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ORIGINAL ARTICLE

Quality Significance and Assessment of Bread Spiced with Chili Pepper *(Capsicum annuum)*

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Abstract

This study was carried out to assess the quality significance of wheat flour bread spiced with chili pepper at varying proportion. Chemical composition and functional properties of spiced wheat flour were determined. Physical characteristics, vitamin A, beta-carotene and sensory evaluation of spiced bread were also evaluated. The results showed that the moisture ranged from 9.67-14.83%, protein from 8.44-12.53%, ash from 0.69-3.57%, fiber from 0.84-1.47% and fat from 1.13-3.00% respectively. The results of the proximate composition increased significantly ($p<0.05$) with increase in chili pepper. The values recorded for wheat flour spiced with 10% was significantly higher. Swelling power and water absorption capacity decreased significantly ($p<0.05$) with increase in chili pepper. Significant difference ($p<0.05$) exists in the values of oven spring (6.19-7.27cm), loaf weight (233.58-270.98 g) and specific volume (5.77-7.16 cm^3/g) of the bread respectively. Inclusion of chili pepper enhanced the colour, vitamin A and β-carotene of the bread. The bread spiced with 2% chili pepper was most preferred by the panelists. This research suggested that inclusion of chili pepper in bread production may promote value addition and utilization of chili pepper.

Practical implications

The use of pepper is a new innovation that could encourage more people to consume bread and the ability of piperine, an active ingredient in pepper that could improve bioavailability of micronutrients in bread that could have been chelated by phytates and other constituents of flour. This will also create opportunity for farmers that grow pepper and improve pepper utilization.

Keyword: Quality Assessment, Wheat flour, Chili Pepper, Bread.

1. Introduction

Bread is one of the important staple foods consumed steadily and increasingly in Nigeria (Shewry *et al.*, 2002; Peighambardoust *et al.*, 2010; Olaoye *et al.*, 2006; Landillon *et al.*, 2008). It constitutes major part of daily food consumption and diet contributing up to about 40% of the daily calorie intake. It is often made from hard wheat flour, yeast, fat, sugar, salt and water (Olapade & Oluwole, 2013; Peluola-Adeyemi *et al.*, 2016). Bread has been reported as a good source of nutrients, such as macronutrients (carbohydrates, protein, and fat) and micronutrients (minerals and vitamins) those that are essential for human health (Oluwajoba *et al.*, 2012).

Chili peppers are spicy or savory food additives widely used in various countries. The hot peppers have high value due to their colour, flavor and pungency attributes (Barbero *et al.*, 2016). The pungency compound in pepper fruits and their products are due to group of alkaloids called capsaicinoids as reported by Orellana-Escobedo *et al.* (2013). Capsaicinoids are secondary metabolites produced in the placenta

of the fruits. According to some researchers, two major capsaicinoids found in the pepper are capsaicin (trans-8- methyl-N-vanillyl-6-nonenamide) and dihydrocapsaicin (DHC; 8-methyl –N- vanillylnonanamide). These two compounds constitute approximately 90% of total capsaicinoids content of chili peppers (Barbero *et al.*, 2016; Orellana-Escobedo *et al.*, 2013). The other compounds in chili peppers include nordihydrocapsaicin (n-DHC), homocapsaicin (h-C), homodihydrocapsaicin (h-DHC) and nonivamide amongst others (Barbero *et al.*, 2016).

Nigeria is one of the major producers of pepper in the World, accounting for about 50% of the African production (Idowu-Agida *et al.*, 2010). According to Suleiman & Isah (2010), the utilization and application of chili in confectionary, medicinal and culinary purpose is gaining more attention. The biological properties and health benefits of capsaicin in chili peppers has been reported. It is used for analgesic against arthritis pain and inflammation, shows anti-cancer effects, anti microbial effects, antioxidant effects, active against neurogenic inflammation (burning and stinging of hands, mouth and eyes), shows protective effects against cholesterol levels and obesity, great effects on gastrointestinal tract, cardiovascular and respiratory system and great effects in the treatment of rheumatoid and atherosclerosis (Zeid *et al.*, 2011; Barbero *et al.*, 2016; Gracia-Banuelos *et al.*, 2017). Since bread production and consumption is now on the increase and well accepted by many people, the inclusion of this health benefitting spice in the production of bread may be necessary and the quality of this bread need to be appropriately evaluated. Therefore, the objective of this work was to determine the quality of wheat flour bread spiced with chili pepper at varying proportion.

