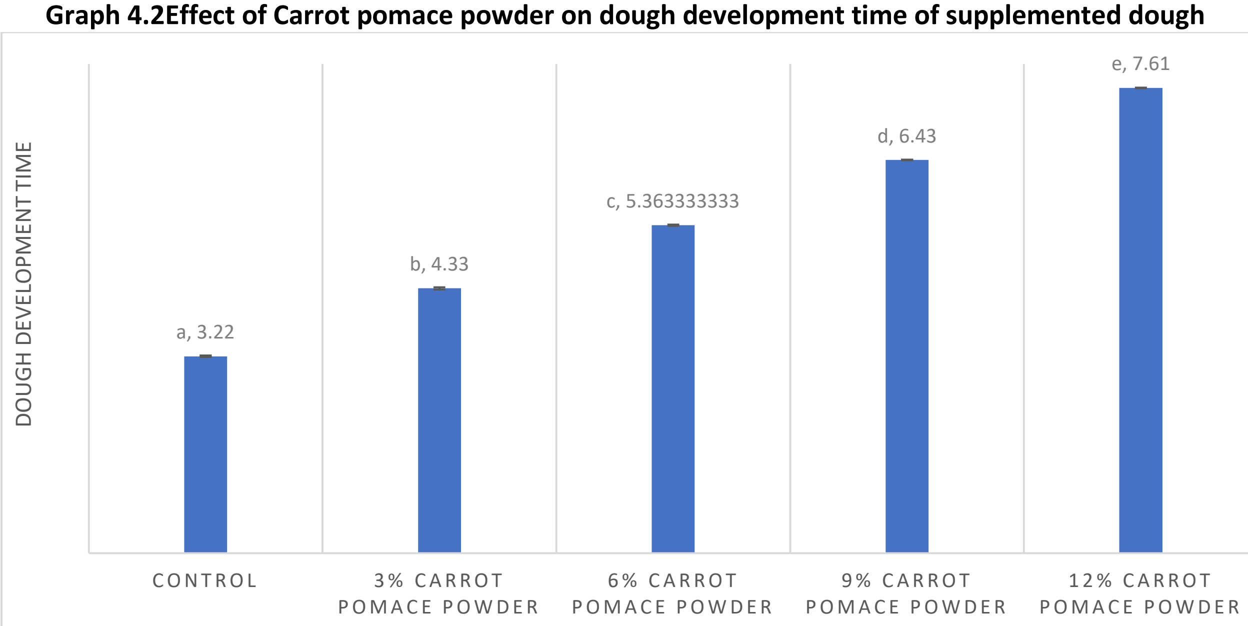
TREATENT	0 DAY	15 DAY	30 DAY
T0	0.62±0.04[l]	0.57±0.04[m]	0.54±0.03[n]
T1	1.33±0.08[j]	1.26±0.08[k]	1.23±0.07[k]
T2	1.82±0.11[g]	1.61±0.11[h]	1.54±0.11[i]
T3	2.28±0.16[d]	2.13±0.15[e]	2.04±0.14[f]
T4	3.02±0.15[a]	2.89±0.16[b]	2.71±0.15[c]

Rheological Parameters

Graph 4.1 Effect of Carrot pomace powder on water absorption of supplemented dough

