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THE EFFECT OF MILK POWDER ADDITION ON THE PROPERTIES OF BREAD QUALITY AND FUNCTIONALITY*

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ABSTRACT

Functional foods have a potential impact on human health beyond basic nutrition. It also helps to reduce the risk of disease. In recent years, studies to increase the nutritional value of bread are gaining importance rapidly. In this study, it was aimed to investigate the changes in quality, antioxidant, and sensory properties of bread by adding milk powder to the traditional bread at levels of 2.5, 5, and 10%. The bread samples were prepared with a bread-making machine. TPC (total phenolic contents), FRAP (ferric reducing antioxidant powers), DPPH (2,2-diphenyl-1-picrylhydrazyl), ABTS (2,29-azinobis-(3-ethylbenzothiazoline-6-sulfonic acid), and sensory analyzes were performed. As a result, a certain amount of milk powder additive had a positive effect on sensory properties. While the total phenolic content raised from 4.86 μg GAE/100g to 35.48 μg/100g; the levels of DPPH, FRAP and ABTS increased from 35.42, 39.17, 10.48 μM TEAC to 97.92, 61.11, 21.70 μM TEAC, respectively.
Keywords: Milk powder, bread, total phenolic content, antioxidant activity, sensory analysis.

SÜT TOZU KATKISININ EKMEK KALİTE ÖZELLİKLERİ VE İŞLEVSELLİĞİ ÜZERİNE ETKİSİ

ÖZ

Fonksiyonel gıdalar temel beslenmenin ötesinde insan sağlığı üzerinde potansiyel bir etkiye sahiptirler. Bununla birlikte hastalık riskini de azaltmaya yardımcı olurlar. Son yıllarda ekmeğin, zenginleştirilerek besin değerinin arttırılmasına yönelik çalışmalar önem kazanmıştır. Bu çalışmada, geleneksel ekmeğe, %2.5, 5, ve 10 olmak üzere farklı oranlarda süttozu eklenerek ekmekte kalite, antioksidan ve duyusal özellikleri açısından meydana gelen değişimlerin incelenmesi amaçlanmıştır. Ekmek makinası ile üretilen ekmek numunelerinde, TPC (toplam fenolik içerik), FRAP (demir (II) indirgeyici antioksidan güç), DPPH (2,2-difenil-1-pikrilhidrazil), ABTS (2,29-azinobis-(3-etilbenzotiyazolin-6-sülfonik asit) ve duyusal analizler yapılmıştır. Sonuç olarak, ekmek yapımında belli oranda süttozu katkısının duyusal özellikleri olumlu yönde etkilediği belirlenmiştir. Toplam fenolik içerik 4.86 μg GAE/100g'dan 35.48 μg/100g'a artarken; DPPH, FRAP and ABTS seviyeleri sırasıyla 35.42, 39.17, 10.48 μM TEAC'dan 97.92, 61.11, 21.70 μM TEAC düzeyine yükselmiştir.
Anahtar kelimeler: Süttozu, ekmek, toplam fenolik içerik, antioksidan aktivite, duyusal analiz.

