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ORIGINAL ARTICLE

Quality Evaluation of Bread Produced from Wheat Flour using Avocado (*Persea americana*) Paste as Substitute

Peluola-Adeyemi, Oluwaranti Abiodun[*a] / Abdus-Salaam, Rofiat Bolanle[a] / Obi, Theodora Ego[b] / Toyiemedo, Nuhesekan Christopher[a] /

Authors' Affiliation

[a]Department of Food Technology, Lagos State Polytechnic, Ikorodu, Lagos State, Nigeria

[b]Department of Chemical Sciences, Igbinedion University, Edo State, Nigeria

Corresponding author

Peluola-Adeyemi, Oluwaranti Abiodun

Email: biodunpeluolaadeyemi@gmail.com

Tel: (+234) 8061537999

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Abstract

Quality evaluation of bread from wheat flour using avocado paste as substitute was investigated. Wheat flour and avocado paste were substituted at different ratios. The chemical composition, physical properties and sensory evaluation of the bread samples were carried out. The results revealed that the moisture, protein, fat, fiber, ash, carbohydrate and energy ranged from 31.04-36.39%, 6.47-9.92%, 2.60-8.84%, 0.69-2.99%, 44.03-54.69% and 272.35-283.73 Kcal/100g respectively. The protein content decreased while the crude fat, crude fiber and total ash increased significantly ($p<0.05$) as the addition of avocado paste increased. The loaf weight, loaf volume, specific volume and oven spring varied between 169-186 g, 1225-1285 cm^3, 7.20-8.78 cm^3/g and 3.00-5.30 respectively. The oven spring, loaf weight and the loaf volume decreased significantly ($p<0.05$) as the addition of avocado paste increased. The colour characteristics L*, a*, b* varied from 35.73-52.34, 11.40-14.26 and 18.01-29.83 respectively. The texture parameters ranged from 162.02-585.00 N. The sensory evaluation showed that the taste, colour, flavour, spread-ability and the overall acceptability ranged from 5.50-7.90, 5.00-8.25, 5.80-7.40, 5.60-8.20 and 5.65-8.20 respectively. The bread sample produced from 95% wheat flour with 5% avocado paste was the most preferred by the panelists. The aforementioned findings show that wheat flour could be substituted with avocado paste up to 5% in bread production.

Practical application

The production of bread using margarine has been reported to increase the rate of cholesterol which predisposes many consumers to various heart diseases. The production of bread with avocado pastes which contains high fatty oil that are predominantly monounsaturated fatty acid, a distinct property that will result in so many health benefits.

Keywords: Quality, Bread, Wheat Flour, Avocado Paste.

1. Introduction

Bread is an important staple food in both developing and developed countries and constitutes one of the most important sources of nutrients such as carbohydrates, protein, fiber, vitamins and minerals in the diets of many people worldwide (Aider *et al*., 2012).

Bread is described as a fermented confectionery product produced mainly from wheat flour, water, yeast and salt by a series of processes involving mixing, kneading, proofing, shaping and baking (Dewettinck *et al*., 2008).

The quality of bread does not only depend on the quality of flour, baking process and improver used but also depends mainly on the rate and amount of heat applied, the type of baking chamber and the baking time. It has been documented that the baking temperature and time that the bakers use in baking their bread varies (Jideani *et al*., 2009).

Wheat (*Triticum vulgare*) is mostly used for making bread flour. It is a choice cereal for production of bread because it contains a large amount of gluten which makes the loaves raise (Badifu & Aka, 2001). The cereal is uniquely rich in methionine and cysteine and evokes low sugar on consumption (Ayo *et al*., 2007). It is generally limited in lysine, an essential amino acid supplementation of cereal based foods with other protein sources, which has gained considerable attentions in recent time among researcher (Olapade *et al*., 2011).