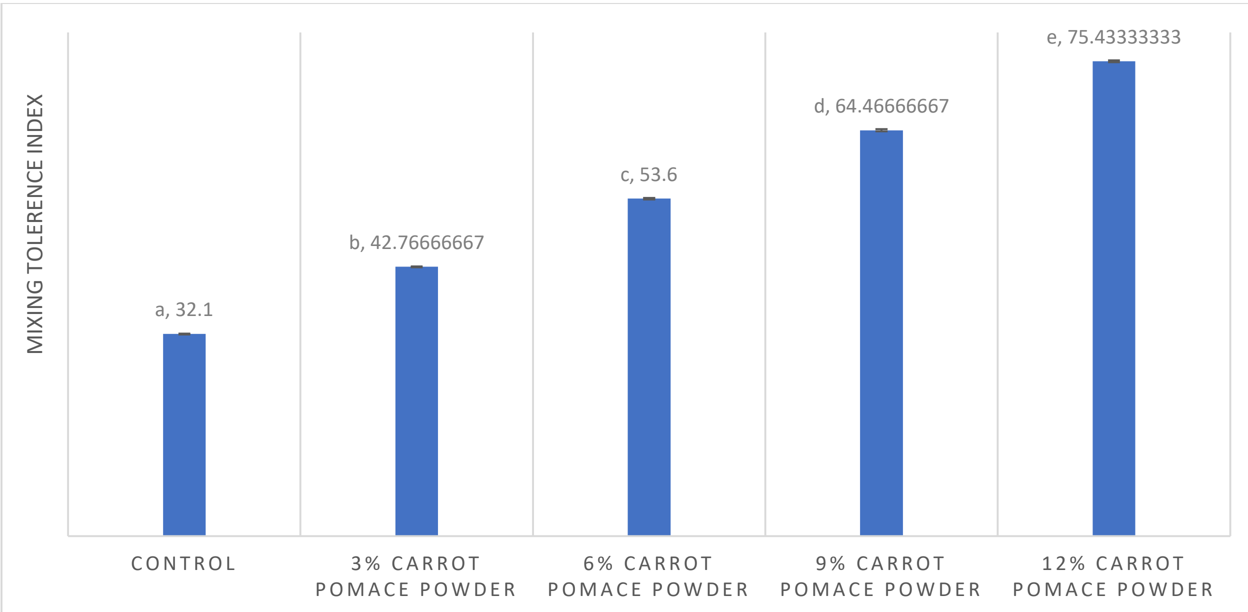


Graph 4.2Effect of Carrot pomace powder on dough development time of supplemented dough