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INTRODUCTION

In the field of food production, the number of studies aimed at enriching food products and improving their qualifications is increasing day by day. The fact that dietary habits are directly related to health has led consumers to become aware of this and expect additional benefits from food (Siro et al., 2008; Kapsak et al., 2011). With these developments, the concept of "functional food" has emerged. This concept expresses to nutrients or nutrient components that positively affect health and reduce the risk of disease (Roberfroid, 1999; Jones, 2002). Functional foods can be obtained by fortifying, enriching or removing several nutrients/antinutrients in foods to support the diet (Biström and Nordstörm, 2002). The concepts of enrichment and fortification can often be used interchangeably, in order to increase the amount of nutrients naturally present in the food or to eliminate the deficiency of a nutrient that is not present in it (Chopra, 1974). Since the benefits are potentially great, enrichment can be a very cost-effective public health intervention (Allen et al., 2006). It has been reported that a wide variety of nutrients and nutritional elements have positive effects on our health and some contribution to the prevention and treatment of some chronic diseases. Functional foods contain natural antioxidant substances such as vitamin C and E, carotenoids to prevent and minimize the effect of oxidative stress caused by free radicals in the organism. Therefore, regular consumption of functional foods is effective in supporting the immune system, preventing and treating cancer, cardiovascular and gastrointestinal system diseases (Coşkun, 2005). Wheat, which is the raw material of bread, contains starch highly as well as dietary fiber, protein, and some vitamins and minerals (Dewettinck et al., 2008). The wheat bread is an important part of the daily diet because it is cheaper, more satisfying and easily accessible than other foods. But it does not provide enough nutritional components, minerals, protein and essential amino acids such as lysine. In recent years, especially in order to interfere with the prevention of malnutrition, efforts are made to increase the nutritional value of bread by strengthening it with various natural additives. Bread enriched with quinoa leaf powder, whole wheat bread enriched with rosemary extracts, flaxseed flour added bread, antihyperlipidemic effective bread enriched with buckwheat, low glycemic index bread, enriched gluten-free bread etc. researches have taken place in the literature. Furthermore, the bread or bread flour mixes that enriched/fortified with micronutrients (iron, zinc, folic acid, etc.) have been presented to consumers in the supermarket nowadays.

For this aim, several studies in which used dairy products about bread enrichment/fortifying were also performed (Amina et al., 2018; Secchi et al., 2018). The skimmed milk powder and whole milk powder have traditionally been used in several bakery products. But they can be replaced by less expensive dairy ingredients such as milk proteins and whey powder with particular functional properties (Kenny et al., 2000). The studies conducted about whey usage on the bread making, the results showed that it reduces fermentation time, decreased the water content, so avoided microbial contamination, provided good organoleptic characteristics with excellent external appearance. Nevertheless, the proteins of dairy products are known to exert negative effects on bread quality, by depressing loaf volume and increasing crumb firmness (Erdogdu-Arnoczky et al., 1996). Additionally, the milk, which is an excellent source for almost all nutrients such as lactose, essential amino acids (isoleucine, leucine, lysine, methionine, threonine, tryptophan, phenylalanine, and valine) and various vitamins and minerals (Jenness, 1988), is necessary for every stage of human life. Because of it rich in several nutrients and protein, it can be used in various bakery products (Jarvis et al., 2006; Hoppe et al., 2008). The milk powder addition instead of fresh milk will contribute to the enrichment of bread in terms of protein, vitamins, and minerals as well as energy value. Moreover, the usage of skimmed milk powder will not cause any rancidity due to oxidation (Tawfik and Huyghebaert, 1999). Also, the dairy ingredients (skim milk powder, caseinate, whey, dry milk) are one of the main additives which are used in the extensive research for the development of gluten-free bread in recent years (Matos and Rosell, 2014).

The main aim of this study is to contribute to the nutritional balance of individuals by increasing the nutritional value of traditional bread by the addition of milk powder at different rates. The effect of the milk powder was evaluated in terms of antioxidant activity and total phenolic content. Because of the depressing effect on to loaf volume of dairy product proteins (Erdogdu-Arnoczky et al., 1996), the volume and specific volume measurements of the bread samples were carried out. In addition, the acceptability of the bread samples by consumers was examined by the sensory analysis.

MATERIALS AND METHODS

Materials

The wheat flour (ash 0.8% max, protein 10.5% min, moisture 14.5% max) for bread making was supplied from Dervişoğlu Flour Industry and Trade Inc. (Trabzon) company. Instant active dry yeast (Dr. Oetker Food Industry Inc. / Izmir), iodized refined table salt (Billur Salt Inc./Izmir) and skimmed milk powder (Pınar Dairy Products Industry Inc./Izmir) were obtained from a supermarket. Energy and nutrient values for 100 g of skimmed milk powder used in the preparation of bread samples: 1518 kj (363 kcal), 1.25 g fat, 52 g carbohydrate, 36 g protein and 1256 mg calcium (157% BRD).