Avocado (*Persea americana*) production reached 4.4 million tons in 2011, increasing about 20% from 2007 - 2011. Mexico is the largest avocado producer, accounting for 25% of the world production, followed by Chile with 8.5% (FAO, 2013). The pulp of avocado fruit represents 70% of the total fruit weight, containing 6.94 g of carbohydrates, 17.34 g of fat, 2.08 g of proteins, 2.72 g of fiber in 100 g of fresh pulp. They have highest level of fiber content of all fruits including 75% insoluble and 25% of soluble fibers, vitamin A, B, E, sterols and carotenoids (Boshra & Tajul, 2013). The fruit has been recognized for its health benefits, especially due to the compounds present in the lipid fraction, such as omega fatty acids, phytosterols, tocopherols and squalene (Santos, 2014). Oil obtained from avocado has been reported to lower cholesterol level and reduce the rate of heart risk because of its unique property such as high content of monounsaturated fatty acid (MUFAs) which is approximately 71% (Indriyani *et al.,* 2015).

Contemporary modes of consumption are responsible for many diseases such as diabetes, coronary heart disease and obesity (Melanson *et al*., 2006). The general consumption of bread products that are naturally rich in dietary fibers has decreased in the societies with higher gross of domestic products (Quilez & Salas-Salvado, 2012). Bread has been a commercialized food for many years and mainly produced from wheat flour using butter and margarine as fat. Due to the problems associated with the consumption of margarines, cheese and butters with high level of cholesterols, alternatives such as avocado pastes which can deliver the functionalities with less nutritional problems are being sought. Consequently, paste made from the avocado fruit has the potential of presenting to the consumers an additional variety in which the fruit can be consumed and also have good potentials in the baking industry (Boshra & Tajul, 2013). According to Bergh (1992), the fruit has 60 % potassium than bananas and is rich in vitamins B, E and K. The smooth and creamy consistency of avocado paste are also reported to be free of sodium and cholesterol per 100g of fresh fruits. This makes the avocado paste a good material worth considering as a good replacer for fattest based foods. Therefore, this project was carried out to substitute wheat flour with avocado paste and also determine the quality of the bread produced.

2. Materials and Methods

2.1. Source of Raw Materials

Wheat flour, salt, sugar, bread improver, dry baker's yeast and fresh avocado fruits were purchased at Sabo Local Market, Ikorodu, Lagos State, Nigeria.

2.2. Production of Avocado Paste

The method of Jacobo-Velazquez & Hernandez-Brenes, (2011) was used. The fruits were washed in clean water to reduce microbial load and foreign materials, peeled and manually macerated into avocado paste, packaged into polyethylene films and refrigerated prior to processing of the bread.

2.3. Production of Bread from Wheat and Avocado Paste

Bread loaves were baked on a pilot scale and randomly selected two times according to the optimized straight dough bread-making method (Das *et al*., 2012; Nwosu *et al*., 2014). This method involves the addition of all the basic ingredients and the proportions of wheat flour and the avocado pastes in the production of the bread samples (wheat flour 500 g, yeast 10 g, salt 2 g, sugar 60 g and water 200 ml). The dough samples obtained were scaled to 100 g dough pieces, placed in already greased baking pans and covered for fermentation and proofing resulting in gas production and gluten development for about 45 minutes and then baked in an oven at 230°C for 25 minutes as previously described by Das *et al*. (2012) and Nwosu *et al*. (2014). The loaves were removed carefully from the baking pans and allowed to cool for about 1hr at room temperature. The cooled bread samples were packed in polyethylene bags and stored prior to analysis.

2.4. Determination of Chemical Composition of Bread from Wheat and Avocado Paste

The moisture, protein, fat, crude fiber, ash, carbohydrate and energy contents were determined according to the method of AOAC (2005).

2.5. Determination of Physical Properties of Bread from Wheat and Avocado Paste

Oven Spring

This was carried out by estimating the differences in the loaf height of dough before and after baking (Peluola-Adeyemi *et al.*, 2020).

