

Quality and Antioxidant Properties of Black Carrot (*Daucus carota* ssp. *sativus* var. *atrorubens* Alef.) Fiber Fortified Flat Bread (Gaziantep Pita)

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Abstract: Cereal-fruit and/or cereal-vegetable combined system has been increasing due to high antioxidant status of cereal products. In present study, the quality characteristics and antioxidant properties of Gaziantep pita (regional flat bread in Turkey) fortified with black carrot fiber (BCF) were evaluated. The changes of total phenolic content (TPC), antioxidant activity (AA), color, physical and sensorial characteristics of Gaziantep pita were examined the effect of BCF addition from 0% to 7.5% (w/w). There is a regular increase for TPC and AA of both outer and inner parts of the bread due to BCF level used. Physical properties were not affected by BCF addition up to 2.5% level. The higher the BCF level use resulted in the darker color of outer and inner parts of the bread. Overall acceptability bread containing all BCF levels is not different from control sample. BCF fortification of flat bread is a simple way to increase antioxidant content and provide more attractive appearance. It could be an alternative way to produce functional bread type for healthy diet.

Key words: Anthocyanin, flat bread, antioxidant activity, quality characteristics.

1. Introduction

Anthocyanins are water-soluble coloring pigments. They are the most abundant found pigments in nature and impart a characteristic color ranging from blue to red. In recent years, there has been a great interest in anthocyanins not only their colorant abilities and aesthetic value but also their being rich in terms of bioactive compounds and their potential role in reducing the risk of coronary heart disease, cancer and stroke [1]. Strong legal restrictions on synthetic coloring agents together with the consumer demand for natural food have caused coloring agents originating from plants to become popular [2]. Many foods have been identified to be rich sources of anthocyanins including fruits, grains and vegetables such as berries, grapes, plums, cherries, black rice, black carrots, purple sweet potatoes and red cabbages [3, 4]. Black carrots (*Daucus carota* ssp. *sativus* var.

atrorubens Alef.) which are originated in Turkey, Afghanistan, Egypt, Pakistan, India and in the Far East [5], have a strong antioxidant activity (AA) because of high concentration of the pigment anthocyanin: 1,750 mg/kg and a high level of acylated anthocyanins [6]. They are becoming more favorable as a source of natural food colorants [7].

Cereal based food products such as bread, biscuit, cake and cookie are consumed in large quantities by providing dietary fiber and other healthy compounds to consumers [8]. Cereal-fruit and/or cereal-vegetable combined system has been increasing due to high antioxidant status of cereal products. Cereal based products are high in protein content with respect to fruits and vegetables whereas fruits and vegetables are high in bioactive compounds such as carotenoids, ascorbic acid and phenolic acids (anthocyanins, tannins). Therefore, the finished product of combined cereal-fruit and vegetable food system can be used in daily life as a healthy diet rich in proteins as well as phytochemicals [9].

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Bread is the most commonly consumed bakery product as the basic food stuff of the society. In all cuisines, the sacred bread is also the symbol of labor and fertility. It is cheap, filling, it is a source of energy and it meets the protein need. One of the most important local breads in the traditional Turkish cuisine is Gaziantep pita which is consumed in almost all urban and rural areas of southeast region of Turkey. In 2017, the geographical sign registration certificate of the Gaziantep pita was awarded to Gaziantep which is among the UNESCO's Creative Cities Network in the gastronomy field by Gaziantep Commodity Exchange. Gaziantep pita, which is made from white wheat flour and baked in Gaziantep bakeries, is a type of flat bread with a width of about 20 cm, a length of 39 cm and a thickness of about 1 cm (Fig. 1). There is a 1.35 cm × 1.40 cm surface area with generally homogeneous nail spacing due to application special dough shaping technique using by fingertips [10, 11].

Nowadays, people show great interest into natural colored food products because of their having health benefit together with high charm. In this way, there is a considerable interest to incorporate anthocyanin in food products such as jam, jellies and dairy products like ice-cream and yoghurt. However, there are few investigations of bakery products fortified with anthocyanins [12-17]. The aim of present study was to

evaluate the quality characteristics and antioxidant properties of Gaziantep pita as a flat bread fortified with black carrot fiber (BCF). The changes of total phenolic content, AA, color, physical and sensorial characteristics of bread were investigated with BCF addition from 0% to 7.5% (w/w) in order to determine the effects of BCF fortification on flat bread.