Chemicals

The chemicals used in the analyses were of analytical or HPLC purity and were supplied from Merck (Darmstadt, Germany) and Sigma-Aldrich (St.Louis, USA).

Instruments

In the bread making, a home type bread making machine (Arçelik K-2715) with a double-compartment mold was used. For preparation and extraction of bread samples; analytical scales (Ohaus, Pioneer TM Balances, PA214C, Parsippany, USA), homogenizer (Daihan Scientific Co. Ltd., WiseTis HG-15A), multi-heater magnetic stirrer (Wisestir, SMSH-6, Daihan), centrifuge (K2015R Centurion Scientific, UK), vortex (MS1 Mini-shaker vortex, IKA® Works, Inc., USA), spectrophotometer (Shimadzu UV-1800, Japan) were used. In addition, black band filter paper (Whatman black ribbon ashless, 589/1) was used for filtration.

Methods

Preparation of Bread Samples

Without any modification, the process steps (kneading, baking, baking steps, and durations) previously optimized by Burnaz et. al. (2018) were adapted to the special program (no.11) of the bread making machine and used. The special program steps were set as: 1) 14 min knead, 2) 32 min rise, 3) 8 min knead, 4) 31 min rise, 5) 50 min last fermentation, 6.) 62 min bake at 180°C. The amounts of water, salt, yeast and milk powder used in the production of bread dough are given in Table 1. These amounts were determined after the literature survey on bakery products and the preliminary experiments in the laboratory. At the end of the baking, the bread samples were removed from the bread machine and kept at room temperature for 24 h. Then the weights of bread samples were measured in terms of grams on the analytical scales. Bread volumes were measured in terms of cm^3 based on the technique of displacement with rapeseeds (AACC, 2001). In bread samples, the "specific volume" that is used as a quality parameter was measured. The specific volume is calculated as the ratio of bread volume to bread weight and expressed as cm^3/g (Koca and Anıl, 1999; Doğan and Yıldız, 2009). With the help of double-compartment mold, the breads were prepared in duplicate.

Table 1. Bread formulations

Additives (g)	*Bread Formulations (Codes)			
	F-1	F-2	F-3	F-4
Wheat flour	300	300	300	300
Skimmed milk powder	-	7.5	15	30
Salt	3.87	3.87	3.87	3.87
Yeast	3	3	3	3
Water	180	180	180	180

* F-1: control, F-2: 2.5% skimmed milk powder added, F-3: 5% skimmed milk powder added, F-4: 10% skimmed milk powder added bread formulations.

Preparation of Bread Extracts

Five grams of sample were taken into a flask and mixed with 50 mL of 80% aqueous methanol. A homogenizer was used to prepare a homogeneous mixture. The mixture extracted on a multi-heater magnetic stirrer at 37°C, 750 rpm, for 2 hours. Then centrifuged at 5000 rpm for 15 min at room temperature and then the supernatant was filtered through the filter paper (Ertop and Sarikaya, 2017). The last volumes completed to 50 mL with the 80% aqueous methanol solution. The extracts were stored in a refrigerator at 4°C for use later in the analyses.

Total Phenolic Content

Total phenolic contents (TPC) were determined according to the Folin-Ciocalteu method. (Singleton and Rossi, 1965). 0.5 mL of Folin-Ciocalteu (1:10 diluted with distilled water) reagent solution was added to each 0.1 mL extract solution and kept in the dark for 5 min. Subsequently, 0.4 mL of sodium carbonate (1M) solution and 4 mL of distilled water were mixed and were kept at room temperature in the dark medium. After 1 hour, the absorbance of the samples was measured at 765 nm with the spectrophotometer. In the analyses, each sample was prepared in triplicate and the sum of the sample and reagent blank values were subtracted from the average of absorbance values and the graphics were plotted with data. The calibration curve was prepared with data obtained from the gallic acid standard (dissolved in methanol) in the range of 0 to 0.200 mg/mL. Total phenolic contents were expressed as μg gallic acid per 100 g dry sample (μg gallic acid equivalent/100 g dry sample, μgGAE/100g DW).