2. Materials and Methods

2.1. Materials

Wheat flour and other ingredients (bakers' yeast, granulated sugar, table salt, baking fat, vegetable fat, dried red chili pepper) were purchased at Mile 12 market, Lagos, Nigeria.

2.2. Production of Chili Pepper Powder

The dried red chili pepper were sorted, winnowed, cleaned and milled in attrition mill to reduce the dry chili flakes to powder. The pepper powder was further sieved to fine particle size using the 2mm-8mm US standard Mesh. The fine powder was used to spice wheat flour at ratio of 0, 2, 4, 6, 8 and 10% respectively.

2.3. Production of Bread Spiced with Chili Pepper

The straight dough method was used to produce the bread. This involved the addition of all the ingredients (flour, salt, water, sugar, yeast etc), mixing and kneading to obtain the dough as described by Igabul *et al.* (2014). The dough samples were placed in baking pans smeared with vegetable oil and was covered for the dough to ferment resulting in gas production and gluten development for about 1 hour. The dough was then baked in the oven at 230°C for 30 minutes. The baked loaves were carefully removed from the pans and allowed to cool and packaged in polyethylene films prior to analysis.

2.4. Determination of Chemical Composition of Wheat Flour Spiced with Chili Pepper

The moisture, protein, ash, crude fiber, fat and carbohydrate were determined according to the standard method (AOAC, 2006; Igbabul *et al.*, 2014).

2.5. Determination of Functional Properties of Wheat Flour Spiced with Chili Pepper

The swelling power, solubility, water absorption capacity and bulk density were determined using the method described by Adeleke & Odedeji (2010).

2.6. Determination of Physical Properties of the Bread Loaves Spiced with Chili Pepper

Oven spring: Oven spring was estimated from the difference in height of dough before and after baking.

Loaves weight: Loaves weight was measured 30 minutes after loaves were removed from the oven using a laboratory scale (CE- 410I, Camry Emperors, China).

Loaf volume: Loaves volume was measured using the rapeseed displacement method as modified by Giami *et al.* (2004).

Specific volume: The specific loaf volume was determined by dividing the loaf volume by its corresponding loaf weight (cm^3/g) as described by Peluola-Adeyemi *et al.* (2016).

2.7. Determination of Color Measurement of the Bread Samples

Crust and crumb color were measured using spectrophotometer .Samples were cut into cubes of 2 x 2 x 2 cm and placed in the colorimeter. The color attributes L*, a *and b* values were recorded using the Spectra magic software. L* defines lightness, a* denotes the red/green value and b* the yellow/blue value. Three measurements were taken from each sample.

2.8. Determination of Vitamin A and β-Carotene Contents of Bread samples

Vitamin A: The vitamin A content of the bread samples were determined by using the modified spectophotometric method of the AMFFA (2011).The sample were irradiated with UV light and its absorbance were measured. The absorbance was proportional to the Vitamin A content in the sample.

β-Carotene Content : Carotenoids extraction was carried out following the modified method of Shigeaki (1985).

2.9. Sensory Evaluation of Bread Spiced with Chili Pepper

The sensory attributes of the bread samples include the crust color, crumb color, texture, taste, pungency and overall acceptability were evaluated about 1hr after baking by 25 panelists that are familiar with the bread using 9 points hedonic scale where 9 is like extremely and 1 is dislike extremely (Iwe, 2002).

2.10. Statistical Analysis

The data obtained were subjected to analysis of variance (ANOVA) and the means were separated by Duncan multiple range test.