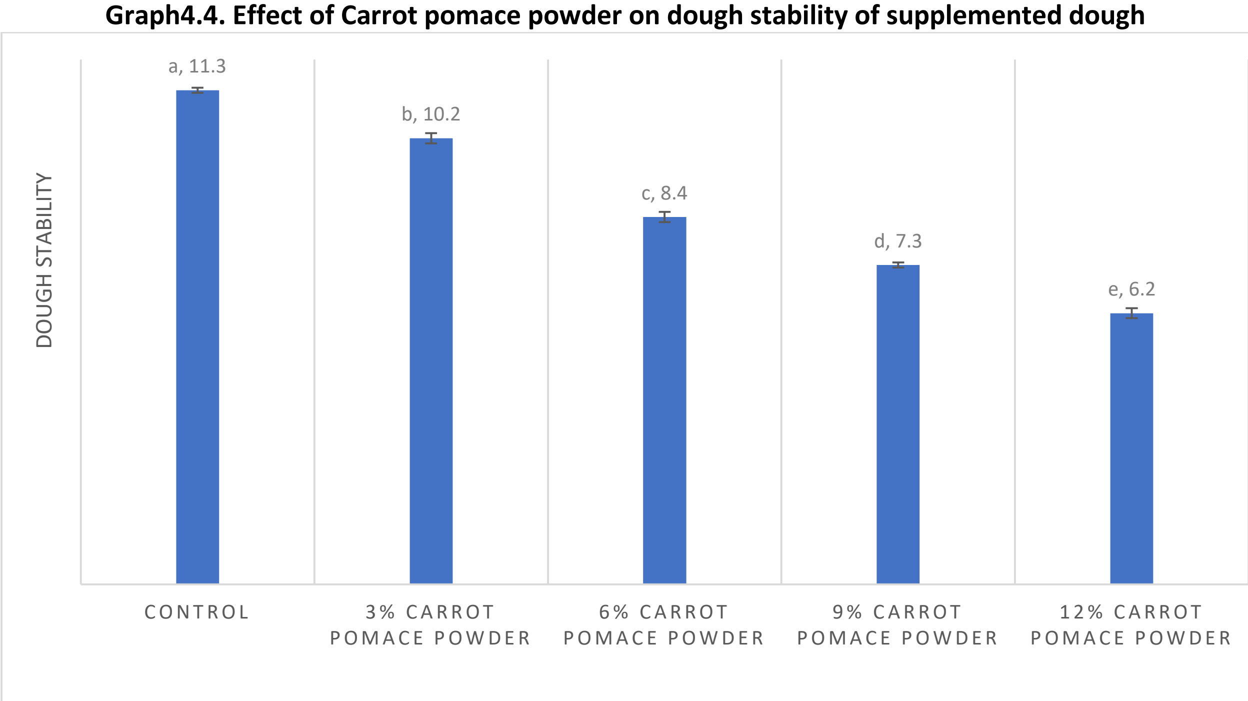


NEUROQUANTOLOGY | May 2023 | Volume 21 | Issue 6 | Page 194-206| doi: 10.48047/nq.2023.21.6.NQ23023

Graph 4.3 Effect of Carrot pomace powder on mixing tolerance index of supplemented dough

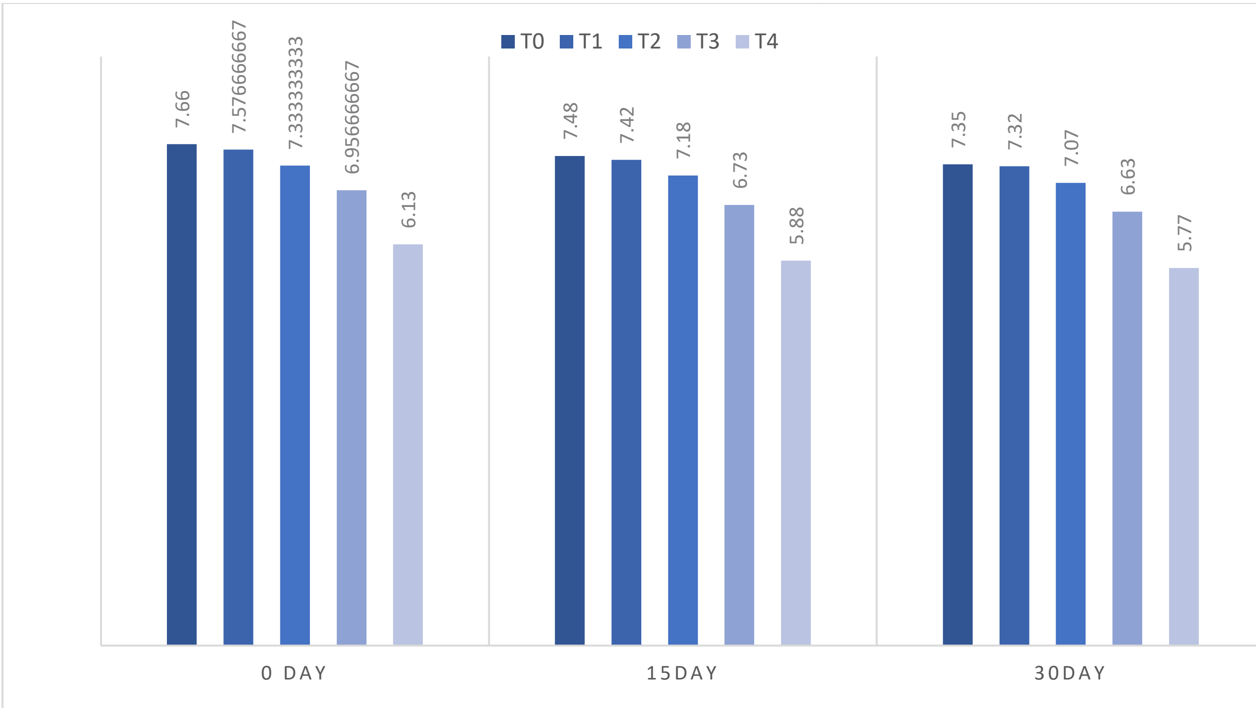


Graph4.4. Effect of Carrot pomace powder on dough stability of supplemented dough

