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Article

The effect of using green tea on the quality characteristics of sponge cake.

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ABSTRACT

The research aimed to determine green tea powder's total protein, phenolic content, and vitamin C. The results were protein1.12%, phenolic content 143 mg / 100g and vitamin C 68 mg / 100g respectively. Beside. The functional properties were also determined. According to the results, green tea powder had a high water holding capacity of 254% and an oil holding capacity of 214% compared with wheat flour. The research also determined the effect of replacing wheat flour with green tea powder at 5%, 7.5% and 10%. The results showed that sponge cake made from green tea at level 5% was higher in short compared with the other sample and control. The hardness of sponge cakes decreased from 700 g, 550 g – 400 g, 350g, to 340 g with an increased additional level of green tea powder. The sponge cake was stored at 25-30Cº for 8 days. The results showed that the peroxide value increased during storage; a high peroxide value was observed in the control sponge cake from 0.4 to 7 liquid Kg. In contrast, low peroxide values ranged from 0.2 to 1 liquid.Kg in sponge cake containing green tea 10%.The results demonstrated that green tea could be a good source of antioxidants in food industries.

Keywords: phenolic, vitamin C. water holding capacity, sensory evaluation, hardness

INTRODUCTION

Tea is a popular beverage originating in Asia and is generally classified into green, black, and oolong tea according to processing techniques. As the most biologically active group in tea ingredients, tea polyphenols have great potential in preventing or reducing the risk of oxidation-related chronic diseases and cancers [1], and everyday consumers may benefit from maintaining good health and long life (Bajerska et al.,2010). The tea itself is no longer a food ingredient processed only for beverages but an ingredient that can be added to a food and beverage product. [2]. These new foods provide nutrition and combine the flavors of food and tea .[3]. Adding an adequately selected, mainly natural, antioxidant

determines food's strength, quality and safety in storage. [4]. Tea can extend the shelf life of foods without affecting their sensory or nutritional quality. [5].

Bakery products containing tea use tea extract, flour, yeast, eggs, oil, protein sugar, milk, salt, fruit and hydrocolloids [3]. With the development of bakery industries, the demand for healthy and functional foods is increasing, not just using cake flour. Sponge cake is one of a variety of cakes made by denaturing the egg whites in the dough [6]. We are researching adding grain, vegetable or fruit powders to sponge cakes to improve sensory and physicochemical properties. [7] showed the use of green tea in the production of sponge cake. [8] found cake enriched with up to 20%green tea replacing was the best sensory acceptability.

MATERIALS AND METHODS

Alatter green tea was purchased from the Basrah local market and ground into fine powder. The green tea powder was stored at 4°C in the dark until Wheat flour, sugar, eggs, milk, sunflower and vanilla were purchased from a Local market in Basrah.

Determination of protein

The protein of green tea powder was determined by using the Kjeidahi method [9]

Determination of total phenols

Total phenol content was measured using the Folin-Ciocalteu method according to [10]. Briefly, 300µL of green tea was put in a test tube and mixed with 1.5 ml of Folin-Ciocalteu, then adding 1.2 ml of (7.5% w/v) sodium carbonate. The tube was mixed and kept for 30 minutes at 25℃

in a dark room for 30 minutes. 25℃ . The absorbance was read at 765 nm by a UV-Vis spectrophotometer. Gallic acid was used to construct the standard curve. Gallic acid standards were Prepared by diluting 100mg of pure Galillic acid in 500 ml of distilled water

Determination of Vitamin C

Vitamin C content was determined using the 2,6-dichloroindophenol titrimetric method, according to the method followed by El-far et al.(2016). The sample was titrated against the solution of 2,6-dichloroindophenol until the pink color lasted for 10 seconds. The result was determined in mg of ascorbic acid per 100 g of the tea.

Functional properties

The water and oil holding capacity of green tea and wheat flour were determined according to the method, followed by [7] samples placed in test tubes, added to 10 ml of distilled water or sunflower oil, and centrifuged at 3000 rpm for 15 min. The suspension was a stand for 1h. The supernatant was removed. The water or oil absorbed pomace weight was Calculated by equations 1 and 2.

$$\text{Water Holding Capacity} = \frac{\text{water obsorbed sample weight} - \text{dry sample weight}}{\text{dry sample weight}} * 100 \quad (1)$$

$$\text{Oil Holding Capacity} = \frac{\text{Oil obsorbed sample weight} - \text{dry sample weight}}{\text{dry sample weight}} * 100 \quad (2)$$

manufacture sponge cake

The formulae sponge cake recipes are shown in Table 1.