3. Results and Discussion

3.1. Chemical composition of wheat flour spiced with chili pepper

The chemical compositions of wheat flour spiced with chili pepper are presented in Table 1. The moisture content ranged from 9.67 - 14.83%. The highest value was observed in wheat flour spiced with 10% chili pepper while the lowest found in wheat flour spiced with 2% chili pepper. The values obtained for wheat flour spiced with chili pepper from 4-10% were significantly higher compared with the control samples. This indicated that the level of chili pepper in the wheat flour caused an increase in the moisture content. There was no significant difference ($p>0.05$) in the moisture of wheat

Table 1: Chemical composition of wheat flour spiced with chili pepper

SAMPLE	MOISTURE (%)	PROTEIN (%)	ASH (%)	CRUDE FIBRE (%)	FAT (%)	CARBOHYDRATE (%)	ENERGY Kcal/100 g
C0WF	12.31± 0.99^{b}	12.53±0.03^{a}	0.69±0.01^{e}	0.84 ±0.08^{c}	1.13 ±0.04^{e}	72.49 ± 1.08^{a}	350.26±4.16^{a}
C2WF	9.67±1.79^{c}	8.44± 0.88^{e}	3.40±0.06^{d}	1.35 ±0.02^{b}	2.68 ±0.01^{d}	74.46 ± 2.28^{a}	355.72 ±7.45^{a}
C4WF	14.10± 0.50^{a}	8.71±0.48^{de}	3.46±0.02^{c}	1.40±0.02^{ab}	2.74± 0.03^{c}	69.58 ± 0.82^{b}	337.85±2.07^{b}
C6WF	14.30± 0.30^{a}	9.68±0.24^{cd}	3.49±0.04^{bc}	1.44 ±0.01^{a}	2.88 ±0.01^{b}	68.22 ± 0.27^{bc}	337.49 ±1.26^{b}
C8WF	14.75±0.09^{a}	10.07±0.64^{c}	3.53±0.01^{ab}	1.41±0.06^{ab}	2.95± 0.05^{a}	67.33 ± 0.69^{a}	336.00 ±0.82^{b}
C10WF	14.83± 0.35^{a}	11.16±0.86^{b}	3.57± 0.02^{a}	1.47± 0.02^{a}	3.00± 0.02^{a}	65.97 ± 1.16^{a}	335.52 ±1.37^{b}

Mean of same superscript within column are not significantly different at p>0.05. C0WF = 100% WHEAT FLOUR (CONTROL), C2WF = 98% WHEAT FLOUR + 2% CHILI PEPPER, C4WF = 96% WHEAT FLOUR + 4% CHILI PEPPER, C6WF = 94% WHEAT FLOUR + 6% CHILI PEPPER, C8WF = 92% WHEAT FLOUR + 8% CHILI PEPPER, C10WF = 90% WHEAT FLOUR + 10% CHILI PEPPER

flour spiced with chili pepper from 4 -10%. The increase in moisture content of this flour samples could be attributed to the high moisture content of chili pepper. Emmanuel-Ikpeme *et al.* (2014), reported that Capsicum genus had the highest moisture content of 11.16% followed by Capsicum frutescens with a value of 10.14% while *Capsicum annuum* had the least value of 9.43%. The high level of moisture in all the samples investigated revealed that the flour had high water activity which could enhance microbial action bringing about food spoilage as reported by Emmanuel-Ikpeme *et al.* (2014). Therefore, long storage should be discouraged except further drying is employed.

The protein content of the wheat flour spiced with chili pepper ranged from 8.44 - 12.53%. The highest value was observed in control wheat flour. The values increased significantly ($p<0.05$) as the level of chili pepper increases from 2 - 10%. This result was in accordance with Sowbhagya *et al.* (2015). These authors reported that incorporation of chili spent residue (CHSR) at 10% level was recommended as it would improve the nutritional quality of bread. The high protein content of wheat flour might be traced to its high percentage of gluten present in wheat flour. Therefore, pepper needs to be combined with other foods of high protein value in order to meet the protein requirements of individuals.

