ajfand SCHOLARLY, PEER REVIEWED
AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
Volume 22 No. 4
June 2022
PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

Afr. J. Food Agric. Nutr. Dev. 2022; 22(4): 20053-20066 https://doi.org/10.18697/ajfand.109.19910

ORGANOLEPTIC PROFILES OF BREAD PRODUCED USING VARIOUS NATURAL FLAVOURS

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ABSTRACT

Bread is one of the world's most common and widely consumed foods. It is an important and affordable food for the poor in developing countries like Nigeria. The nutritional values of bread can be greatly improved by the addition of natural flavours. However, there have not been many studies on flavouring breads with natural flavours. The objective of this study was to evaluate sensory and consumer acceptability of breads produced using natural flavours. Selected flavours were ginger, garlic, cinnamon, turmeric, and nutmeg. These natural flavours are revered for their potential health attributes. They are reported to have positive effects in the treatment of numerous diseases, especially chronic ones such as cancer, diabetes, and cardiovascular diseases. Nutrition and health are intricately linked, and this is a well-established fact. The ability of nutrition (in this case, nutrients from the selected natural flavours) to reduce the risk of diseases has engaged the attention of researchers and nutritionists alike in recent decades. In this study, five samples were produced using each of the selected flavours in the production of breads. Each of the five bread samples was produced using 5 % ginger, garlic, cinnamon, turmeric or nutmeg powder. Bread was baked using automatic commercial baking line according to American Association of Cereal Chemists. Production of the various bread samples was done under the same environmental conditions. Sensory analysis was done for various sensory attributes of the five bread samples by 50 consumer panelists comprising staff and students of Obafemi Awolowo University, Ile-Ife, Nigeria. The panelists ranked the consumer acceptability of the various samples using a 9-point hedonic scale. The colour, taste, flavour, texture, and general acceptability were rated. Bread produced using 5 % ginger powder had the highest mean hedonic score for colour, taste, flavour, texture, and general acceptability, implying that sample A was the most preferred and would be the likely most acceptable by consumers.

Key words: flavours, bread, sensory, acceptability, nutrition, health, food, organoleptic

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INTRODUCTION

Bread is a staple food prepared from flour dough and water usually by baking. Bread, in all its various forms, has served as "humanity's staff of life" for centuries [1]. Its ability to provide nourishment to the human body is undeniable, and the pure enjoyment of eating fresh bread is unquestioned. While many people around the globe think of bread simply as a part of their daily diet, it is much more than that to many others [2].

Bread is a nourishing food that can be stored and eaten later, a desirable attribute that enabled civilization throughout history to survive [3]. After ancient humans initiated farming, they developed tools to process the harvested crops and procedures to cook the grains. The first bread was a type of flat bread dating back to Neolithic times (New Stone Age), which began in approximately 8,000 to 10,000 BC [3]. Nowadays, many different forms of bread are produced throughout the world. Hence, the term "bread" is used to describe a range of products with different shapes, sizes, textures, crusts, colours, elasticity, eating qualities, and flavours. With a long history of bread production in diverse cultures, many different types of breads have evolved, and new variations continue to be developed to meet consumer demands for more varied and nutritious foods [1, 3]. As would be expected for a product that has been in existence for long, bread has evolved over the years such that it means different things to different people. Indeed, the geographical and cultural differences in bread are quite broad, as evidenced by the different bread types and textures in the developed economies of the world. Pan breads, hearth breads, buns and rolls and flat breads are increasingly available around the world, even if they are not indigenous to the consumer's homeland [2]. The different types of bread are defined by the ingredients used and the manner in which those ingredients are processed into the final product. Many consumers enjoy the bread product they eat, whether they were made using an ancient process or came from the most modern high-speed production bakery [1, 2]. Bread may be leavened by different processes ranging from the use of naturally occurring microbes (sourdough recipe) to high-pressure artificial aeration method during preparation or baking. However, some products are left unleavened either for preferences or for traditional or religious reasons. In Nigeria, bread is the second most widely consumed non-indigenous food product in homes, restaurants and hotels; and most breads baked and sold in Nigeria are made without flavours [4].