The Ingredients	Amount
Green tea	5 – 10%
Wheat flour	100 g
Whole egg	72g
Sunflower oil	57g
when	4g
Nonfat dry milk	2g
Baking powder	2g
Vanilas	0.5 g
water	30 ml

Table 1. Preparation of sponge cake

The sponge cake was prepared according to the method followed by Gaboos et al.(2018): sugar and sunflower oil were mixed for 4 minutes, whole eggs were placed in a mixture and mixed for 4 minutes, and baking powder, flour, nonfat dry milk, whey and vanillas were placed in a mixer and mixed for 4minute, water was placed in a mixer and mixed for 1 minute. 30 g of cake batter was placed in the cake pan and baked in an electric oven at 195Cº for 30 minutes; after baking, the cake was cooled at room temperature and put in polythene bags

Sensory evaluation

Ten semi-trained judges did the sensory evaluation of the sponge cake. Food Science, College of Agriculture, University of Basrah. Semi-trained judges were assessed on a nine-point hedonic scale. The sensory evaluation contains cumb color, texture, porosity, flavor, and overall acceptability.

Textural properties

Textural properties of sponge cake were measured using Stable Micro System TA -XT plus according to the method following by [11]. The experiment is arranged to calculate the hardness at the time of the experiment by determining the load. And the movement of the predetermined point on the TPA curve 5-5. Probe at 20 min/sec. Speed before and after the test and 75% compression were selected for TPA analysis. The maximum force required to break the sponge cake is recorded as hardness.

Storage

After cooling, sponge cake pieces were placed in a polyethylene bag and stored at 25-30Cº for 8 days. Cake pieces were ground into fine powder to determine the peroxide value.

Peroxide value

Peroxide value was measured according to the method followed by Timoshenkova et al.(2020)

Statistical analysis

These data were analyzed using GenState Release's (2009) analysis of variance (ANOVA). LSD carried out a comparative analysis between parameters. LSDprobability ($P < 0.05$).

RESULTS

The result presented in Table 2 illustrated that green tea had a high phenols content of 143 mg / 100g and vitamin C 68 mg / 100g. respectively
Also, the result showed that green tea had low protein

Parameter (%)	green tea
Protein	**3.88**
Phenolic	**143 mg / 100g**
Vitamin C	**68 mg / 100g**

Table 2. Total protein, Phenolic and Vitamim C of green tea

Functional properties

The water holding capacity and oil holding capacity are shown in Table 4. There were no significant differences ($P<0.05$) in The water-holding capacity between green tea powder and wheat flour. The high water holding capacity was observed in green tea at 254% compared with the water holding capacity of wheat flour at 114%.

There were also no significant differences ($P<0.05$) in oil holding capacity between green tea powder and wheat flour. The low oil holding capacity was observed in wheat flour at 211%, compared with the oil-water holding capacity of green tea powder at 214%. This difference might be related to the particle size of the material.

Properties	Green tea	Wheat flour
Water holding capacity **(%)**	254%a	**114%a**
Oil holding capacity**(%)**	214%b	**211%b**
level significant	*	*****

Table 3. Functional properties of green tea and wheat flour

These results agreed with Baljeet et al. (2014) That The high water holding and holding capacities were 149.3% and 169%, respectively.

Sensory evaluation of green tea sponge cake

Table 4 showed significant differences ($P<0.05$) between the control cake and cake containing different levels of green tea powder. lt could be seen from Table 4 and Figure 1 the effect of adding green tea on the color and flavor. The lowest scores for color and flavor were observed in cake containing green tea at 7.5% and 10% at 6.61,4.63%, and 7.33**,** 6.49%, while the highest scores were observed for color in control cake at 8.64**%.** The resin belonging to the cake became green in color. The strongest flavor was observed in a cake containing 5% green tea.