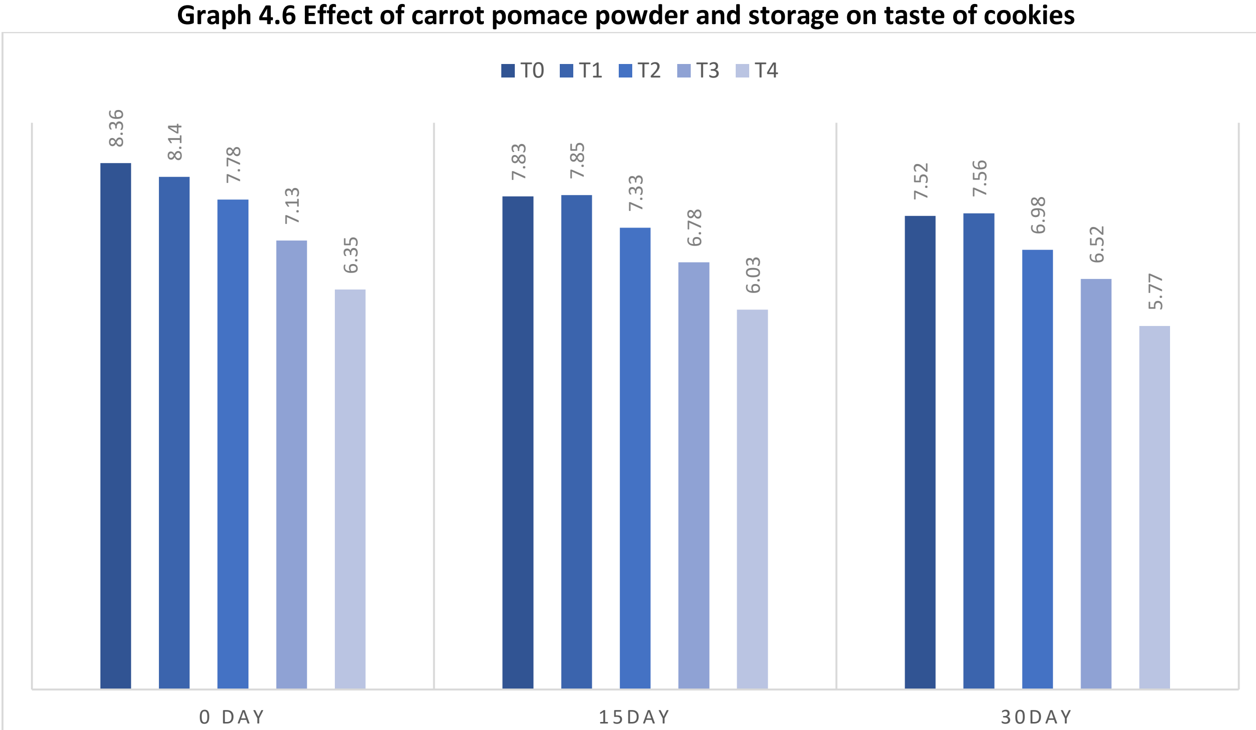


eISSN1303-5150

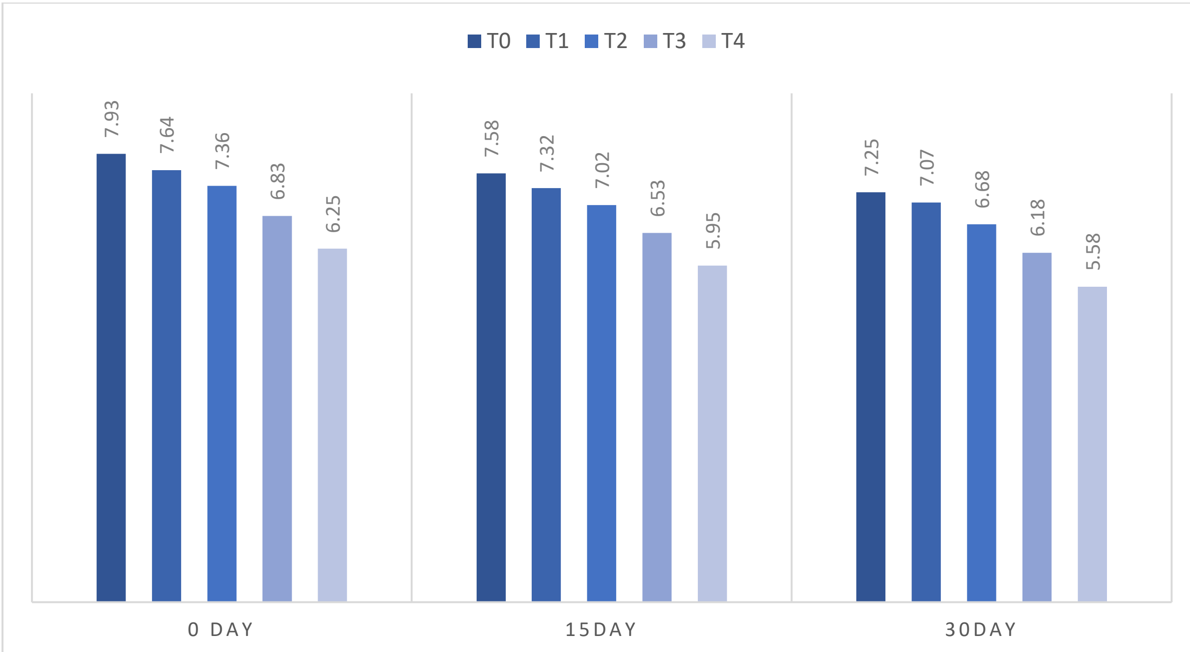
Graph 4.5 Effect of carrot pomace powder and