Natural flavour has been defined as a flavouring substance that is obtained by physical, enzymatic, or microbiological processes from a material of vegetable or animal origin [4]. Herbs (basil, bay leaf, celery seed, lemongrass, and thyme), fruit juices, eggs, spices (cinnamon, cloves, nutmeg, turmeric, ginger, and garlic), edible yeast, and vegetable juice are common examples of natural flavours.

Interests in incorporating active ingredients such as dietary fibre and phenolic antioxidants into breads have grown rapidly due to increased consumer health awareness [5]. Several previous studies have aimed at finding potential sources of natural antioxidant for bread production (Cite the studies). A study by Lim *et al*. [6] showed that the incorporation of turmeric in bread markedly increased the antioxidant

activities. The antioxidant activities and total phenolic content of Malaysian ginger was studied by Ghasemzadeh *et al.* [7], while Heitmann *et al.* 2015 [8] studied aroma production as a yeast quality characteristic in breads. Their findings both show that yeast strain significantly affected aromas in breads as well their acceptability by consumers. Limbad *et al.* [9] investigated changes to the physicochemical properties of bread from production with coconut water, which could affect its shelf life, texture and nutritional values, significantly. Although these studies among others have studied a few natural flavours used in the production of bread, bread products with other natural flavours have not been thoroughly studied to be considered readily available ingredients for bread production. Adding natural flavours can increase the nutritional value of breads but its acceptability by consumers is a different question. This study focuses on evaluation of the acceptability of bread spiced with natural flavours by the general consumer.

Ginger, garlic, cinnamon, turmeric and nutmeg was studied as candidate natural flavours with reputable nutritional and health benefits for the production of bread. These selected natural flavours also double as functional foods as a result of their non-nutritional beneficial effect on certain target functions in the human body [10-13,14-20]. Garlic extract supplements reduce high cholesterol levels, and blood pressure in patients with hypertension [11]. Ginger contains gingerol, a compound with potent antioxidant and anti-inflammatory properties that have been linked to many unique health benefits [12, 13]. These natural flavours occur in varied flavours, colour, and aroma complementing nutrient profiles of foods [21].

The selected natural flavours have positive effects on the treatment of numerous diseases, especially chronic cancer, diabetes, and cardiovascular diseases [11-13, 22, 23,14-20]. Nutrition and health are intricately linked and thus, reduce the risk of diseases [24].

Considering the health benefits of ginger, garlic, cinnamon, turmeric and nutmeg, their incorporation in the preparation of bread may enhance the nutritional and health status of consumers. The aim of the study was to develop a novel recipe for bread production incorporating selected natural flavours as key ingredients and rich in organoleptic characteristics. The study focused on evaluation of the organoleptic profiles of these breads. Five different bread types made with different natural flavours were evaluated by panelists for a set of organoleptic characteristics in order to access consumer acceptability of breads made with natural flavours.

MATERIALS AND METHODS

Materials

Ingredients for bread production such as flour, yeast, fat/oil, sugar, water, salt and natural flavouring ingredients such as ginger, garlic, cinnamon, turmeric and nutmeg, were purchased from the Lagere market in Ile-Ife, Osun State, Nigeria. The natural flavours chosen were selected as they are commonly known and affordable within the geographical area of the study. Figure 1 shows a flow chart of the production of bread with natural flavours.