Adding green tea powder significantly improves the flavor and texture of sponge cake at a 5% level, with a gradual decrease in Porosily and texture at 7.5% and 10*%*, 7.46% for Porosily and 8.14, 7.14% for texture. The best values were when adding green tea powder at a replacement rate of 5%.

levels	Cumb color	Porosity	Flavor	Texture	Overall acceptability
0%	8.64a	8.49a	7.98a	8.18a	**8.15ab**
5%	8.01b	8.70a	8.17a	8.42a	**8.33a**
7.5%	6.61c	8.47a	7.33ab	8.14a	**7.69b**
10%	4.63d	7.46b	6.49b	7.14b	**6.48c**
	*	*	*	*	**level significant**

Table 4. Sensory evaluation of green tea sponge cake (Ghaboos et al.,2018)

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0% 5% 7.5% 10%

Figure 1: The effect on the color caused by the addition of different concentrations of green tea

The sensory evaluation values decrease as the replacement ratio increases compared to the control sample.

samples	Hardness
0%	**700 g, 550 g**
5%	**540 g, 450 g**
7.5%	**250 g**
10%	**400 g , 350 g , 340 g**

Table 5. Texture analysis of sponge cake replacement with green tea powder

The texture properties of sponge cake are in Table 3 and Figures 2, 3, 4 and 5. Hardness changed when wheat flour with different levels of green tea. The hardness of the cake decreases from 700, 550 to 400g, 350 g, and 340 g with the replacement of green tea powder from 0 to 10% level.

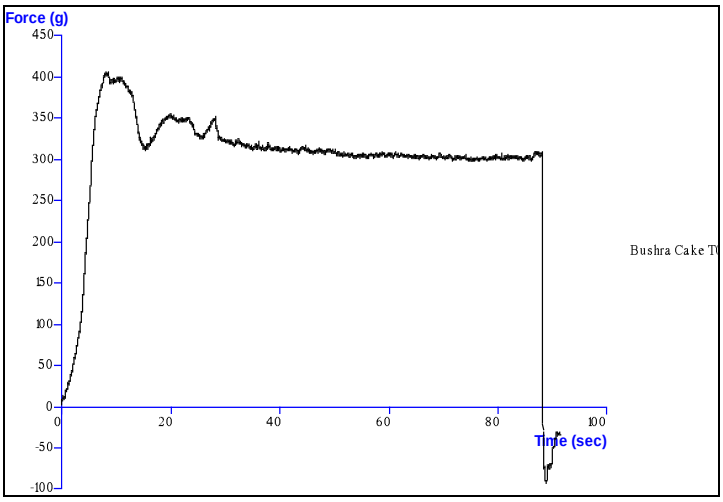

Figure 2. Representative TPA fight for control samples

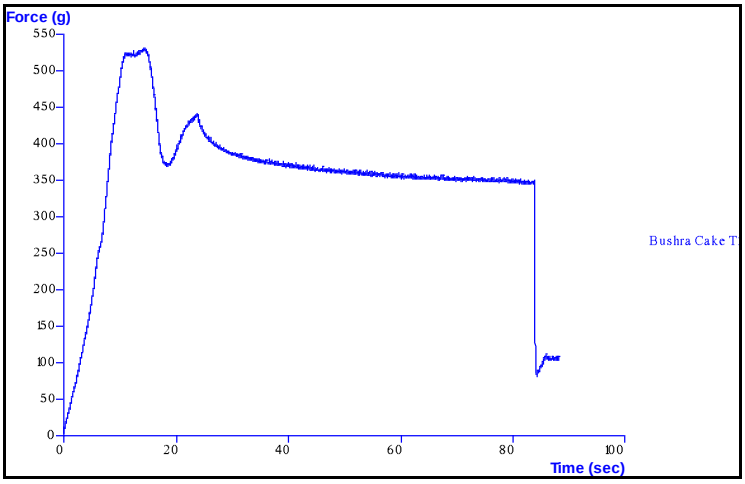

Figure 3. Representative TPA forTPAonge cake sample (5% green tea powder)

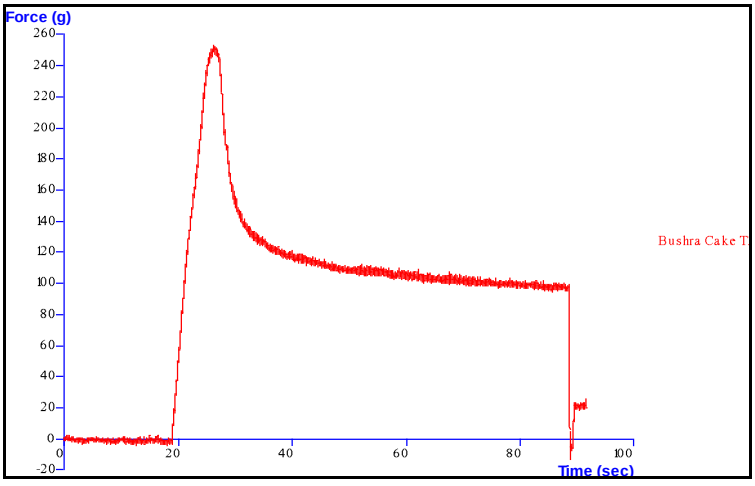

Figure 4. Representative TPA forTPAonge cake sample (7.5% green tea powder)