2. Materials and Methods

2.1 Materials

The commercial wheat flour and other ingredients salt, yeast and black carrots (*D. carota* L. ssp. *sativus* var. *atrorubens* Alef.) were obtained from local market. After black carrot samples were washed in cold tap water, they were blended with 0.1 M citric acid (Merck) in a glass blender (8011ES Model Hgb2wts3, USA). Black carrot pomace which remains after the extraction of juice from carrot was dried at 35 °C in a forced-air oven for 24 h until 12% moisture content. After the dried sample was powdered using a laboratory mill (JXFM110 Lab Mill) to produce particles with a size 425 µm, they were stored in polyethylene bags and kept in fridge (+4 °C) for further analysis. Blends of 0, 1%, 2.5%, 5% and 7.5% were prepared by addition of the BCF into bread dough.



Fig. 1 Picture of Gaziantep pita (Gaziantep Commodity Exchange, 2017).

2.2 Preparation of Flat Bread (Gaziantep Pita)

The bread making formula consisted of different levels of wheat flour/BCF blends 100/0, 99/1, 97.5/2.5, 95/5 and 92.5/7.5 (w/w) were designated as the control, 1%, 2.5%, 5% and 7.5%, respectively. The all ingredients wheat flour/BCF blends, instant dry yeast (4.0%), salt (1.5%) and water (the amount of water is required to reach 500 BU of consistency) were mixed by using professional mixer at speed 2 for 3 min. Later, dough was rested for 20 min and divided (150 g). Dough was kneaded and molded to obtain a desirable shape. The dough was put on the tray in a fermentation unit (at 35 °C and 85% relative humidity for 10 min). Fermented dough was baked at 250 °C for 5 min. Picture of control and different amounts of BCF fortified flat bread samples was shown in Fig. 2.

2.3 Chemical Analysis

2.3.1 Determination of Total Phenolic Content (TPC)

The TPC of control and different amounts of BCF added flat bread samples were estimated by the

Folin-Ciocalteu method by using gallic acid as standard, and results were expressed as gallic acid equivalent (mg GAE/100 g) [18].

2.3.2 Determination of AA

AA of control and different amounts of BCF added flat bread samples was evaluated using *in vitro* assays—abilities to reduce iron (III) (Ferric reducing antioxidant power (FRAP)) [19] and according to 2,2,-di-phenyl-2-picryl-hydrazyl (DPPH) method, described by Brand-Williams *et al.* [20]. AA (%) was expressed as percentage inhibition of the DPPH radical and was determined by Eq (1):

$$AA(\%) = \left[1 - \frac{Abs_{sample}}{Abs_{control}} \right] \times 100 \quad (1)$$

where AA (%) represents antioxidant activity; Abs_{sample} is the absorbance value of sample; $Abs_{control}$ is absorbance value for the control.

2.4 Quality Characteristics

2.4.1 Determination of Physical Properties

Diameter (W) and thickness (T) of control and different amounts of BCF added whole bread samples

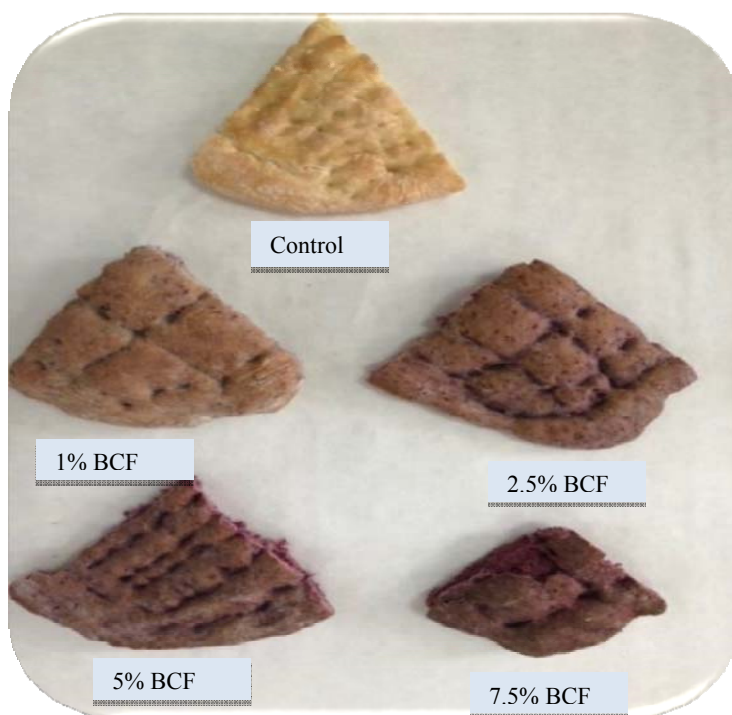


Fig. 2 Picture of control and different amounts of black carrot fiber (BCF) fortified flat bread samples.