storage on color of cookies



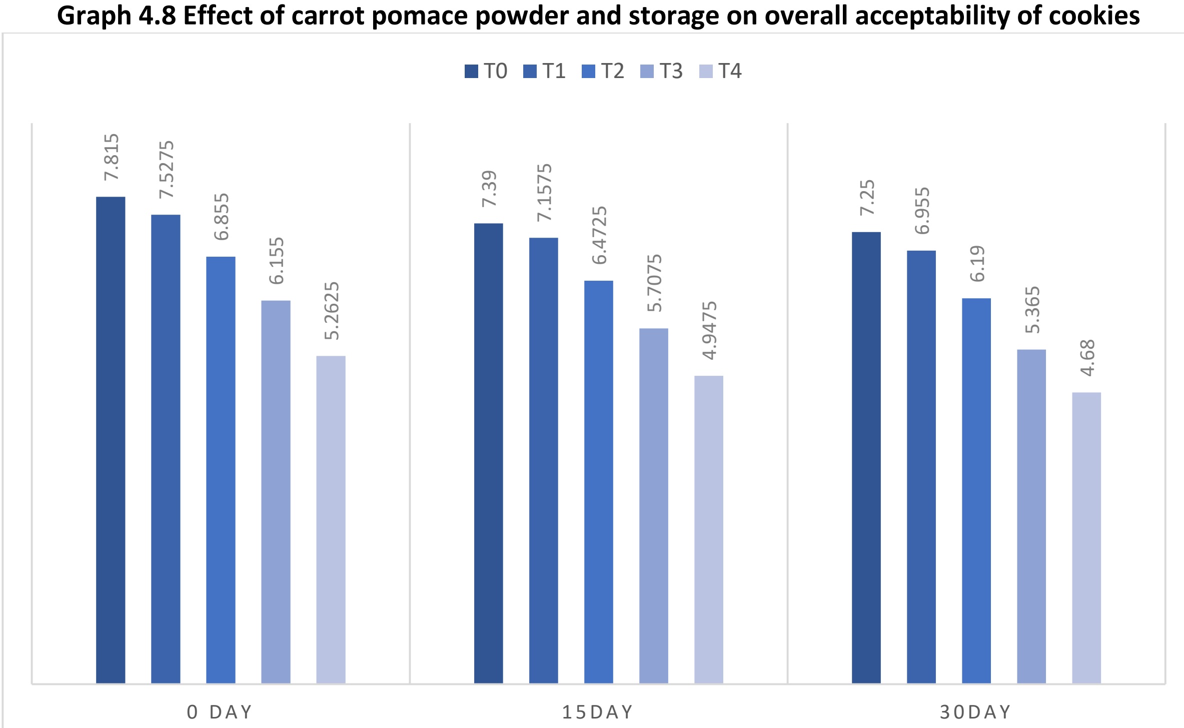
Graph 4.6 Effect of carrot pomace powder and storage on taste of cookies