Loaf Weight

The loaf weight for each sample was determined by weighing directly on a weighing balance (Peluola-Adeyemi *et al.*, 2020).

Loaf Volume

The loaf volume of each of the bread samples was measured 2 hours after the loaves were removed from the oven using rapeseed displacement method as described by Peluola-Adeyemi *et al.* (2020).

$$\text{Loaf volume} = \frac{W_2 \times V_1}{W_1}$$

W_1 = Initial weight.

W_2 = Final weight.

V_1 = Volume of the container

Specific Loaf Volume

The specific loaf volume analysis was carried out by the following Modified Method of Peluola-Adeyemi *et al.* (2020). The specific loaf volume for each sample was obtained by dividing the loaf volume of each sample with the corresponding loaf weight thus;

$$\text{Specific loaf volume (cm}^3\text{/g)} = \frac{\text{Loaf volume (cm}^3\text{)}}{\text{Loaf weight (g)}}$$

2.6. Determination of Colour of Bread from Wheat and Avocado Paste

Colour determination was carried out on bread crumbs using a Minolta CR-400 colorimeter (Konica Minolta., Japan), using CIE illuminant D_{65}, a measurement area of 8mm, and a 2^0 standard observer (Kurek *et al*., 2016). The parameters for colour measurements were L^* ($L^* = 0$ (black), and $L^* = 100$ (white or lightness), a^* ($-a^*$ = greenness and $+a^*$ = redness), b^* ($-b^*$ = blueness and $+b^*$ = yellowness). These parameters were measured 24 hours after baking.

2.7. Determination of Texture of Bread from Wheat and Avocado Paste

The mechanical characteristic of the bread samples in a double compression cycle were recorded using an Instron 5965 Universal Testing machine (Instron, USA). The maximum load was 500N with a 50% penetration depth obtained using a 40mm diameter probe, and a 20 second gap between compressions on crumb cubes with dimensions of 20 * 20 * 20 mm with a seed of 20 cm per minute (Kurek *et al*., 2016).

2.8. Sensory Evaluation

The sensory evaluation was carried out on the bread samples and the attributes include taste, colour, flavor, spread-ability and overall acceptability using hedonic scale; where 9 indicates extremely like and 1 indicates extremely dislike as described by Ihekoronye & Ngoddy (1985). The seven coded samples of bread were presented to 20 panelists who were selected among students.

2.9. Statistical Analysis

The data collected were subjected to analysis of variance (ANOVA). Duncan test was used in separating the means using Statistical Package (SPSS) 19 version 2011.

3. Results and Discussion

3.1. Chemical Composition of Bread from Wheat Flour and Avocado Paste

The chemical composition of bread samples produced from wheat flour and avocado paste are presented in Table 1. The moisture content of the bread samples ranged from 31.04-36.39%. The highest value was observed in sample SMC (50%WF: 50%AP) while the lowest value was observed in sample NCS (95%WF: 5%AP). The results obtained in this study are significantly ($p < 0.05$) higher than the values (31.04-31.46% and 30.98-33.84%) reported by other authors (Nwosu *et al*., 2014; Olaoye & Onilude, 2008) respectively. Most fruits contain about 70% moisture or more with the seed having lesser (Pamplona-Roger, 2007). This moisture content affects the physical and chemical properties (the structure, appearance and taste) of the food products. According to Akua *et al*. (2012), these food properties become important in determining the food's susceptibility to spoilage, shelf life, processing and packaging conditions. Zghal *et al*. (2002) reported that moisture content in bread may be governed by the extent of gelatinization of starch in dough during baking. The higher values obtained in this study could be attributed to high moisture content in the avocado paste. The crude protein content of the bread samples ranged from 6.47 - 9.92%. Sample NSC (100% WF) had the highest value while sample SMC (50% WF: 50%AP) had the lowest value. The protein content was observed to decrease with an increase in proportion of avocado paste and there was significant difference ($p< 0.05$) among the samples.