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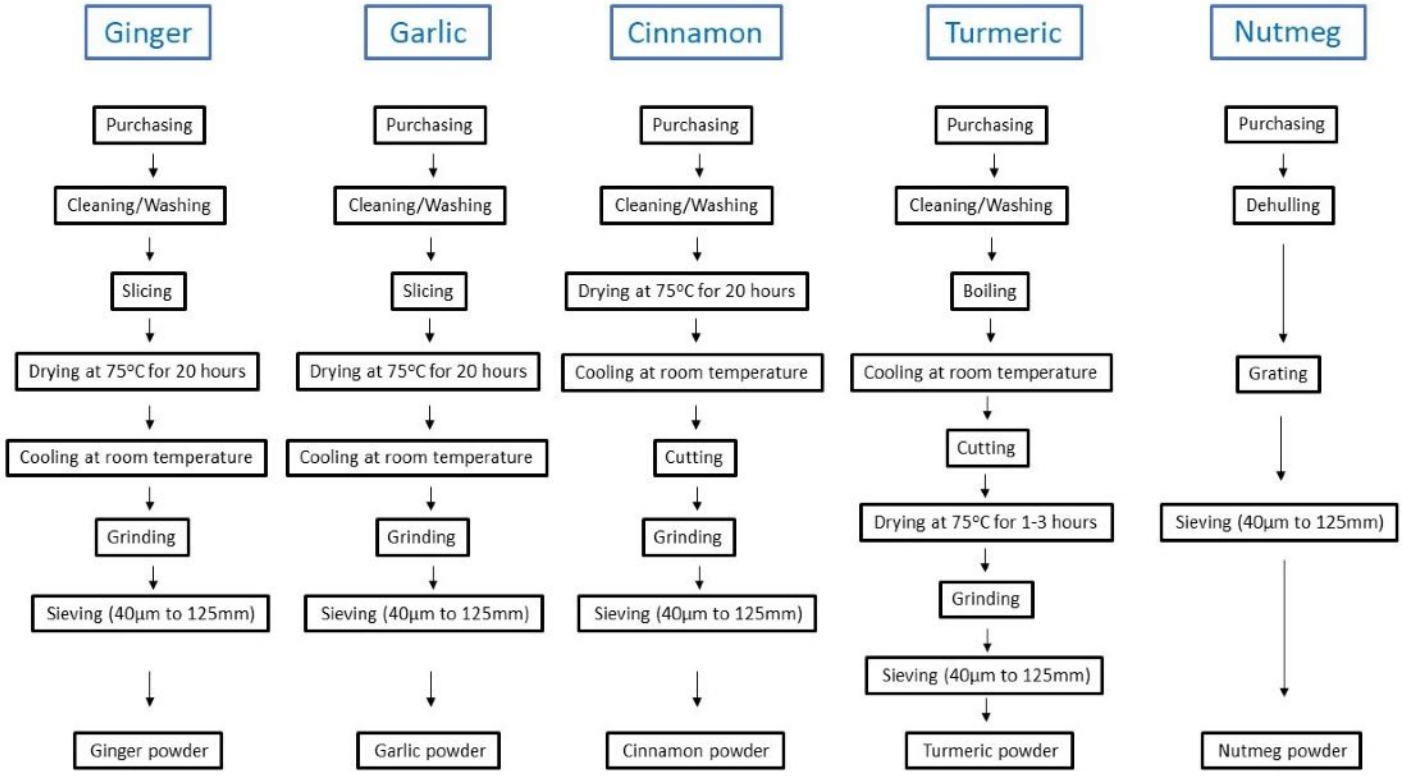

Figure 1: Flow chart of the production of bread with ginger, garlic, cinnamon, turmeric and nutmeg powder. Source: Shirshir, Hossain, & Hossain [25]

Preparation of powders from natural flavours

All natural flavour powders were prepared using the method by Shirshir, Hossain, & Hossain [25] with some modifications. Fresh ginger, garlic, cinnamon, turmeric, or nutmeg was collected from a local market and washed with clean water to remove dirt, debris, and other field-damaged portions.

For ginger and garlic, after cleaning, the vegetable was sliced up to 2-3 mm thickness with a knife. The slices were dried in an oven dryer at 75 °C for 20 hours up to 9 - 11 % moisture content. After cooling at room temperature, the dried ginger or garlic slices were ground into powder in a blender.