Graph 4.7 Effect of carrot pomace powder and storage on texture of cookies



Graph 4.8 Effect of carrot pomace powder and storage on overall acceptability of cookies



Discussion

cookies containing different concentrations of carrot pomace powder were analyzed statistically for their moisture content (Table 4.1) Varying treatments and storage intervals had considerably different moisture contents, and there was also significant interaction between them. Moisture mean values ranged from 1.62 to 2.64 percent, with T4 having the highest value (2.64 percent) and T0 having the lowest score (1.62 percent). Different storage treatments variance analyses for crude fiber content have been presented in (Table 4.2). The results show that the crude fiber contents of cookies treated in various ways differ significantly. The sample T0 had the lowest crude fiber content, as shown in the means, with a content of only 0.4 percent.The percentages of crude fiber content increased as the concentration of pomace increased due to the increase in the amount of fiber in various treatments. Cookies' fiber content increases as pomace content in cookies increases, as shown by findings.Ash content increased when the amount of powder was increased. A total of 0.905% to 2.72% of ash was found in several cookie samples after various treatments. There was a non-significant relation in T1 at 15thday for both 0 and 30th day of storage similar results were observed for T4.

An investigation into protein content in cookies has been published (Table4.4). Protein content is significantly affected by treatments, storage and their interaction had also significant effect. According to Table 4.4 values of protein content dropped over time as the amount of powder rose. From 5.41 to 4.90 proteins were found in different cookie samples in different treatments.It is clear from the results that the fat level of cookies differs significantly between treatments. Table-4.5 showed that T0 had the lowest fat content (23.25 percent) among the various samples studied. T4 was found to have the highest crude fat content (23.55%). Table 4.6 shows that the lowest value of 0.62 percent was found in treatment T0, while the greatest value of 3.02 percent was found in treatment T4. Antioxidant activity declined dramatically during storage, with a peak of 1.81 percent at zero days and a low of 1.60 percent after 30 days. An increase of 3.02 percent in antioxidant activity was detected when the pomace was raised by up to 12 percent in the control sample, which had an antioxidant activity of 0.62 percent.

Treatments had a considerable impact on water absorption, according to an analysis of variance. Graph 4.1 shows that the water absorption capacity varied between 62.60 and 74.30 percent depending on the treatment. T4 had the highest water absorption capacity (74.30 percent), followed by the T3 (69.50 percent), T2 (65.40 percent), and T1 (61.25 percent), while T0 had the lowest water absorption capacity (60.60 percent) for cookies making, despite the use of 88 percent wheat flour or 12 percent carrot pomace powder for the latter. Different treatments had a substantial impact on dough development time, according to an analysis of variance of dough development time. Graph 4.2 shows that the mean dough formation time ranged from 3.2 minutes to 7.6 minutes across the various treatments studied. Treatment T4 employed 88 % wheat flour and 12 % carrot pomace powder, resulting in the longest dough development time (7.6 minutes).Treatments had a mixing tolerance index of 32.0 to 75.2FU. It was revealed that the treatment T4 had the highest mixing tolerance index (75.2FU), while the treatment T0 had the lowest (32.0FU) mixing tolerance. For dough stability (Graph 4.4) the treatment T0, in which 100 % wheat flour was used, displayed the greatest degree of dough stability (11.20), which was then followed by T1 (10 minutes), T2 (8.6 minutes), and T3 (7.4 minutes), with the treatment T4, in which 88% percent wheat flour and 12% pomace powder were used, exhibiting the least amount of dough stability (5.50 minutes).