Table 1: Chemical composition of the bread from wheat flour and avocado paste

SAMPLE	MOISTURE (%)	PROTEIN (%)	FAT (%)	FIBER (%)	ASH (%)	CARBOHYDRATE (%)	ENERGY (Kcal/100g)
NSC	32.28 ± 0.10^{d}	9.92 ± 0.09^{a}	2.60 ± 0.02^{g}	0.69 ± 0.01^{f}	1.09 ± 0.04^{e}	53.44 ± 0.16^{b}	276.78 ± 0.12^{bc}
NCS	31.04 ± 0.05^{e}	8.65 ± 0.01^{b}	2.99 ± 0.01^{f}	0.96 ± 0.01^{e}	1.68 ± 0.03^{d}	54.69 ± 0.09^{a}	280.25 ± 0.44^{b}
CNS	32.50 ± 0.73^{d}	8.11 ± 0.03^{c}	4.88 ± 0.03^{e}	1.00 ± 0.01^{d}	1.90 ± 0.09^{cd}	51.62 ± 0.88^{c}	282.82 ± 3.17^{a}
CSN	33.30 ± 0.05^{c}	7.60 ± 0.01^{d}	5.28 ± 0.04^{c}	1.03 ± 0.02^{d}	2.30 ± 0.47^{bc}	50.58 ± 0.59^{cd}	280.18 ± 1.97^{ab}
SNC	34.52 ± 0.19^{b}	7.14 ± 0.04^{e}	5.05 ± 0.04^{d}	1.13 ± 0.01^{c}	2.58 ± 0.04^{ab}	49.60 ± 0.13^{d}	272.35 ± 0.39^{c}
SCN	33.76 ± 0.32^{c}	6.91 ± 0.06^{f}	7.09 ± 0.13^{b}	1.24 ± 0.00^{b}	2.93 ± 0.01^{a}	48.09 ± 0.53^{e}	283.73 ± 0.66^{a}
SMC	36.39 ± 0.17^{a}	6.47 ± 0.06^{g}	$8.84\pm0.\ 01^{a}$	1.29 ± 0.03^{a}	2.99 ± 0.04^{a}	44.03 ± 0.16^{f}	281.50 ± 0.36^{ab}

Mean values with different superscripts within the same column are significantly different ($p<0.05$).
Mean ±SD of three replicate determinations

FOOT NOTE
NSC – Bread produced from 100% wheat flour, NCS - Bread produced from 95% wheat flour and 5% avocado paste, CNS - Bread produced from 90% wheat flour and 10% avocado paste, CSN - Bread produced from 85% wheat flour and 15% avocado paste, SNC - Bread produced from 80% wheat flour and 20% avocado paste, SCN - Bread produced from 75% wheat flour and 25% avocado paste, SMC - Bread produced from 50% wheat flour and 50% avocado paste

Sample NSC (100% WF) was significantly higher compared to all the samples substituted with avocado paste. According to Akua (2012), avocado fruit spread is a poor source of protein and should be used in conjunction with other foods that are rich in protein. The decreased in protein content of the bread samples could be attributed to the low protein content of avocado paste, indicating that the replacement of margarine with avocado paste could probably have affected the protein content of the bread.

The crude fat of the bread samples ranged from 2.60 - 8.84%. Sample SMC (50%WF: 50% AP) had the highest value while sample NSC (100%WF) had the lowest value. There was significant difference ($p<0.05$) among the samples. The crude fat increased with an increase in proportion of avocado paste. Sample SMC (50%WF: 50% AP) was significantly higher compared to all other samples. Recent research on fat contents have shown that fruits such as avocado and coconut have high level of fat compared to banana, pawpaw and mango (Akaniwor & Arachie, 2002; Pamplona-Roger, 2007; Afolabi, 2008). The fat content of avocado fruit spread is lower than that of salad cream, peanut butter, margarine (including planta margarine) and cheddar cheese as reported by FSA (2007). The high fat observed in all the samples could be attributed to the high fat content in the avocado paste which contains monounsaturated fatty acid which could be beneficial to the health of the bread consumers as reported by Indriyani *et al.* (2015).