The ash, crude fiber and fat contents ranged from 0.69 - 3.57%, 0.84 - 1.47% and 1.13 -3.00% respectively. The values increased significantly ($p<0.05$) with increase in inclusion of chili pepper. This trend was similar with the work reported by Berke & Shieh (2001). The low fiber content in wheat flour could was in line with the submission of Landillon *et al.* (2008). Emmanuel-Ikpeme *et al.* (2014) reported that Capsicum genus (long chili pepper) contain fiber up to 6.44% when comparing three varieties of chili pepper. Flour samples with high fiber content could serve as an added nutritional

advantage. According to Schneeman (2002), crude fiber contributes to the health of the gastrointestinal system and metabolic system in man.

Carbohydrates and energy ranged from 65.97 - 74.46% and 335.52-355.70 kcal/100 g respectively. The highest carbohydrate and energy were found in wheat flour spiced with 2% chili pepper. These values decreased significantly ($p<0.05$) with increase in inclusion of chili pepper. The decrease in carbohydrate and energy value of this flour samples would result in bread with low energy and carbohydrate content.

increased significantly ($p<0.05$) with increase in level of chili pepper. Water absorption characteristics represent the ability of a product to associate with water under conditions where water is limited (Singh, 2001). The water absorption capacity of 2% flour spiced with chili pepper was significantly higher compared with other chili pepper spiced samples. The water absorption capacity decreased significantly ($p<0.05$) with increased in inclusion of chili pepper. Sowbhagya *et al.* (2015), reported similar trend in water absorption capacity of wheat flour with supplementation of chili spent residue.

Table 2: Functional properties of wheat flour spiced with pepper

SAMPLE	SWELLING POWER	SOLUBILITY (%)	WATER ABSORBTION CAPACITY (%)	BULKDENSITY (LOOSE) (g/cm^3)	BULKDENSITY (PACKED) (g/cm^3)
C0WF	10.75±0.01^a	6.65 ± 0.02^f	267.33±0.01^a	0.39 ± 0.06^f	0.95 ± 0.02^a
C2WF	5.43±0.05 ^{b}	7.44 ± 0.58^e	237.67±0.01^b	0.42 ± 0.05^e	0.84 ± 0.58^b
C4WF	4.73 ± 0.58^c	9.37 ±0.01^d	196.67±0.01^f	0.44 ± 0.04^d	0.79 ± 0.01^c
C6WF	3.96 ±0.01^d	10.28 ± 0.01^c	182.67±0.58^e	0.46 ±0.01^c	0.74 ± 0.00^d
C8WF	3.27 ±0.05^e	11.64 ±0.00^b	175.67±0.57^d	0.47 ± 0.04^b	0.72 ±0.01^e
C10WF	2.69 ± 0.01^f	12.56 ± 0.02^a	165.67±0.58^c	0.48 ±0.01^a	0.70 ± 0.00^f

Mean of same superscript within column are not significantly different at $p>0.05$. C0WF = 100% WHEAT FLOUR (CONTROL), C2WF = 98% WHEAT FLOUR + 2% CHILI PEPPER, C4WF = 96% WHEAT FLOUR + 4% CHILI PEPPER, C6WF = 94% WHEAT FLOUR + 6% CHILI PEPPER, C8WF = 92% WHEAT FLOUR + 8% CHILI PEPPER, C10WF = 90% WHEAT FLOUR + 10% CHILI PEPPER

3.2. Functional Properties of Wheat Flour Spiced With Chili Pepper

The functional properties of wheat flour spiced with chili pepper are as presented in Table 2. Swelling power is an indication of the water absorption index of the granules during heating. The swelling power and solubility decreased and

The bulk density which values ranged from 0.70 -0.95 g/cm3 decreased as the inclusion of chili pepper increased. Significant higher value ($p<0.05$) was observed in the control wheat flour. This observed trend was in agreement but higher than the values reported by Mepba *et al.* (2007). The high bulk density of flour suggested suitability for use in food preparations

(Adegunwa *et al.*, 2014).The bulk density may be affected by the particle size and the density of the flour which could have relevant application in packaging requirements and material handling (Adebowale *et al.*, 2008).