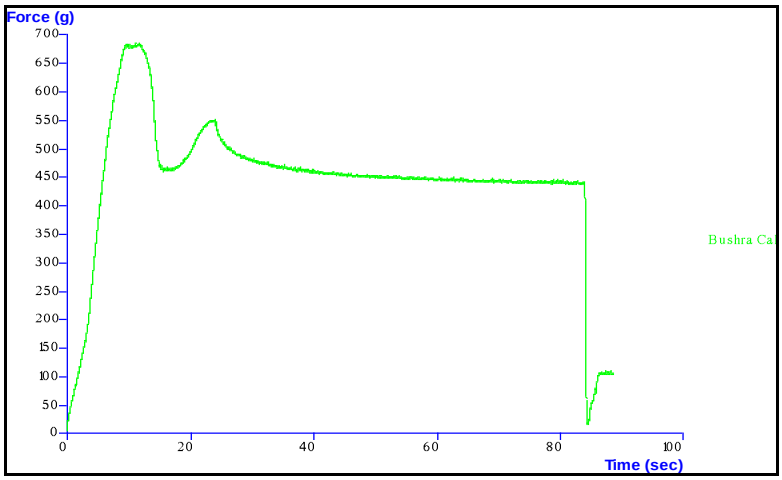

Figure 5. Representative TPA forTPAonge cake sample (10% green tea powder)

The results were presented in Table 6, and Figures 6, 7,8 and 9 indicate that the replacement of green tea powder from 5% to 10% decreased the crispness from 2500 g, 2100 g for control to 2100 g, and 1700 g in cake containing different levels of green tea.

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samples	Force	Force / 75 second
0%	2500 g	**2100 g**
5%	1250 g	**1100 g**
7.5%	2000 g	**1600 g**
10%	2100 g	**1700 g**

Table 6. The crispness of sponge cake was replaced with green tea powder

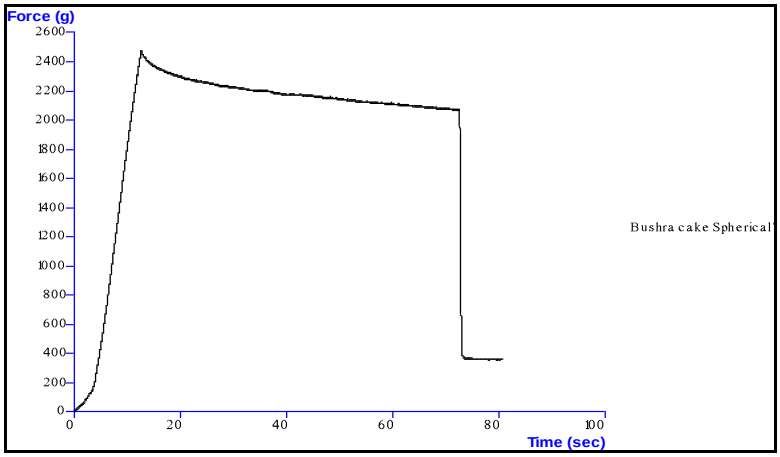

Figure 6. Representative TPA fights for the control sample

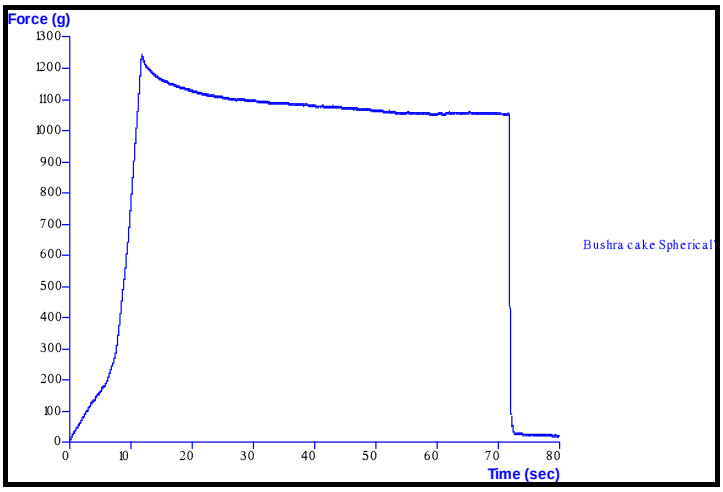

Figure 7. Representative TPA forTPAonge cake sample (5% green tea powder)