The crude fiber of the bread samples ranged from 0.69-1.29%. Sample SMC (50%WF: 50%AP) had the highest value while sample NSC (100%WF) had the lowest value. There were significant differences ($p<0.05$) among the samples except samples CNS (90%WF: 10%AP) and CSN (85%WF: 15%AP). The crude fiber increased with an increase in proportion of avocado paste. The increased fiber content of the bread samples could be attributed to the high fiber content in the avocado paste, indicating that the avocado fruit spread is a good source of fiber which could help in the digestion of food in the intestinal tract and good potential in the bakery (Boshra & Tajul, 2013).

The ash content ranged from 1.09-2.99% in the bread samples. Sample SMC (50%WF: 50%AP) had the highest value while sample NSC (100%WF) had the lowest value. The ash content increased with an increase in proportion of avocado paste. Similar increase in ash content was observed by some authors (Scheuer *et al*., 2006; Nwosu *et al*., 2014; Olaoye & Onilude, 2008; Das *et al*., 2012) during the production of bread. The increase in ash content of the bread samples could be attributed to high ash content in the avocado paste, indicating that the avocado fruit spread contains appreciable amount of mineral content.

The carbohydrate content ranged from 44.03–54.69%. Sample NCS (95%WF: 5%AP) had the highest value while sample SMC (50%WF: 50%AP) had the lowest value. The carbohydrate content decreased with an increase in proportion of avocado paste. Sample NCS (95%WF: 5%AP) was significantly higher compared to the control and other samples. The values obtained are lower than the values (54.03-61.46% and 52.25-60.58%) reported by Scheuer *et al*. (2006) and Olaoye & Onilude (2008) respectively. The decrease in carbohydrate content of the bread samples could be attributed to low carbohydrate content in the avocado paste and reduction in the proportion of wheat flour.

The energy ranged from 276.78 – 283.73$\pm$0.658Kcal/100g. Sample SCN (75%WF: 25%AP) had the highest value while sample NSC (100% WF) had the lowest value. Since both wheat flour and avocado paste have high energy, they can be used in daily supplement energy intake for consumers (Nkafamiya *et al*., 2007).

3.2. Physical Properties of Bread from Wheat Flour and Avocado Paste

The physical characteristics of bread from wheat flour and avocado paste are shown in Table 2. The oven spring ranged from 0.20-0.50cm. Samples NSC (100%WF), NCS (95%WF: 5%AP) and CNS (90%WF: 10%AP) had the highest value and all these samples were significantly higher compared to other samples. The oven spring decreased as the proportion of avocado paste increases. Oven spring is the rapid expansion of dough in the first few minutes in the oven, and many factors are held responsible such as gases, heat, increase in volume, water, carbon dioxide and ethanol evaporation. All these causes increase in internal pressure of dough and the dough rise rapidly in the initial stage of baking. The values obtained in this research work are lower than the values (0.30-2.40 cm) reported by Nwosu *et al*. (2014) who showed similar decrease in the oven spring of bread produced from substitution of wheat flour with cassava flour using soybean as an improver.

The loaf weight ranged from 169-186g. Sample NSC (100% WF) had the highest value while sample SMC (50%WF: 50%AP) had the lowest value. There was significant difference ($p<0.05$) among the samples. Loaf weight decreased with an increase in the proportion of avocado paste. The values obtained in this research work are lower than the value (199.50-213.00 g) reported by Igbabul *et al*. (2014). The decrease in loaf weight could be attributed to the reduction in the proportion of wheat flour and an increase in avocado paste.