For cinnamon, the fresh sticks were dried in an oven dryer and cooled, after cleaning. The dried cinnamon sticks were cut into small pieces, the small pieces of cinnamon sticks were then placed into a manual or automatic coffee grinder (in the absence of a coffee grinder, the cinnamon sticks were pounded in a mortar with a pestle before using a regular dry blender).

For turmeric, after cleaning, the clean-fresh turmeric was boiled in clean water until soft and cooled, the cooled turmeric was cut into pieces and spread on a baking sheet or

in a dehydrator, and it was then dried for 1 to 3 hours until dry and crisp. The dried turmeric was placed in a blender and blended until it is smooth.

Nutmeg seeds with shells were purchased from the same local market, the shell was cracked open to expose the seed, a nutmeg grater was held at a 45-degree angle to the cutting board, the tip of the nutmeg was held with the thumb and forefinger and the edge of the nutmeg was then slid in a fluid motion up and down the nutmeg grater to produce nutmeg in the powdered form.

The grounded or grated natural flavours were sieved with a 40 µm to 125 mm mesh sieve and packaged in high-density polythene bags and plastic containers. All polythene bags and plastic containers containing the natural flavours in powdered form were labelled and stored at room temperature.

Different bread types and mixing proportions

The various bread samples were prepared to have a natural flavour content of 5 %, that is, the mass ratio of natural flavour to wheat flour was 1:19 for all samples. 5 % was used in all samples for uniformity and fair comparison. This natural flavour content level was chosen so that the natural flavour will not have too much interference in the organoleptic properties of the final products. Also, low to moderate natural flavour content allows for affordable production of the final products in large-scale for sale and distribution. Therefore, each sample had 285 g of wheat flour and 15 g of the natural flavour being used, making a total mass of 300 g. Sample A had ginger as the natural flavour; Sample B had garlic, Sample C cinnamon; Sample D turmeric; and Sample E had nutmeg.

Preparation of bread samples using selected natural flavours

Bread preparation was carried out using automatic commercial baking line according to the American Association of Cereal Chemists [26]. Ingredients include 285 g strong wheat flour and 15 g powdered natural flavour, 3 g instant active dry yeast, 3 g salt (sodium chloride), 15 g sugar (sucrose), 15 g shortening and an adequate amount of water.

The dry ingredients were manually mixed in a wide bowl and then added to a mixing bowl. Shortening and water were added to all ingredients. The components were thoroughly mixed manually. The dough was divided into pieces, rounded by hand and allowed to cool for 10 min. The divided dough was moulded, then panned and fermented for 60 min at 30 °C and 86 % relative humidity in a fermentation cabinet. The proofed pieces were baked at 210 °C for 21 min in an electric oven. Subsequently, the baked bread samples were cooled for 1 hour at room temperature.

Organoleptic Evaluation of Bread Samples

The five different bread samples (A, B, C, D and E) were evaluated by fifty consumer panelists among staff and students of Obafemi Awolowo University, Ile Ife, Osun State, Nigeria. The panelists rated consumer acceptability of the bread produced using the different natural flavours. The panelists were requested to score the samples according to their degree of likeness using the 9-point hedonic scale, where 9 is ‘like

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extremely' and 1 is 'dislike extremely'. The organoleptic qualities that were evaluated included colour, taste, flavour, texture and overall acceptability. The panelists were instructed to rinse their mouth thoroughly with water after tasting any of the samples before proceeding to the next sample. This was done to prevent the taste of the samples from interfering with one another.

Statistical Analysis

Data generated from the study were subjected to analysis of variance (ANOVA) using test procedure of IBM Statistical Product and Service Solutions (SPSS, version 210) and the mean values were compared using Duncan multiple range test ($p \leq 0.05$).

RESULTS AND DISCUSSION

The level of acceptability of bread produced using various natural flavours was evaluated using a 9-point hedonic scale. The 9-point hedonic scale ranged from 1-dislike extremely, through 5-neither like nor dislikes, to 9-like extremely. There was a significant difference ($p < 0.05$) among all the samples with respect to all the sensory parameters (colour, taste, texture, flavour and general acceptability). See Table 1. This shows that the natural flavours used possess different sensory attributes.