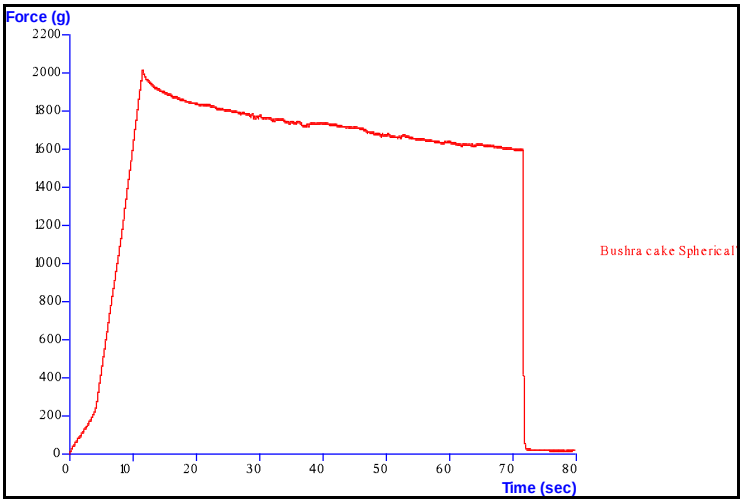

Figure 8. Representative TPA forTPAscuit sample (7.5% green tea powder)

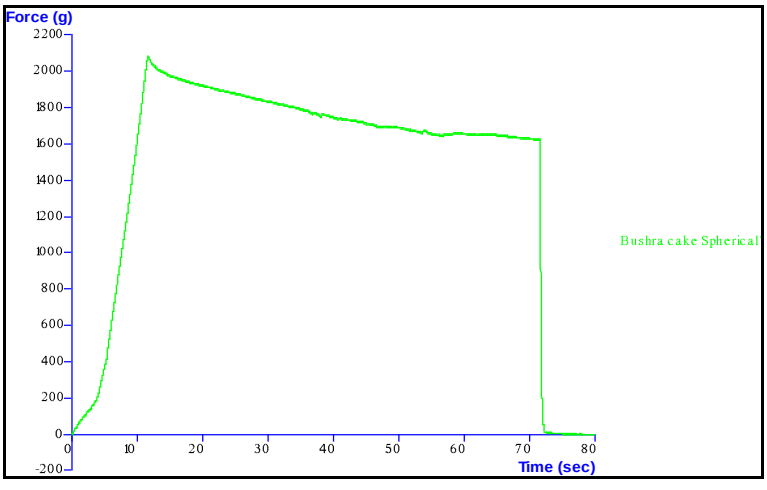

Figure 9. Representative TPA forTPAscuit sample (10% carrot pomace powder)

The effect of adding green tea powder and storage period on the quality of sponge cake

The results of the sponge cake are presented in Table 7 and Figure 10. There were significant differences (P<0.05) between the control cake and all cakes containing different levels of green tea powder in effect tea concentration and effect days. The results showed that the peroxide value increased as the storage period increased; it was observed that the higher peroxide value in the control cake was 0.4 to 7 liquid.Kg, whereas the lowest peroxide value in cake is 10% green tea powder 0.2 to 1 liquid. Kg.

Tea concentration	days					Effect tea concentration
	0	2	4	6	8	
0%	0.40	0.50	1.5	2.0	7.0	**2.28a**
5%	0.57	0.47	0.99	1.0	2.0	**0.966b**
7.5%	0.30	0.40	0.85	0.99	1.5	**0.808b**
10%	0.20	0.30	0.70	0.85	1.0	**0.61b**
	2.875a	1.21b	1.0b	0.41c	0.37c	**Effect days**

Table 7. The effect of green tea concentration and storage period on peroxide value