were measured. The spread ratio (W/T) was calculated as physical property.

2.4.2 Measurement of Color Characteristics

L (brightness), *a* (redness) and *b* (yellowness) values of control and different amounts of BCF added flat bread samples were measured using a HunterLab ColorFlex, A60-1010-615 model colorimeter (Hunterlab, Reston, VA).

2.4.3 Evaluation of Sensory Properties

A 1-9 hedonic scale was used to evaluate the samples and panelists rated each sensory attribute between one point (unacceptable) and nine point (very well). After cooling of control and different amounts of BCF added flat bread samples in room temperature, bread parts from a quarter of whole bread were prepared. The samples were evaluated in terms of outer part color, inner part color, taste-flavor, odor, texture, appearance and overall acceptability.

2.5 Statistical Analysis

Results were statistically analyzed with analysis of variance (one-way ANOVA), followed by Duncan's test using SPSS, version 16 (SPSS Inc., Chicago, IL). Statistical significance was indicated at a confidence level of 95%.

3. Results and Discussion

3.1 Total Phenolic Content

TPCs of bread portions are given in Table 1. The TPC which was 86.24 mg GAE/100 g for outer part and 92.74 mg GAE/100 g for inner part of the control sample considerably increased depending on the BCF addition ($p \leq 0.05$), and these values, respectively, increased to 793.12 mg GAE/100 g and 788.86 mg GAE/100 g in the sample with the addition of the BCF of 7.5%. Fig. 3 shows that there is a regular increase for TPC of both outer and inner parts due to BCF level used ($p \leq 0.05$). In the studies on fruits and vegetables, it was reported that a considerable increase observed for Jamun supplemented flat bread [21], but a considerable decrease occurred in the phenolic content during cooking [14, 17, 22, 23]. The TPCs of the flat bread portions incorporated by BCF were observed approximately nine times for outer and inner parts, compared to the control samples.

3.2 Antioxidant Activity

The AAs of bread portions are shown in Table 1. Control bread was attributed to the lowest AA for both outer and inner portions. As the proportion of black

Table 1 The total phenolic contents (TPCs) and antioxidant activity of flat bread samples fortified with different amounts of black carrot fiber (BCF).

BCF level (%)	Bread portion	Total phenolics (mg GAE/100 g)	Ferric reducing/antioxidant power (FRAP) ($\mu\text{g FeSO}_4/\text{g}$)	Antioxidant activity (% inhibition)
0 (control)		86.24 \pm 1.71 ^e	193.25 \pm 2.46 ^e	50.64 \pm 1.64 ^e
1		175.97 \pm 8.76 ^d	1,331.42 \pm 5.33 ^d	56.72 \pm 0.88 ^d
2.5	Outer	396.63 \pm 7.69 ^c	2,205.86 \pm 8.51 ^c	66.03 \pm 0.52 ^c
5		508.24 \pm 4.70 ^b	4,038.01 \pm 10.39 ^b	71.08 \pm 0.37 ^b
7.5		793.12 \pm 10.73 ^a	4,649.19 \pm 14.71 ^a	75.26 \pm 0.57 ^a
0 (control)		92.74 \pm 2.44 ^d	407.52 \pm 2.37 ^e	46.52 \pm 3.74 ^e
1		119.67 \pm 1.16 ^d	586.247 \pm 10.12 ^d	56.56 \pm 1.03 ^d
2.5	Inner	212.82 \pm 3.81 ^c	880.08 \pm 3.78 ^c	63.99 \pm 0.66 ^c
5		347.28 \pm 5.85 ^b	1,309.41 \pm 6.96 ^b	68.20 \pm 0.18 ^b
7.5		788.86 \pm 2.64 ^a	4,233.18 \pm 14.57 ^d	76.22 \pm 0.57 ^a

All data are the mean \pm SD of three replicates.