According to Table 1 and Figure 2, sample A (bread containing ginger flavour) was the most preferred by the panelists over the other products with respect to colour (6.34), followed by sample B (bread containing garlic) (6.26), then sample E (bread containing nutmeg) (5.58).

Taste is a very important parameter in determining the general acceptability of food products, the taste of sample A (bread containing ginger) was the most preferred by the panelists over the other products (5.08), followed by sample C (bread containing cinnamon) (4.46) and sample B (bread containing garlic) (4.36). Sample D (bread containing turmeric) had the least mean hedonic score (4.02). The taste results from garlic and turmeric might be due to excessive amounts of volatiles and phenolic compounds, which can negatively affect the taste of food, according to the work of Drewnowski & Gomez-Carneros [27].

Sample A (bread containing ginger) was most preferred by panelists (6.44) with respect to texture, followed by sample B (bread containing garlic) (5.76), sample E (bread containing nutmeg) had the third highest mean hedonic score (5.72) while sample C (bread containing cinnamon) had the least mean hedonic score (5.28).

Considering flavour and general acceptability, sample A (bread containing ginger) was the most preferred by panelists, followed by sample C (bread containing cinnamon), sample B (bread containing garlic) had the third highest mean hedonic score, with sample D (bread containing turmeric) having the least mean hedonic score. See Table 1.

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Overall, according to Table 1 and Figure 2, sample A (bread containing ginger) is the most preferred product among all samples because it has the highest mean hedonic score with respect to colour, taste, texture, flavour and general acceptability.

This study looks into the production and sensory evaluation of bread produced using different natural flavours (ginger, garlic, cinnamon, turmeric and nutmeg powders). Results obtained from this study shows that bread can be produced using different flavours and this is in line with the finding of Lim *et al.* [6].

These results are also in agreement with Balestra, Cocci, Pinnavaia, & Romani [28], who suggested that the addition of ginger powder in the bread formula would not interfere with bread physical properties. It is also in line with Shalini & Lakshami [29] who showed that bread having 10% of ginger had good acceptability among panelists.