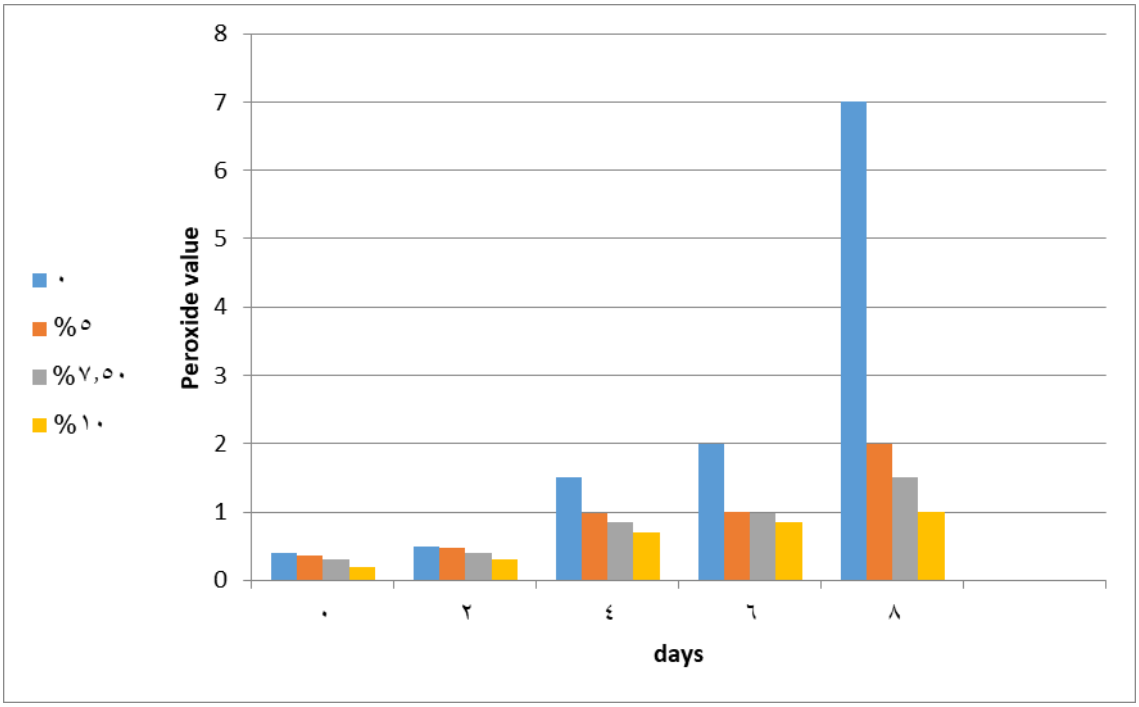

Figure 10. The effect of adding green tea powder and storage period on the quality of sponge cake

DISCUSSION

The results were similar to The report by Kausar et al. (2018), who showed that green tea had 6.24% moisture, 1.80% fat and 9.45% fiber. Also, the results were lower than those reported by [10], showing green tea had a Phenolic content of 184.58 mg / 100g. The holding capacities increased when using smaller particle sizes due to the highest bulk density of smaller particles [12]. The color is thought to come from chlorophyll pigment, which breaks down at high temperatures [13].

The lowest hardness was reached in the level 10 % green tea 400g, 350 g, 340 g. The reduction in hardness might be due to changes in gluten content [14]; gluten reduction in sponge dough by replacing green tea resulted in delayed gluten matrix formation. The results agreed with the report by [15] that the hardness of sponge cake decreased with the replacement of barley flour. The results agreed with those reported by [5], who studied the effect of adding green tea powder on bread quality and found that the control bread had the highest peroxide value compared to the bread containing different concentrations of green tea. Unsaturated fatty acids in bread were easily oxidized during storage and led to off-flavors and bitterness. [4] showed that unsaturated fatty acids in the cake were easily formed by oxidation during storage. Off-flavors and bitterness Green tea extract were found to have excellent antioxidant effects on biscuit lipid stability.

CONCLUSIONS

It could be from the results of research utilization of green tea powder for improving the nutritional value of sponge cake because green tea has high phenols content and vitamin C . Besides, green tea has high water and oil holding capacity. In contrast, wheat flour has low water and oil holding capacity. The results showed that replacing wheat flour with a 5% level of green tea powder positively affected sensory evaluation. Higher scores were obtained at the 5% level, while levels 7.5 and 10% showed lower scores. The hardness of sponge cake was slightly decreased as the replacement level of green tea. Storage studies of sponge cake showed a higher peroxide value was observed in the control cake, while a higher peroxide value was observed in cake containing tea at 10%. Our research shows that tea retards the fatty acid oxidation of green tea cake and demonstrates its ability to prolong the shelf life of the cakes. The result showed that green tea, a good source of phenols and vitamin C, could be used in food industries such as sponge cake.

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