DPPH (2,2-diphenyl-1-picrylhydrazyl)

DPPH• radical solution was prepared for the determination of free radical-scavenging antioxidant activity according to a previously described method (Brand-Williams, 1995). The purple DPPH radical solution is reduced to yellow color when mixed with an antioxidant which can give hydrogen atom. Firstly 100 μM DPPH• radical solution was prepared in 80% aqueous methanol. Then Trolox® standard solutions were prepared in methanol at different concentrations from 0 to 200 μM. For analysis, a 2.9 mL stable DPPH• radical solution (100 μM) was added to each 0.1 mL of standards/extracts and then mixed with the vortex. After 1 hour at dark and room temperature, the absorbance was read at 517 nm. The sample/standards were studied in three parallel. The standard calibration curve was plotted, and the results were calculated and expressed in terms of μM TEAC (Trolox® equivalent antioxidant capacity) and inhibition % DPPH• scavenging. DPPH inhibition percentage was calculated by the following formula:

$$Inhibition\% = \frac{A_{DPPH} - A_{Sample}}{A_{DPPH}} x100 \quad (1)$$

A_{DPPH} = absorption of blank DPPH solution (t=0 min);

A_{Sample} = absorption of tested extract solution (t=60 min).

FRAP (ferric reducing antioxidant power)

FRAP method was performed to determine the antioxidant capacity developed by Benzie and Strain (1996) was used. The FRAP assay is based on Fe^{3+}-TPTZ complex is reduced in the presence of antioxidants to form the blue complex Fe^{2+}-TPTZ and this complex gives maximum absorbance at 595 nm. Briefly, fresh FRAP reagent solution was prepared by mixing three solutions respectively in a ratio of 10:1:1; acetate buffer (300mM) adjusted to pH 3.6 by addition of acetic acid, 10 mM 2,4,6-Tris (2-pyridyl) -s-triazine (TPTZ) dissolved in 40 mM HCl, and 20 mM ferric chloride hexahydrate ($FeCl_3.6H_2O$) dissolved in purified water. Then, different concentrations in the range of 0-1000μM were prepared from the standard Trolox® (in methanol). For analysis, 1950 μl FRAP solution was added to each 50 μL of standards/extracts and then vortexed. After 20 min at dark and room temperature, the absorbance was read at 595 nm. The standard calibration curve was plotted with the data of the Trolox® standard and FRAP values were calculated in terms of μM TEAC. The sample/standards were studied in three parallel. In this method, the increased absorbance value indicates the increased reducing power.

FRAP value = μM Trolox® concentration corresponding to sample absorbance.

ABTS (2,29-azinobis-(3-ethylbenzothiazoline-6-sulfonic acid))

The stable ABTS•+ radical solution was prepared according to a previously described method for the determination of free radical scavenging antioxidant activity (Re et al., 1999). Firstly, the ABTS•+ radical solution was prepared the day before. ABTS stock solution was obtained by mixing 7 mM ABTS•+ radical cation solution with 2.45 mM potassium persulfate solution in pure water. The prepared solution was waited in the dark at room temperature for 16 h. The day after, the solution was diluted with ethanol until the absorbance reaches 0.70 (± 0.02) AU at 734 nm. Then Trolox® standard solutions were prepared in ethanol at different concentrations from 0 to 500 µM. For analysis, 1950 µl $ABTS^{\bullet+}$ radical solution was added to each 50 µl of standards/extracts and mixed with a vortex. After 20 min at dark and room temperature, the absorbance was read at 734 nm. The sample/standards were studied in three parallel. The net absorbance values were obtained by using the same calculation method as in DPPH. The standard calibration curve was plotted, and the results were calculated and expressed as µM TEAC and inhibition % $ABTS^{\bullet+}$ scavenging. ABTS inhibition percentage was calculated by the following formula:

$$Inhibition\% = \frac{A_{ABTS} - A_{Sample}}{A_{ABTS}} x100 \quad (2)$$

A_{ABTS} = absorption of blank ABTS solution (t=0 min);

A_{Sample} = absorption of tested extract solution (t=20 min).

Sensory Analysis

Consumer choice is important for the bread obtained by the enrichment process to gain an industrial dimension (Mialonet al., 2002). In this context, the sensory evaluation was made in the breads obtained in order to determine the taste tendencies and tastes of the consumers and compare the products. In the sensory analysis, a form was formed in order to evaluate the preference or liking status of consumers in terms of color, appearance and sensory characteristics of bread samples (Altuğ-Onoğur and Elmacı, 2011). In this form, breads were coded with randomly selected 3-digit numbers. Bread samples were sliced and placed on plates and presented to eighty-five panelists. Samples were evaluated by using a 9 point hedonic scale test at which 1 is dislike extremely and 9 is like extremely (gradation of liking statuses was respectively as; "1.) dislike extremely, 2.) dislike very much, 3.) dislike moderately, 4.) dislike slightly, 5.) neither like nor dislike, 6.) like slightly, 7) like moderately, 8.) like very much, 9.) like extremely") (Lawless and Heymann 2010). The scores equal to or higher than 5, indicate the acceptability of the sample (Torbica et al., 2010). The scores given to the breads containing milk powder additive were compared to the control bread and the results were evaluated statistically.

Statistical Analysis

SPSS (Statistical Package for Social Science) 20.0 package program was used for statistical analysis. LSD and Duncan tests were used (One-Way ANOVA-Post Hoc Multiple comparisons) while comparing the phenolic content, antioxidant analysis (DPPH, FRAP, ABTS), and the sensory analysis results of the breads enriched with milk powder additive and the control breads.

RESULTS AND DISCUSSION

Determination of Bread Quality Characteristics

Staling is a factor that limits the shelf life and thus reduces the acceptability of bread (Çolakoğlu, 2011). In addition to weight and volume measurements in determining the bread quality characteristics, specific volumes (cm^3/g) used as a quality parameter in terms of delayed staling are given in Table 2.

The specific volumes of the breads were ranged from 2.95 to 3.91 cm^3/g according to formulation type. The highest specific volume was found in control white bread (3.91 cm^3/g) and the lowest specific volume was found in bread with 10% milk powder added (2.95 cm^3/g). Therefore, it can be considered that the milk powder additive cannot contribute to the bread in terms of shelf life. When the data in the table were evaluated, there was no statistically significant difference between the weights of the 5% milk powder

supplemented bread which was closest to the control bread quality parameters, while the volume of the control bread was significantly higher than the others.

Table 2. Bread properties

Bread Codes†	Weight (g)*	Volume (cm^3)*	Specific Volume (cm^3/g)*
F-1	400.99 ± 2.31^{b}	1568 ± 11.31^{a}	3.91 ± 0.006^{a}
F-2	386.05 ± 2.79^{c}	1206 ± 14.14^{c}	3.12 ± 0.014^{c}
F-3	395.72 ± 1.51^{b}	1359 ± 9.90^{b}	3.43 ± 0.012^{b}
F-4	413.22 ± 2.55^{a}	1218 ± 10.61^{c}	2.95 ± 0.008^{d}

† F-1: control, F-2: 2.5% skimmed milk powder added, F-3: 5% skimmed milk powder added, F-4: 10% skimmed milk powder added bread formulations.
*Values represent the means ± standard deviations, (N=2). Values followed by different superscript letters in the same column are significantly different from each other (LSD and Duncan's tests, $P < 0.05$).