3.3. Physical Characteristics of Bread Spiced With Chili Pepper

The physical characteristics of bread spiced with chili pepper are presented in Table 3. Oven spring is the difference in the height of the bread dough before baking and bread loaf after baking (Mepba *et al.*, 2007). The oven spring ranged from 6.19-7.29 cm. There was significant difference ($p<0.05$) in oven spring of the bread samples. The highest value was observed in the bread sample spiced with 2% chili pepper and the bread sample spiced with 10% chili pepper had the least value. The oven spring decreased with increase in addition of chili pepper addition. However, samples spiced with chili pepper were significantly lower to the control. The loaf weight of the bread samples ranged from 233.58-270.98 g. The values observed in bread samples from the control were significantly higher compared with bread samples spiced with chili pepper. The loaf weight of chili pepper spiced bread increased with increase in inclusion of chili pepper. The higher loaf weight observed in the bread samples could have positive effect on the bread at the retail end. This is in agreement with the findings of Shittu *et al.* (2008). The specific volume ranged from 5.77 - 7.16 cm^3/g. A lower specific volume was observed from the bread samples with 8% chili pepper. The specific volumes obtained in this study except for wheat flour were higher than values reported by some researchers (Oluwalana *et al.*, 2012; Mepba *et al.*, 2007). The specific volume obtained in the control bread samples was similar to that reported by Mepba *et al.* (2007).

Table 3: Physical characteristics of bread spiced with chili pepper

SAMPLE	OVENSPRING (cm)	LOAF WEIGHT(g)	LOAF VOLUME (cm^3)	SPECIFIC VOLUME (cm^3/g)
C0WF	7.29 ± 0.02^a	270.98 ±0.03^a	1562.33±2.08^f	5.77 ±0.04^e
C2WF	6.95 ±0.02^b	233.58 ±0.52^f	1603.33±11.5^e	7.16 ±0.20^a
C4WF	6.44 ± 0.02^c	247.55 ±1.38^e	1705.33±1.1^d	7.03 ± 0.08^b
C6WF	6.37± 0.02^{cd}	250.33± 1.15^c	1761.00±1.0^b	6.94 ±0.08^c
C8WF	6.34 ± 0.04^d	253.83 ± 0.29^c	1720.33±1.53^c	6.89 ± 0.12^c
C10WF	6.19 ± 0.10^e	260.13 ± 0.99^b	1806.33±5.51^a	6.78 ±0.09^d

Mean of same superscript within column are not significantly different at $p>0.05$. C0WF = 100% WHEAT FLOUR (CONTROL), C2WF = 98% WHEAT FLOUR + 2% CHILI PEPPER, C4WF = 96% WHEAT FLOUR + 4% CHILI PEPPER, C6WF = 94% WHEAT FLOUR + 6% CHILI PEPPER, C8WF = 92% WHEAT FLOUR + 8% CHILI PEPPER, C10WF = 90% WHEAT FLOUR + 10% CHILI PEPPER

The specific volume for a standard bread according to China Grain Products Research and Development Institute (CGPRDI) should be 6 cm^3/g and should not be less than 3.5 cm^3/g (Malomo *et al.*, 2011), only the control bread fell in this range whereas bread samples spiced with chili pepper were slightly higher than the standard. The higher specific loaf volume of the bread samples spiced with chili pepper could be responsible for their higher weights. The result was also in agreement with Sowbhgya *et al.* (2015), who stated that the inclusion of chili spent residue in bread at level of 5-10% affected the physical characteristics of the bread.