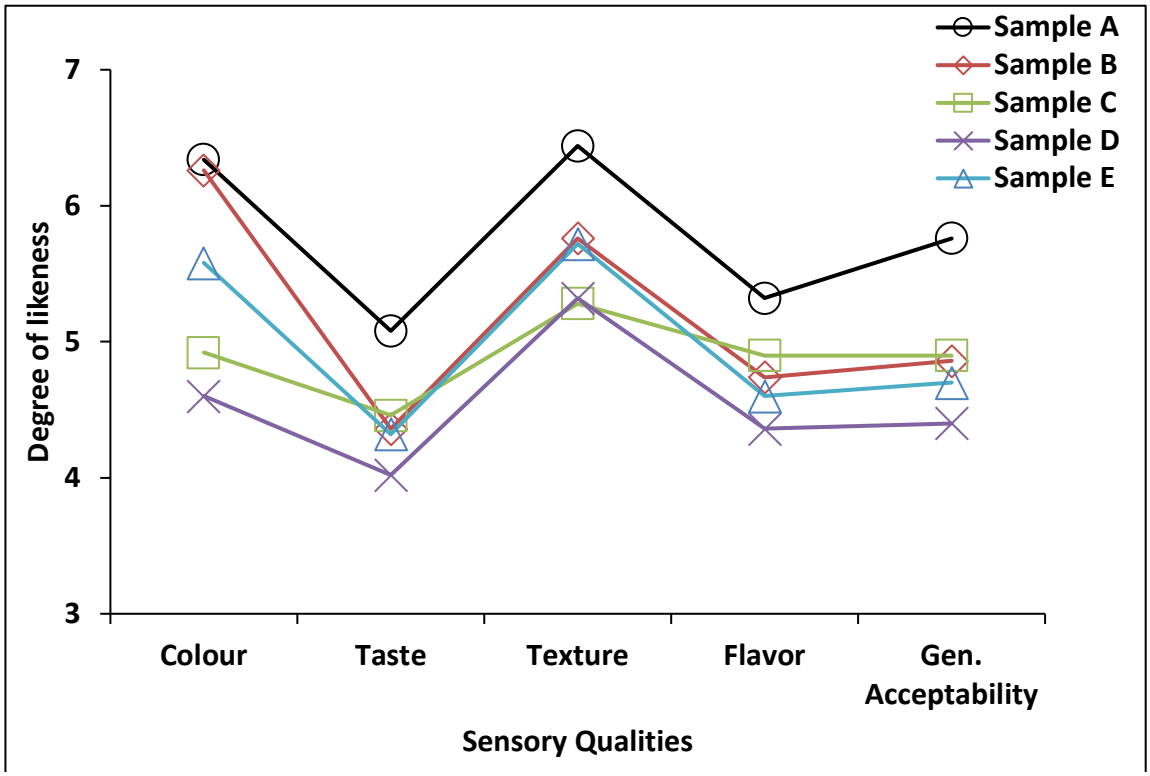

Figure 2: Sensory qualities evaluation of all bread samples. This plot shows comparison of the organoleptic properties of the samples

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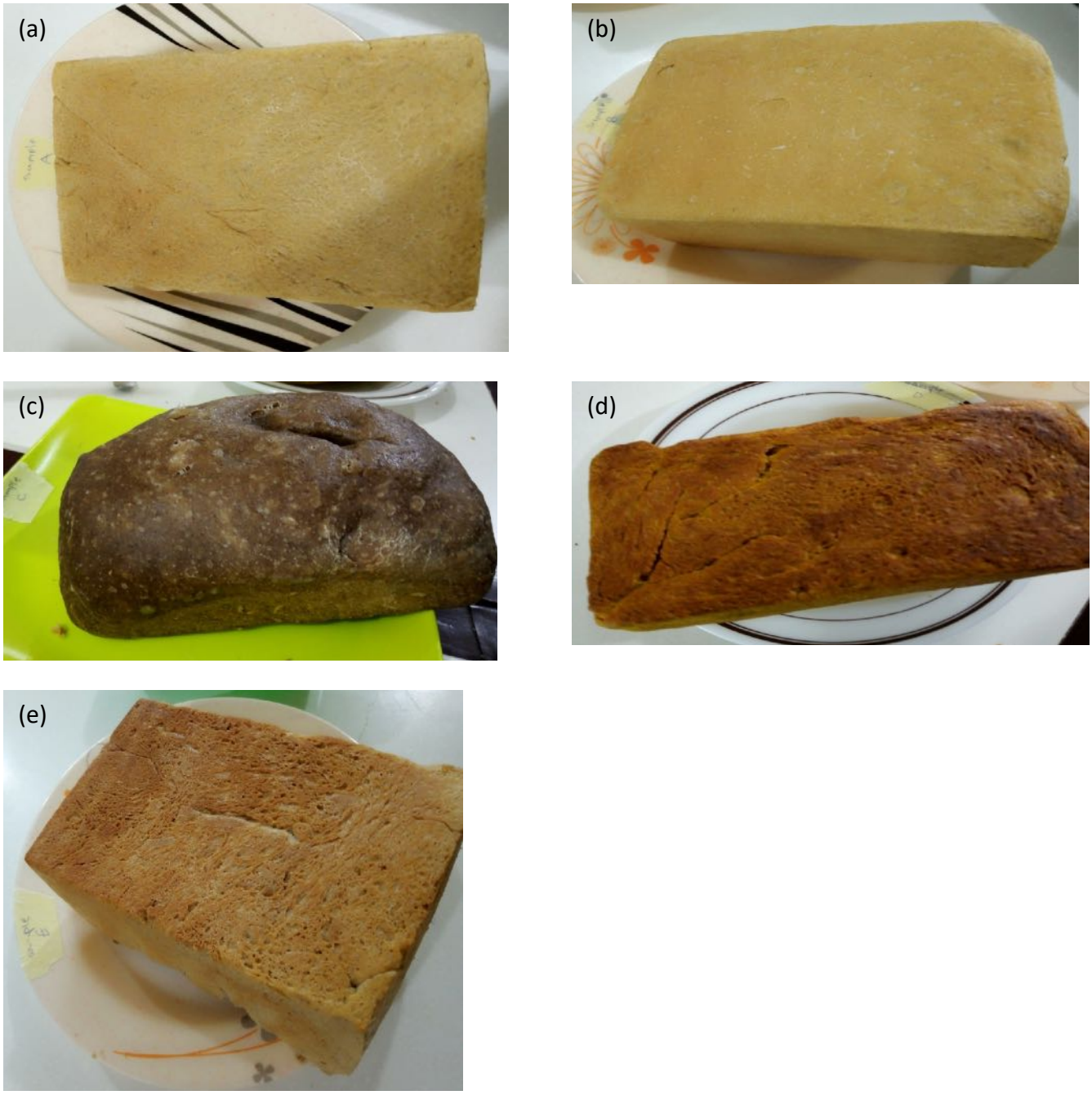