In a study conducted by Özer and Altan (1995), the ascorbic acid, sugar, amylase enzyme, lecithin, fat and milk powder were used in various bread formulations and then compare the pore structure, moisture content properties of the bread samples with control bread. They stated that 1% of milk powder contribution had no significant effect on the volume properties of bread.

Demir et al. (2009) investigated the effect of whey, churning, and strained yoghurt juices, which is one of the by-products of dairy products, on bread quality. They investigated the effect of dairy by-products on dough rheological properties and also volume, specific volume, crust color, texture and color values of breads in the production process. They found the volume and specific volume of the control bread to be higher than those formulated breads, similarly as the present study.

Nunes et al. (2009) developed gluten-free bread formulation using different dairy powders as additives and evaluated the effect of these additives on the breads rheological and baking quality. When the breads were compared, milk powder added breads had the lowest water hydration capacity and texturally, particle size was higher than whey protein isolate, spray-dried whey protein isolate, and milk protein isolate.

Total Phenolic Contents of Breads

Total phenolic contents of bread extracts were found in terms of gallic acid equivalent (GAE) and calculated on dry matter and the results are given in Table 3.

Table 3. Comparison of total phenolic contents and antioxidant activities of the breads.

Bread code†	Total phenolic content*	DPPH*		FRAP*	ABTS*	
	μg GAE/100g DW	μM TEAC	Inhibition %	μM TEAC	μM TEAC	Inhibition %
F-1	$4.86^{c} \pm 1.79$	$35.42^{d} \pm 1.91$	$2.63^{d} \pm 0.15$	$39.17^{b} \pm 3.33$	$10.48^{d} \pm 0.26$	$13.99^{d} \pm 0.34$
F-2	$5.44^{c} \pm 1.31$	$72.50^{c} \pm 5.00$	$5.45^{c} \pm 0.36$	$41.67^{b} \pm 3.01$	$15.41^{c} \pm 0.34$	$20.57^{c} \pm 0.45$
F-3	$26.90^{b} \pm 1.47$	$87.08^{b} \pm 5.63$	$6.55^{b} \pm 0.41$	$43.89^{b} \pm 5.09$	$16.78^{b} \pm 0.22$	$22.40^{b} \pm 0.29$
F-4	$35.48^{a} \pm 2.48$	$97.92^{a} \pm 3.15$	$7.37^{a} \pm 0.24$	$61.11^{a} \pm 2.93$	$21.70^{a} \pm 0.50$	$28.98^{a} \pm 0.67$

† F-1: control, F-2: 2.5% skimmed milk powder additive, F-3: 5% skimmed milk powder additive, F-4: 10% skimmed milk powder additive bread formulations.
*Values represent the means ± standard deviations, (N=3). Values followed by different superscript letters in the same column indicate a statistically significant difference between the data (LSD and Duncan's tests, $P < 0.05$).
GAE: Gallic acid equivalent, TEAC: Trolox® equivalent antioxidant capacity, DW: Dry weight

According to the data, it was determined that milk powder additive increases the total phenolic content of bread and thus antioxidant activity. So, there is a linear relationship between milk powder additive and total phenolic content in the bread.

Antioxidant Activities of Breads

Ferric (III) reducing antioxidant power and scavenging activities of DPPH/ABTS free radicals in bread extracts were calculated in terms of Trolox equivalent antioxidant capacity (TEAC) and calculated on dry matter and the results are given in Table 3.

According to the data, the bread samples made by adding different ratios of milk powder have higher antioxidant activity as it depends on the usage ratio compared to control bread. Compared to control bread, no significant difference was found between FRAP values when milk powder was added to the breads below 10% ($P > 0.05$).