Mean in the same column with different letters differ significantly ($p \leq 0.05$).

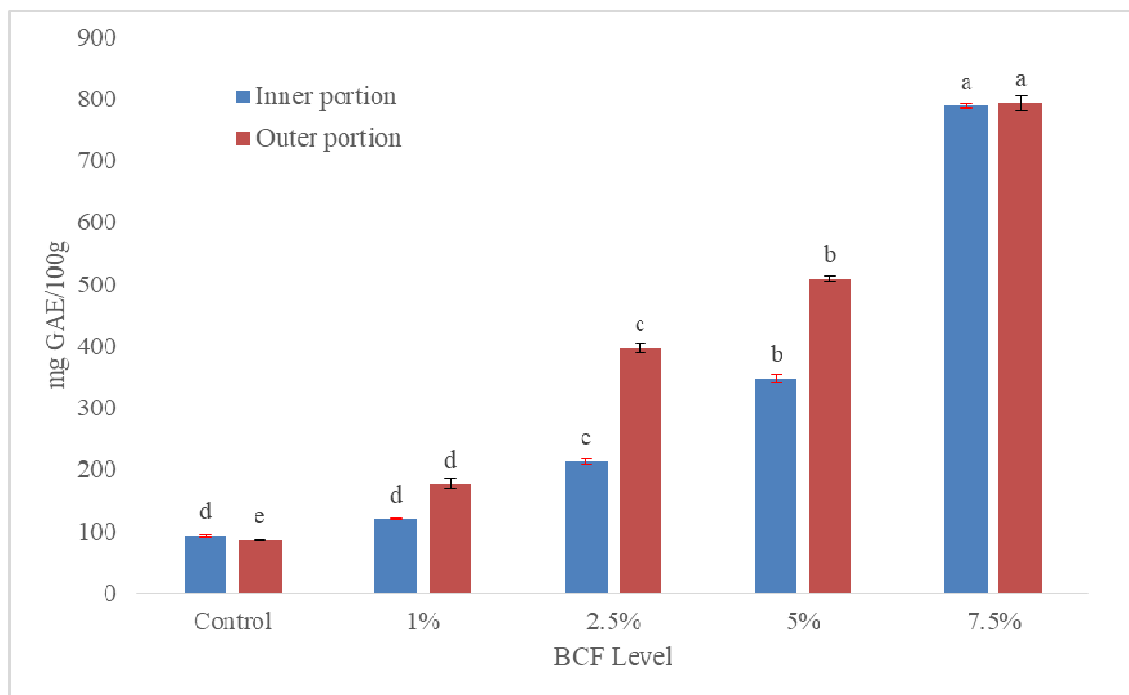


Fig. 3 Total phenolic content (TPC) of BCF fortified flat bread.

carrot (*D. carota* L. ssp. *sativus* var. *atrorubens* Alef.) addition increased, the AA toward the DPPH radical also increased significantly for both portions of bread ($p \leq 0.05$). Estimation of AA revealed that 7.5% BCF supplemented outer part sample had highest AA (75.26%) followed by 5%, 2.5%, 1% BCF added and control samples. The 7.5% BCF supplemented inner portion of bread had highest AA (76.22%) followed by decreasing BCF supplementation and control. Fig. 4 indicates that there is a regular increase for AA of both outer and inner parts due to BCF level used ($p \leq 0.05$). Similar results were obtained by other studies for rocket used in bread [24], black carrot flour added sponge cake [16], Jamun enriched flat bread [21] and BCF incorporated cookies [17]. In present study, the results indicate that BCF could be considered as rich sources of total phenolics and antioxidants, accordingly, bread supplemented with BCF increased the antioxidant potential.

3.3 Physical Properties

The effect of the BCF addition at different ratios on the physical properties, diameter, thickness and spread

ratio of bread are listed in Table 2. The diameter (W) and spread ratio (W/T) values of the flat bread samples supplemented with 1% to 7.5% BCF decreased regularly, while the thickness (T) values of the flat bread samples showed a regular increase due to BCF level used ($p \leq 0.05$). Especially the diameter values for 5% and 7.5% BCF levels were lower than the diameter values for control, 1% and 2.5% BCF added samples, while the thickness values for 5% and 7.5% BCF levels were higher than the thickness values for control, 1% and 2.5% BCF added samples. As a consequence, physical properties of flat bread mentioned in present study were not affected significantly by BCF addition up to 2.5% level ($p > 0.05$). As the high water absorption capacity of the BCF may have decreased the diameter and spread ratio of the bakery products due to increase the dough viscosity and limit the spread in other studies [17, 25, 26], similarly a significant regular decrease on the spread ratio of flat bread was observed due to BCF level used in present study ($p \leq 0.05$).