3.4. Colour of Bread Samples Spiced with Chili Pepper

The colours of bread samples spiced with chili pepper are shown in Table 4. The values for the colour L*, a* and b* increased significantly ($p<0.05$) as the level of chili pepper increased. The bread samples with 10% chili pepper had the higher value of L*, a* and b*. The values of L*, a* and b* of the bread samples were significantly ($p<0.05$) higher than the control samples. The high redness in the bread samples could be due to its high content of capsanthin which is the main carotenoid in red chili pepper. Capsanthin was reported to be responsible for the red colour in chili pepper and often accounting for up to 50% of the total carotenoid content (Suna *et al.*, 2009). The combination of high lightness (L*), redness (a*) and yellowness (b*) could indicate that the bread spiced with chili pepper could be a form of attractiveness to the consumer compared to the control bread. Therefore, adding chili pepper could enhance the color of the bread (Aziah & Komathi, 2009).

Table 4: Colour of bread spiced with chili pepper

SAMPLES	COLOUR		
	L*	a*	b*
C0WF	28.54 ± 0.01^a	0.77 ± 0.01^a	2.84 ± 0.01^a
C2WF	59.73 ± 0.13^b	1.51 ± 0.01^b	22.42 ± 0.02^b
C4WF	59.92 ± 0.02^c	1.55 ± 0.01^c	22.62 ± 0.02^c
C6WF	60.04 ± 0.04^d	1.61 ± 0.01^d	22.82 ± 0.01^d
C8WF	62.22 ± 0.02^e	1.65 ± 0.01^e	22.91 ± 0.01^e
C10WF	62.52 ± 0.03^f	1.68 ± 0.01^f	22.95 ± 0.02^f

Mean of same superscript within column are not significantly different at p>0.05. C0WF = 100% WHEAT FLOUR (CONTROL), C2WF = 98% WHEAT FLOUR + 2% CHILI PEPPER, C4WF = 96% WHEAT FLOUR + 4% CHILI PEPPER, C6WF = 94% WHEAT FLOUR + 6% CHILI PEPPER, C8WF = 92% WHEAT FLOUR + 8% CHILI PEPPER, C10WF = 90% WHEAT FLOUR + 10% CHILI PEPPER

3.5. Vitamin Content of Bread Spiced With Chili Pepper

The vitamin A and β-carotene contents of the bread samples spiced with chili pepper are presented in Table 5. The vitamin A and β-carotene of the bread samples ranged from 0.03 - 0.59 mg/100 g and 0.58-7.58 mg/100 g respectively. The vitamin A and β-carotene increased significantly ($p>0.05$) as the level of chili pepper increased. Riza *et al.* (2015) reported that β-carotene are readily available in vegetables and this results was in agreement with their findings in the incorporation of pepper leaves.

3.6. Sensory Evaluation of Bread Samples Spiced with Chili Pepper

The results of sensory evaluation of bread samples spiced with chili pepper are presented in Table 6. The inclusion of chili pepper in the bread samples increased the crumb color, creating an attractive appearance significantly as

Table 5: Vitamin A and beta-carotene of bread spiced with chili pepper

SAMPLE	VITAMIN A (mg/100 g)	β-CAROTENE (mg/100 g)
C0WF	0.03± 0.01^{f}	0.58 ±0.02^{f}
C2WF	0.46 ±0.02^{e}	1.05 ±0.01^{e}
C4WF	0.48 ±0.02^{d}	1.22 ±0.02^{d}
C6WF	0.52 ±0.01^{c}	4.16 ±0.01^{c}
C8WF	0.54 ±0.01^{b}	5.75 ±0.02^{b}
C10WF	0.59 ±0.01^{a}	7.58 ±0.01^{a}