Table 2: Physical properties of bread from wheat flour and avocado paste

Sample	Oven spring (cm)	Loaf weight (g)	Loaf volume (cm^3)	Specific volume (cm^3/g)
NSC	0.50 ± 0.00^a	186.00 ± 0.00^a	322.00 ± 0.00^a	1.73 ± 0.00^b
NCS	0.50 ± 0.00^a	184.00 ± 0.00^b	318.00 ± 0.00^{ab}	1.73 ± 0.00^b
CNS	0.50 ± 0.00^a	182.00 ± 0.00^c	312.00 ± 0.00^b	1.71 ± 0.00^c
CSN	0.30 ± 0.00^b	178.00 ± 0.00^d	308.00 ± 0.00^{bc}	1.73 ± 0.00^b
SNC	0.30 ± 0.00^b	177.00 ± 0.00^e	305.00 ± 0.00^{bc}	1.71 ± 0.00^c
SCN	0.30 ± 0.00^b	172.00 ± 0.00^f	301.00 ± 0.00^c	1.75 ± 0.00^a
SMC	0.20 ± 0.00^c	169.00 ± 0.00^g	296.00 ± 0.00^d	1.75 ± 0.00^a

Mean values with different superscripts within the same column are significantly different ($p<0.05$).
Mean ±SD of three replicate determinations

FOOT NOTE
NSC – Bread produced from 100% wheat flour, NCS - Bread produced from 95% wheat flour and 5% avocado paste, CNS - Bread produced from 90% wheat flour and 10% avocado paste, CSN - Bread produced from 85% wheat flour and 15% avocado paste, SNC - Bread produced from 80% wheat flour and 20% avocado paste, SCN - Bread produced from 75% wheat flour and 25% avocado paste, SMC - Bread produced from 50% wheat flour and 50% avocado paste

The loaf volume ranged from 296.00-322 cm^3. Sample NSC (100% WF) had the highest value while sample SMC (50%WF: 50%AP) had the lowest value. Loaf volume decreased with an increase in the proportion of avocado paste. The values obtained in this study are lower than the values (376.00-391.00 cm^3) reported by Igbabul *et al*. (2014) who reported a decrease as the proportion of wheat flour decreases. The decrease in loaf volume could be attributed to the reduction in the proportion of wheat flour and an increase in avocado paste.

The specific volume ranged from 1.71-1.75 cm^3/g. Samples SCN (75%WF: 25%AP) and SMC (50%WF: 50%AP) had the highest value and were significantly higher compared to the other samples. According to Ragaee & Abel-Aal (2006), the specific volume could probably be affected by the protein content of the flour as well as other factors such as the proofing time, temperature and the differences in the rate of gas retention. The values obtained in this study are lower compared to the values (3.35-3.90 $cm^{3/}g$ and 1.77-1.96 $cm^{3/}g$) reported by Peluola-Adeyemi *et al*. (2016) and Igbabul *et al*. (2014) respectively. Reduction in gas production and the retaining ability of the bread carbon dioxide could have led to the decrease observed in specific volume of the samples.

3.3. Colour Analysis of Bread from Wheat Flour and Avocado Paste

The colour attributes of breads from wheat flour and avocado paste are presented in Table 3. The $L*$ parameter ranged from 35.73-52.34. Sample SNC (80%WF: 20%AP) had the highest value while sample SMC (50:50) had the lowest value. There was significant difference ($p<0.05$) among the samples. According to Gomez *et al*. (2011), the colour of bakery products could be due to changes in caramelization process (maillard reaction) as a result of high temperature used in baking.