3.4 Color Characteristics

The effect of the BCF on the color characteristics of

flat bread portions is presented in Table 3. BCF addition into dough considerably decreased the “*L*” values of both outer and inner parts of the flat bread (p

≤ 0.05). The color of BCF is dark brown-purple due to high level of anthocyanin content. When it was added to the bread dough, it darkened the color of the crust

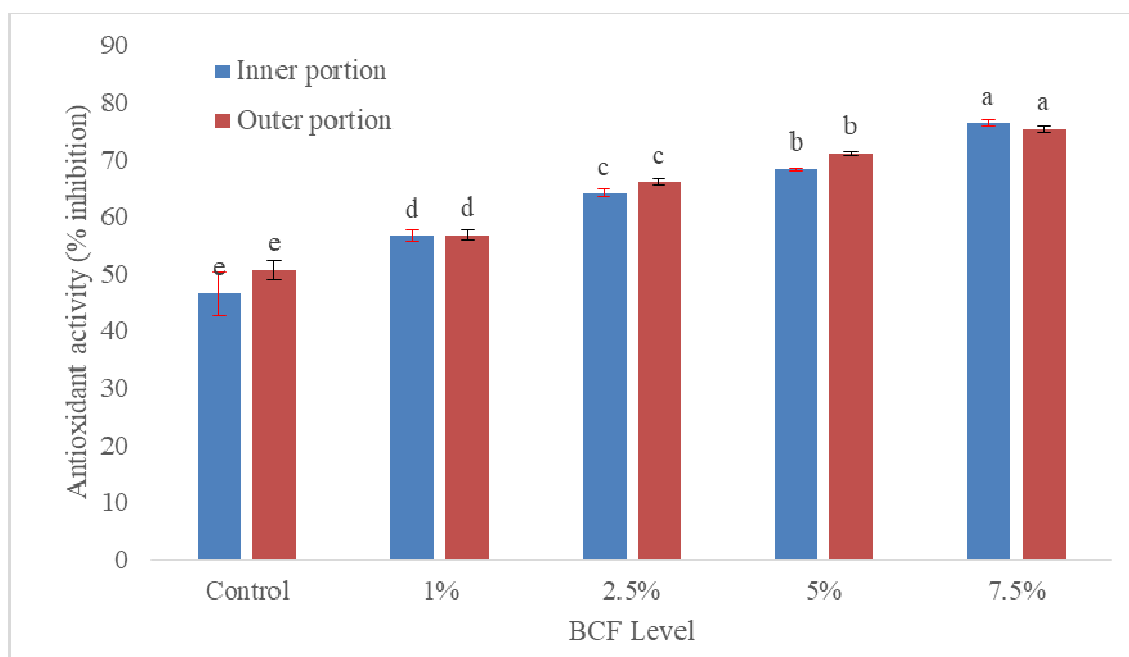


Fig. 4 Antioxidant activity of BCF fortified flat bread.

Table 2 Effect of different amounts of BCF addition on the physical characteristics of flat bread samples.

BCF level (%)	Diameter (W, mm)	Thickness (T, mm)	Spread ratio (W/T)
0 (control)	187.7 ± 0.25 ^a	12.5 ± 0.20 ^c	15.0 ± 0.33 ^a
1	171.9 ± 0.84 ^{ab}	14.5 ± 0.35 ^{bc}	11.8 ± 0.21 ^{ab}
2.5	170.5 ± 0.12 ^{ab}	16.9 ± 0.26 ^b	10.1 ± 0.31 ^{ab}
5	161.8 ± 0.11 ^b	20.4 ± 0.68 ^a	7.93 ± 0.46 ^{cd}
7.5	152.3 ± 0.90 ^b	21.3 ± 0.10 ^a	7.15 ± 0.30 ^d

All data are the mean ± SD of three replicates.

Mean in the same column with different letters differ significantly ($p \leq 0.05$).