Figure 3: Images of bread samples. (a) Sample A (with ginger as natural flavour), (b) Sample B (with garlic as natural flavour), (c) Sample C (with cinnamon as natural flavour), (d) Sample D (with turmeric as natural flavour), (e) Sample E (with nutmeg as natural flavour)

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CONCLUSION

This study has shown that bread can be produced using ginger, garlic, cinnamon, turmeric and nutmeg as natural flavours. These products are locally available, which may minimize the outlay of foreign currency, which is an important economic consideration for developing countries like Nigeria and many other African nations. The study showed that bread produced using ginger as a natural flavour was the most acceptable to the consumer panelists. Considering the nutritional and health benefits of ginger, ginger-flavoured bread will help improve the nutritional status of consumers in Africa and the world at large; and this study has given a level of understanding to its acceptability by consumers.

The study recommend that efforts be made to promote the consumption of bread produced using ginger, garlic, cinnamon, turmeric and nutmeg as natural flavours since these flavours are readily available and can improve the nutritional and health status of consumers. Further studies should also be carried out to include nutritional and health benefits of breads flavoured with natural flavours. Consumers should be educated on the desirable organoleptic attributes of bread produced using these natural flavours (most especially ginger, which was shown in this study to be the most acceptable) through different access channels such as radios, television and through health workers. Also, bakeries producing bread should be encouraged to use these natural flavours in the production of bread, so as to make bread available to consumers in different flavours, with improved nutritional value.

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Table 1: Organoleptic evaluation of the bread samples on a scale of 1 to 9, where 1 is dislike extremely and 9 is like extremely

Sample (with its flavour)	Colour	Taste	Texture	Flavor	General Acceptability
A- Ginger	6.34±2.33^{a}	5.08±2.23^{a}	6.44±2.12^{a}	5.32±2.24^{a}	5.76±2.19^{a}
B- Garlic	6.26±2.28^{b}	4.36±2.36^{c}	5.76±2.25^{b}	4.74±2.41^{c}	4.86±2.37^{c}
C- Cinnamon	4.92±2.46^{d}	4.46±2.46^{b}	5.28±2.16^{e}	4.90±2.26^{b}	4.90±2.26^{b}
D- Turmeric	4.60±2.23^{e}	4.02±2.28^{e}	5.32±2.32^{d}	4.36±2.42^{e}	4.40±2.20^{e}
E- Nutmeg	5.58±2.33^{c}	4.32±2.37^{d}	5.72±2.18^{c}	4.60±2.47^{d}	4.70±2.57^{d}

The values are mean and standard deviation for duplicate experiments, and those in the same column not sharing the same superscript letter are significantly different from each other in the quality property of the column ($P<0.05$)

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