Table 3: Colour and texture of bread from wheat flour and avocado paste

Sample	*L**	*a**	*b**	Peak force (N)
NSC	41.62±0.03^{c}	13.80±0.03^{c}	417.99±0.02^{c}	25.43±0.03^{c}
NCS	40.56±0.03^{d}	13.70± 0.03^{d}	22.78±0.03^{d}	329.00±0.00^{f}
CNS	38.84±0.03^{f}	14.26±0.03^{a}	21.21±0.03^{f}	481.02±0.03^{b}
CSN	39.46±0.03^{e}	13.91±0.03^{b}	21.23±0.03^{e}	332.01±0.01^{e}
SNC	52.34±0.03^{a}	11.40±0.03^{g}	29.83±0.03^{a}	585.00±0.007^{a}
SCN	44.63±0.01^{b}	13.63±0.01^{e}	28.43±0.013^{b}	374.00±0.00^{d}
SMC	35.73±0.03^{g}	13.37±0.03^{f}	18.01±0.03^{g}	162.02±0.03^{g}

Mean values with different superscripts within the same column are significantly different (p<0.05).
Mean ±SD of three replicate determinations

FOOT NOTE
NSC – Bread produced from 100% wheat flour, NCS - Bread produced from 95% wheat flour and 5% avocado paste, CNS - Bread produced from 90% wheat flour and 10% avocado paste, CSN - Bread produced from 85% wheat flour and 15% avocado paste, SNC - Bread produced from 80% wheat flour and 20% avocado paste, SCN - Bread produced from 75% wheat flour and 25% avocado paste, SMC - Bread produced from 50% wheat flour and 50% avocado paste

Dietary fiber when added to bakery products result in an increase in the *L** parameter value and reduced lightness of bakery products as a result of increase in water activity (Kurek *et al.*, 2016). The values obtained in this research work are lower compared to the values (68.10-76.09) reported by Kurek *et al*. (2016).

The value of *a** ranged from 11.40-14.26. Samples CSN (90%WF: 10%AP) had the highest value while sample SNC (75%WF: 25%AP) had the lowest value. There was significant difference ($p<0.05$) among the samples. The *b** values ranged from 18.01-29.83. Samples SNC (75%WF: 25%AP) had the highest value while sample SMC (50%WF: 50%AP) had the lowest value.

The texture ranged from 162.02-585.00N. Sample SNC (80%WF: 20%AP) had the highest value while sample SMC (50%WF: 50AP) had the lowest value. There was significant difference ($p<0.05$) among the samples. This could be attributed to the reduction in the proportion of wheat flour and an increase in avocado paste. The crumb hardness could be as a result of evaporation of water content in the dough during baking and it is the maximum force required to cause failure of the crumb (Peluola-Adeyemi *et al*., 2016). Hardness is an important factor in bakery products and is strongly related to the consumer's perception of bread freshness (Ahlborn *et al*., 2005) and the formation of bread crumb is largely dependent on the ability of starch granules to swell and gelatinized during baking. The values obtained in this study are higher than the values reported by Kurek *et al*. (2016) and Peluola-Adeyemi *et al*. (2016) respectively.

3.4. Sensory Evaluation of Bread Produced from Wheat Flour and Avocado Paste

The sensory characteristics of bread produced from wheat flour and avocado pastes are presented in Table 4. The taste ranged from 5.50 - 7.90%. Sample NSC (100%WF) had the highest value while sample SMC (50%WF: 50AP) had the lowest value. The panelists preferred the taste of CNS which has 10% avocado compared to the other samples except for sample NSC (100%WF). The colour ranged from 5.00 - 8.25%. Sample NSC (100%WF) had the highest value while sample SMC (50%WF: 50AP) had the lowest value. The colour of the bread samples decreased with an increase in the proportion of avocado paste. The study showed that sample NCS (95%WF: 5%AP) are the most preferred by the panelists among the avocado samples. The flavour ranged from 5.80 - 7.4%. Sample NSC (100%WF) had the highest value while sample SMC (50%WF: 50AP) had the lowest value. The flavour of the bread samples decreased with an increase in the proportion of avocado paste. The values obtained in this research work showed that sample NSC (100%WF) was highly preferred by the panelists. The overall acceptability varied from 5.65 – 8.20. Sample NSC (100%WF) had the highest value while sample SMC (50%WF: 50AP) had the lowest value. The overall acceptability of the bread samples decreased with an increase in the proportion of avocado paste. Although, the panelists still preferred the bread from NSC (100%WF) but there was no significant difference (p>0.05) with the bread produced from sample NCS (95%WF: 5%AP) which indicates that avocado paste could be used for substitution in the production of bread.