Table 3 Effect of different amounts of BCF addition on the color characteristics of flat bread samples.

BCF level (%)	Bread portion	<i>L</i>	<i>a</i>	<i>b</i>	ΔE
0 (control)		62.88 ± 0.16 ^a	4.49 ± 0.82 ^d	21.15 ± 0.14 ^a	15.59 ± 0.47 ^d
1		51.25 ± 0.11 ^b	7.17 ± 0.39 ^c	9.00 ± 0.12 ^c	16.74 ± 0.94 ^b
2.5	outer	41.15 ± 0.19 ^c	10.79 ± 0.01 ^b	9.43 ± 0.36 ^b	22.49 ± 0.16 ^a
5		35.66 ± 0.68 ^d	11.24 ± 0.10 ^{ab}	7.05 ± 0.15 ^d	9.53 ± 0.93 ^c
7.5		28.46 ± 0.57 ^e	11.79 ± 0.20 ^a	7.21 ± 0.22 ^d	10.17 ± 0.17 ^c
0 (control)		71.59 ± 0.21 ^a	-0.48 ± 0.03 ^c	17.49 ± 0.025 ^a	6.27 ± 0.14 ^a
1		55.69 ± 0.27 ^b	7.14 ± 0.08 ^d	4.94 ± 0.11 ^b	12.32 ± 0.98 ^b
2.5	inner	44.16 ± 0.26 ^c	12.45 ± 0.36 ^c	2.10 ± 0.02 ^d	38.51 ± 0.73 ^d
5		31.01 ± 0.25 ^d	14.18 ± 0.06 ^b	2.14 ± 0.02 ^d	36.22 ± 0.29 ^d
7.5		27.36 ± 0.51 ^e	15.82 ± 0.46 ^a	3.62 ± 0.28 ^c	16.74 ± 0.25 ^c

All data are the mean ± SD of three replicates.

Mean in the same column with different letters differ significantly ($p \leq 0.05$).

Table 4 Effect of different amounts of BCF addition on the sensory characteristics of flat bread samples.

BCF level (%)	Outer part color	Inner part color	Taste-flavor	Odor	Appearance	Overall acceptability
0 (control)	7.5 ± 0.53 ^a	8.0 ± 0.10 ^a	6.7 ± 0.23 ^a	7.3 ± 0.17 ^a	7.2 ± 0.15 ^a	7.6 ± 0.11 ^a
1	7.0 ± 0.19 ^a	5.7 ± 0.22 ^b	6.8 ± 0.10 ^a	6.7 ± 0.18 ^a	6.2 ± 0.21 ^a	6.7 ± 0.22 ^a
2.5	6.8 ± 0.14 ^a	6.5 ± 0.20 ^{ab}	6.1 ± 0.22 ^a	6.7 ± 0.15 ^a	6.7 ± 0.16 ^a	6.8 ± 0.15 ^a
5	7.7 ± 0.13 ^a	7.3 ± 0.18 ^{ab}	6.4 ± 0.21 ^a	6.8 ± 0.15 ^a	7.1 ± 0.23 ^a	6.9 ± 0.19 ^a
7.5	7.3 ± 0.16 ^a	7.1 ± 0.22 ^{ab}	5.2 ± 0.19 ^a	6.5 ± 0.18 ^a	6.6 ± 0.18 ^a	6.8 ± 0.17 ^a

All data are the mean ± SD of three replicates.

Mean in the same column with different letters differ significantly ($p \leq 0.05$).

and crumb depending on BCF level addition [17]. Similarly, the higher the BCF level use resulted in the darker color of outer and inner parts of flat bread in present study. Beside this, an irregular decrease for “*b*” values of both bread portions was observed due to BCF levels ($p \leq 0.05$), although a regular increase for the “*a*” values of outer and inner samples containing 1%, 2.5%, 5% and 7.5% of BCF was found compared to the control samples ($p \leq 0.05$). The higher the BCF level caused an increase in redness for outer and inner parts of flat bread due to the natural coloring pigments. The most total color difference (ΔE) for both outer and inner parts was observed for 7.5% BCF level. In addition, there is not a regular significant increase for total color difference of both samples due to BCF level used ($p \leq 0.05$).