The results show that the color of the cookies changes significantly as the amount of carrot pomace powder is increased. With T0 at the top and T4 at the bottom, all treatments were highly significant ($p<0.05$) among each other. Graph 4.5 shows the values for the colors of cookies during storage. There are a wide variety of treatment values for color, from 7.64 to 6.15. Cookies that have been stored for less than 30 days have a maximum score of 7.12, while those that have been stored for 30 days have a minimum value of 6.15.Different storage periods resulted in a wide range of results for taste. Among the available treatment options, T0 received a mean score of 8.34, while T4 received a mean score of 6.34. When it came to the taste of cookies, the highest score was 7.54 after only one day of storage, and the lowest was 6.78 after 30 days. Graph 4.7 shows the texturing results. All treatments storage periods were shown to differ significantly. The data clearly shows that the judges ranked the T0 as the highest and the T4 as the lowest. While T0 received a total score of 7.91, each of the following scores: 7.63 for T1, 7.36 for T2 and 6.82 for T3 and 6.32 for T4. The results varied from 7.2 to 6.59 at 0 and 30 days of storage, respectively.It was found that the overall acceptability of cookies with varying levels of carrot pomace powder was highly significantly changed among treatments and storage days. Graph 4.8 shows thetotal fitness score for cookies, T0 received the highest overall acceptability rating of 7.90, while T4 received the lowest rating of 5.35. In the first 30 days, the overall acceptability rating is at its best, while it drops to its lowest in the second 30 days.

References

AACC. (2000). Method No. 08-03. Approved methods of the American Association of Cereal Chemists, 10th Edition, American Association of Cereal Chemists, St. Paul, MN, USA.

Ahmad, M., T.A. Wani, S. Wani, F. Masoodi and A. Gani. 2016. Incorporation of carrot pomace powder in wheat flour: effect on flour, dough and cookie characteristics. J. Food Sci. Technol. 53:3715-3724.

Kausar, H., S. Parveen, M.M. Aziz and S. Saeed. 2018. Production of carrot pomace powder and its utilization in development of wheat flour cookies. J. Agric. Res. 56:49-56

Kumar, N. and K. Kumar. 2011. Development of carrot pomace and wheat flour based cookies. J. Pure Appl. Sci. Technol. 1:5-11.

Meilgaard, M.C., G.V. Civille and B.T. Carr. 2007. Sensory Evaluation Techniques. 4th ed. C.R.C. Press, New York.

Ou, S., K.C. Kwok, Y. Li and L. Fu. 2001. In vitro study of possible role of dietary fiber in lowering postprandial serum glucose. J. Agric. Food Chem. 49:1026-1029.

Singh, B., P. Panesar and V. Nanda. 2006. Utilization of carrot pomace for the preparation of a value added product. World J. Dairy and Food Sci. 1:22-27

Steel, R.G.D. J.H. Torrie and D.A. Dickey. 1997. Principles and Procedures of Statistics: A Biometrical Approach, 3rd ed. McGraw Hill Book Co. Inc. New York, USA. Pp. 336-352.

Zlatica, K., J. Karovicova and M. Jurasova. 2012. Influence of carrot pomace powder on the rheological characteristics of wheat flour dough and on wheat rolls quality. Acta Scientiarum Polonorum Technologia Alimentaria. 11:381-387.