The results of LSD and Duncan's tests indicate a statistically significant ($P < 0.05$) difference between enriched bread samples with milk powder and control bread, especially in terms of DPPH and ABTS radicals scavenging activities. As a result, it was found that there was a linear relationship between milk powder additive and antioxidant activity in the bread.

In the present study, antioxidant activities and total phenolic content of the bread samples enriched with milk powder were researched. In the breads developed with milk and dairy product additives, only rheological structure and quality parameters (Kenny et al., 2000; Demir et al., 2009; Alsuhaibani, 2018) of bread were examined. In this context, no comparable study was found in the literature. There are bioactive peptides that are separated and characterized from the milk and milk product proteins with various biological activities such as antimicrobial, immunomodulatory, antithrombotic, and antioxidative activities in the literature. The strong antioxidant activity of these peptides was attributed to their high content of some amino acids such as histidine and leucine, both known to be effective inhibitors for the oxidation of unsaturated fatty acids (Abd El-Salam and El-Shibiny, 2013)

Sensory Analysis in Breads

In the sensory analysis, general acceptability statuses were determined by averaging the scores given by the panelists to evaluate each bread sample. When the results were taken into consideration, it was found that the bread with 10% milk powder added was the most acceptable (8.26 / 9) and the average general liking status was described as "like very much". Panelists' general liking statuses of the other breads: 5% milk powder added bread "like moderately" (7.38 / 9), 2.5% milk powder added bread "like moderately" (7.04 / 9), control bread "like slightly". Although the standard deviations (STD) in sensory analyzes ranged from 0.97 to 1.48, a statistically significant ($P < 0.05$) difference was found in general likings and the linear increase in sensorial liking scores by the milk powder supplementation compared to the control bread (Table 4).

Table 4. Overall acceptability of panelists about the breads.

Bread code†	Average scores*	Acceptability
F-1	$6.60^{c} \pm 1.48$	like slightly
F-2	$7.04^{b} \pm 0.97$	like moderately
F-3	$7.38^{b} \pm 1.28$	like moderately
F-4	$8.26^{a} \pm 1.09$	like very much

† F-1: control, F-2: 2.5% skimmed milk powder added, F-3: 5% skimmed milk powder added, F-4: 10% skimmed milk powder added bread formulations.

*Values represent the means ± standard deviations, (N=85). Values followed by different superscript letters in the same column are significantly different from each other (LSD and Duncan's tests, $P < 0.05$).

In an available study in the literature, when the turmeric powder at 2% ratio was added to the bread dough, although the sensorial properties were higher than the control bread, the general acceptability was found to be quite low at the rate of 4%, 6%, and 8% (Lim et al., 2011). In this study, the general acceptability increased with the increasing milk powder addition. Because of the excess in milk powder addition causes to reduce the bread quality characteristics, milk powder was

added between 1-10% in preliminary experiments. In similar studies, the addition of whey protein, acid casein, medicinal and aromatic spices such as flaxseed, black seed, turmeric, ginger in functional bread-making had caused changes in the rheological structure of the bread, a decrease in the specific volume and a decrease in the bread quality (Kenny et al., 2000; Lim et al., 2011; Balestra et al., 2011; Osman et al., 2014). However, the additives generally provide an increase in functional aspects and may have a positive or negative effect on sensory properties.

CONCLUSION

As a result, it has been observed that the addition of milk powder additive in over a certain ratio affects bread quality characteristics negatively; however, it was found that phenolic content, the antioxidant activity, and sensory properties positively affected. Milk is an excellent source of many nutrients. Skimmed milk powder, which is a dairy product, is an important natural additive especially in terms of protein and calcium. In our country, since individuals consume a lot of bread in their daily nutrition, it can be considered that by the milk powder addition, he nutritional value of bread will be increased and benefit to individuals. In this context, it is envisaged that bread, which is the main foodstuff, can be enriched nutritionally and can be entitled to the food sector as a functional product by adding milk powder.

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