3.5 Sensory Properties

Flat bread fortified with BCF at different levels exposed to sensory evaluation is given in Table 4. Sensory properties such as outer and inner part color, taste-flavor, odor, appearance and overall acceptability were affected positively by the addition of 0%-7.5% BCF. The high level anthocyanin content of BCF darkened the color of bread. However, the color of outer part and inner part, odor, texture and appearance of flat bread are not significantly different from each other ($p > 0.05$). For bread containing 7.5% taste-flavor score was 5.2, whereas the score was markedly greater (6.8 and 6.4, respectively) for bread containing 1% and 5% BCF added flat bread samples. According to the sensory

evaluation by the panelists, overall acceptability bread containing all BCF levels are not different from control sample ($p > 0.05$). Thus, bread fortification with BCF could provide an important balance between nutritional value and sensory quality for consumer preferences towards cereal products as flat bread.

4. Conclusions

The present study showed that the BCF fortification of flat bread consumed by local people is a simple way to increase antioxidant and polyphenolic contents. It can be concluded that acceptable products can be prepared by incorporation of BCF for flat bread production without affecting their physical properties up to 2.5% BCF level. BCF also provides more attractive appearance for bread especially for children due to its brown-purple color. Therefore, BCF fortification could be an alternative way to produce functional flat bread for healthy daily diet. However, further analyses such as textural, rheological, dietary fiber content analyses and also flavor improvement studies are required for more acceptable flat bread samples.

References

- [1] Bay Yılmaz, B., Pekmez, H., and Türker, N. 2018. “Anthocyanin Enigma.” In *Proceedings of the International Conference on Raw Materials to Processed Foods*, 169.
- [2] Giusti, M. M., and Wrolstad, R. E. 2003. “Acylation of Anthocyanins from Edible Sources and Their Applications in Food Systems.” *Biochem. Eng. J.* 14 (3): 217-25.
- [3] Fernandes, I., Marques, F., de Freitas, V., and Mateus, N.