Mean of same superscript within column are not significantly different at p>0.05. C0WF = 100% WHEAT FLOUR (CONTROL), C2WF = 98% WHEAT FLOUR + 2% CHILI PEPPER, C4WF = 96% WHEAT FLOUR + 4% CHILI PEPPER, C6WF = 94% WHEAT FLOUR + 6% CHILI PEPPER, C8WF = 92% WHEAT FLOUR + 8% CHILI PEPPER, C10WF = 90% WHEAT FLOUR + 10% CHILI PEPPER

the taste, firmness, texture, crust colour, pungency and the overall acceptability of the bread samples spiced with chili pepper. The level of pungency could be attributed to the high content of capsaicin infused by the chili pepper. Zeid *et al.* (2011), reported that capsaicin is made up of about 71% of the total capsaicinoids in most of the pungent varieties. The bread samples spiced with 2% chili pepper was the most preferred while 10% chili pepper was least preferred. The decrease in the acceptability of the bread samples spiced with chili pepper could also be due to high level of pungency infused by capsaicin in the chili pepper. It was reported by Riza *et al.* (2015) that chili spent residue (CHSR) at 5-15% level in bread affected the bread sensory characteristics.

Table 6: Sensory Evaluation of Bread Spiced With Chili Pepper

SAMPLE	CRUMB COLOR	TASTE	CRUMB FIRMNESS	TEXTURE	CRUST COLOR	PUNGENCY	OVERALL ACCEPT-ABILITY
C0WF	6.48±1.45^{a}	6.16±2.32^{a}	6.08±2.08^{a}	6.60±1.72^{a}	7.28±1.47^{a}	6.40±2.22^{a}	7.80±1.94^{b}
C2WF	6.12±1.17^{a}	6.36±1.44^{a}	6.44±1.36^{a}	6.48±1.71^{a}	6.72±1.43^{ab}	6.36±2.27^{a}	8.82±1.73^{a}
C4WF	6.64±1.19^{a}	6.24±2.01^{a}	6.40±1.38^{a}	6.32±1.46^{a}	6.68±1.46^{ab}	6.20±2.58^{a}	6.44±2.12^{c}
C6WF	6.68±1.16^{a}	6.00±1.66^{a}	6.32±1.97^{a}	6.16±1.86^{a}	6.68±1.46^{ab}	6.08 ±2.24^{a}	5.32±2.25^{d}
C8WF	6.68±0.95^{a}	5.72±1.94^{a}	6.16±1.72^{a}	5.96±1.84^{a}	6.56±1.33^{ab}	5.12±2.42^{b}	4.30±2.26^{e}
C10WF	6.72±1.75^{a}	5.68±2.02^{a}	6.08±1.68^{a}	5.88±1.64^{a}	6.04± 1.97^{b}	5.04±2.30^{b}	4.00±2.24^{e}

Mean of same superscript within column are not significantly different at p>0.05. C0WF = 100% WHEAT FLOUR (CONTROL), C2WF = 98% WHEAT FLOUR + 2% CHILI PEPPER, C4WF = 96% WHEAT FLOUR + 4% CHILI PEPPER, C6WF = 94% WHEAT FLOUR + 6% CHILI PEPPER, C8WF = 92% WHEAT FLOUR + 8% CHILI PEPPER, C10WF = 90% WHEAT FLOUR + 10% CHILI PEPPER

the panelists rated the bread samples with chili pepper higher than the control. This could be attributed to the high content of capsanthin (Suna *et al.*, 2009). As the inclusion of chili pepper in bread samples increased, there was decrease in

4. Conclusion

In conclusion, the 10% inclusion of chili pepper in wheat flour improved the protein, ash, fiber and fat contents of the bread samples. The swelling power, water absorption capacity and

bulk density decreased with inclusion of chili pepper at 2% in the wheat flour. The oven spring and specific volume of the bread spiced with 2% chili pepper were significantly higher compared to other levels of chili pepper. The inclusion of chili pepper increased the colour values (L*, a*, b*), vitamin content and the β-carotene in the bread samples. This study also revealed that inclusion of chili pepper at 2% in bread was most preferred by the panelists.

Conflict of interest

The authors declare that there are no conflicts of interest.

Ethics

This Study does not involve Human or Animal Testing.

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