Table 4: Sensory evaluation of bread produced from wheat flour and avocado paste

Sample	Taste	Colour	Flavour	Spreadability	Over acceptability
NSC	7.90 ± 11.07^{a}	8.25 ± 0.44^{a}	7.40 ± 0.99^{a}	8.10 ± 1.07^{a}	8.20 ± 0.83^{a}
NCS	6.85 ± 1.31^{ab}	7.50 ± 1.28^{ab}	6.70 ± 1.12^{ab}	7.75 ± 0.79^{ab}	7.45 ± 1.05^{ab}
CNS	7.00 ± 1.49^{ab}	7.05 ± 1.19^{bc}	6.35 ± 1.35^{b}	6.90 ± 1.37^{b}	6.80 ± 1.51^{b}
CSN	6.50 ± 1.47^{bc}	6.65 ± 1.04^{bc}	6.25 ± 1.12^{b}	7.10 ± 1.07^{b}	6.75 ± 1.12^{b}
SNC	6.00 ± 2.41^{bc}	6.65 ± 1.93^{bc}	6.60 ± 1.31^{ab}	7.10 ± 1.25^{b}	6.95 ± 1.58^{b}
SCN	6.20 ± 1.99^{bc}	6.20 ± 1.54^{c}	6.10 ± 1.59^{b}	7.10 ± 1.29^{b}	6.60 ± 1.93^{b}
SMC	5.50 ± 2.37^{c}	5.00 ± 2.18^{d}	5.80 ± 1.61^{b}	5.60 ± 2.16^{c}	5.65 ± 2.03^{c}

Mean values with different superscripts within the same column are significantly different ($p<0.05$).
Mean ±SD of three replicate determinations

FOOT NOTE
NSC – Bread produced from 100% wheat flour, NCS - Bread produced from 95% wheat flour and 5% avocado paste, CNS - Bread produced from 90% wheat flour and 10% avocado paste, CSN - Bread produced from 85% wheat flour and 15% avocado paste, SNC - Bread produced from 80% wheat flour and 20% avocado paste, SCN - Bread produced from 75% wheat flour and 25% avocado paste, SMC - Bread produced from 50% wheat flour and 50% avocado paste

4. Conclusion

In conclusion, bread sample produced from 50% wheat flour with 50% avocado paste had high protein, fat, crude fiber and ash contents. The addition of avocado paste shows significant effect on the physical properties of the bread such as the oven spring, loaf weight, loaf volume, specific volume, colour and texture. The 95% wheat flour with 5% avocado paste was found to have highest value in weight, loaf volume, L* and b* compared to the other samples substituted with avocado paste. The bread sample produced from 95% wheat flour with 5% avocado paste was highly preferred. Avocado pastes could be an excellent alternative for consumption and good potential in the bakery industry due to its nutritional compositions and the beneficial compounds. Substitution with 5% avocado pastes in bread production could give bread more nutritional, physical and sensory qualities.

4. Conclusion

In conclusion, the results of this study indicate that mangaba and araticum fruit could be used as flavoring agents for Greek yogurt and that sucralose addition does not affect the physicochemical characteristics and shelf-life of the product. There were no undesirable changes in the product characteristics due to the interaction of sucralose with the yogurt constituents. Moreover, the Greek yogurt with fruits pulp remained fit for consumption over 35-day storage, even without the addition of preservatives.

Conflict of interest

The authors declare that there are not conflicts of interest.

Ethics

This study does not involve Human or Animal Testing.

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