2013. "Antioxidant and Antiproliferative Properties of Methylated Metabolites of Anthocyanins." *Food Chem.* 141: 2923-33.
- [4] Wiczowski, W., Topolska, J., and Honke, J. 2014. "Anthocyanins Profile and Antioxidant Capacity of Red Cabbages Are Influenced by Genotype and Vegetation Period." *J. Funct. Foods* 7: 201-11.
- [5] Kammerer, D., Carle, R., and Schieber, A. 2003. "Detection of Peonidin and Pelargonidin Glycosides in Black Carrots (*Daucus carota* ssp. *sativus* var. *atrorubens* Alef.) by High-Performance Liquid Chromatography/Electrospray Ionization Mass Spectrometry." *Rapid Commun. Mass Spectrom.* 17 (21): 2407-12.
- [6] Kirca, A., Özkan, M., and Cemeroglu, B. 2006. "Stability of Black Carrot Anthocyanins in Various Fruit Juices and Nectars." *Food Chem.* 97 (4): 598-605.
- [7] Kammerer, D., Carle, R., and Schieber, A. 2004. "Quantification of Anthocyanins in Black Carrot Extracts (*Daucus carota* ssp. *sativus* var. *atrorubens* Alef.) and Evaluation of Their Color Properties." *Eur. Food Res. Technol.* 219 (5): 479-86.
- [8] Ktenioudaki, A., and Gallagher, E. 2012. "Recent Advances in the Development of High-Fiber Baked Products." *Trends Food Sci. Technol.* 28: 4-14.
- [9] Francis, D., and Phelps, S. K. 2003. "Fruit and Vegetable Juice Powders Add Value to Cereal Products." *Cereal Foods World* 48: 244-6.
- [10] Gaziantep Commodity Exchange (GTB). 2017. "The Geographical Sign Registration Certificate for Antep Tırnaklı Pidesi (Gaziantep Tırnaklı Pidesi, Antep Pidesi)." No. 223, Gaziantep, Turkey.
- [11] Pekmez, H., and Bay Yılmaz, B. 2018. "Properties of Gaziantep Pita." In *Proceedings of the International Conference on Raw Materials to Processed Foods*, 161.
- [12] Bartl, P., Albrecht, A., Skrt, M., Tremlová, B., Ošťádalová, M., Šmejkal, K., Vovk, I., and Ulrih, N. P. 2015. "Anthocyanins in Purple and Blue Wheat Grains and in Resulting Bread: Quantity, Composition and Thermal Stability." *Int. J. Food Sci. Nutr.* 66 (5): 514-9.
- [13] Rosales-Soto, M. U., Powers, J. R., and Alldredge, J. R. 2012. "Effect of Mixing Time, Freeze-Drying and Baking on Phenolics, Anthocyanins and Antioxidant Capacity of Raspberry Juice during Processing of Muffins." *J. Sci. Food Agric.* 92: 1511-8.
- [14] Sui, X., Yap, P. Y., and Zhou, W. 2015. "Anthocyanins during Baking: Their Degradation Kinetics and Impacts on Color and Antioxidant Capacity of Bread." *Food Bioprocess Tech.* 8 (5): 983-94.
- [15] Sui, X., Zhang, Y., and Zhou, W. 2016. "Bread Fortified with Anthocyanin-Rich Extract from Black Rice as Nutraceutical Sources: Its Quality Attributes and *in Vitro* Digestibility." *Food Chem.* 196: 910-6.
- [16] Song, K. Y., Hyeonbin, O., Zhang, Y., and Kim, Y. S. 2016. "Quality Characteristics and Antioxidant Properties of Sponge Cakes Containing Black Carrot (*Daucus carota* ssp. *sativus* var. *atrorubens* Alef.) Flour." *Prog. Nutr.* 18 (2): 176-83.
- [17] Turksoy, S., Keskin, S., Ozkaya, B., and Ozkaya, H. 2011. "Effect of Black Carrot (*Daucus carota* L. spp. *sativus* var. *atrorubens* Alef.) Fiber Addition on the Composition and Quality Characteristics of Cookies." *J. Food, Agri. Environ.* 9: 57-60.
- [18] Al-Farsi, M. A., and Lee, C. Y. 2008. "Optimization of Phenolics and Dietary Fiber Extraction from Date Seeds." *Food Chem.* 108 (3): 977-85.
- [19] Thaipong, K., Boonprakob, U., Crosby, K., Cisneros-Zevallos, L., and Byrne, D. H. 2006. "Comparison of ABTS, DPPH, FRAP and ORAC Assays for Estimating Antioxidant Activity from Guava Fruit Extracts." *J. Food Compos. Anal.* 19 (6): 669-75.
- [20] Brand-Williams, W., Cuvelier, M. E., and Berset, C. 1995. "Use of a Free Radical Method to Evaluate Antioxidant Activity." *LWT—Food Sci. Technol.* 28: 25-30.
- [21] Kapoor, S., Ranote, P. S., and Sharma, S. 2015. "Antioxidant Potentials and Quality Aspects of Jamun (*Syzygium cumini* L.) Supplemented Unleavened Flat Bread (Indian Chapatti)." *J. App. Natural Sci.* 7 (1): 309-15.
- [22] Ajila, C. M., Leelavathi, K., and Prasada Rao, U. J. S. 2008. "Improvement of Dietary Fiber Content and Antioxidant Properties in Soft Dough Biscuits with the Incorporation of Mango Peel Powder." *J. Cereal Sci.* 48: 319-26.
- [23] Turkmen, N., Sari, F., and Velioglu, Y. S. 2005. "The Effect of Cooking Methods on Total Phenolics and Antioxidant Activity of Selected Green Vegetables." *Food Chem.* 93: 713-8.
- [24] Jdir, H., Jridi, M., Mabrouk, M., Ayadi, M. A., Nasri, M., Zouari, N., and Fakhfakh, N. 2017. "The Rocket, *Diplotaxis simplex*, as a Functional Ingredient: LC-ESI-MS Analysis and Its Effect on Antioxidant and Physical Properties of Bread." *J. Food Nutr. Res.* 5 (3): 197-204.
- [25] Arshad, M. U., Anjum, F. M., and Zahoor, T. 2007. "Nutritional Assessment of Cookies Supplemented with Defatted Wheat Germ." *Food Chem.* 102: 123-8.
- [26] McWatters, K. H., Ouedraogo, J. B., Resurrection, A. V. A., Hung, Y. C., and Philips, R. D. 2003. "Physical and Sensory Characteristics of Sugar Cookies Containing Mixtures of Wheat, Fonio (*Digitaria exilis*) and Cowpea (*Vigna unguiculata*) Flours." *Int. J. Food Sci. Technol.* 38: 403-10.