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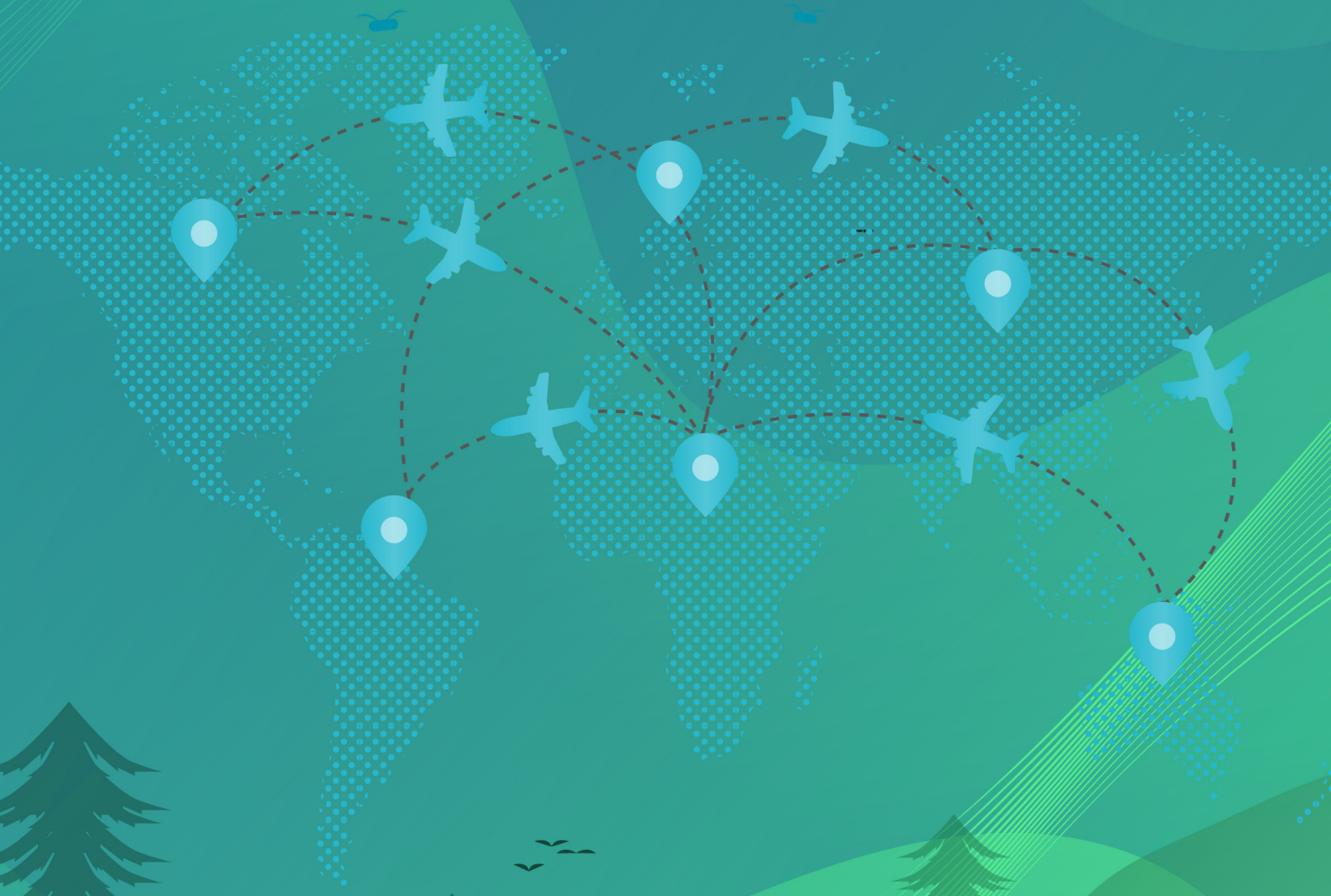

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Sensory Assessment of Fruit and Vegetable in the Production of Breads Used as a Replacement for Wheat Bran

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ABSTRACT

Partial or full substitution of wheat bran by the addition of locally available raw materials for bread making is worth experimenting with. The study's main objective was to evaluate the formulation ratio of fruit and vegetable breads and the analysis of sensory assessment. An experimental design under pinned by a quantitative approach was adopted. The questionnaire was employed to collect data, and a convenience sampling technique was used to select 189 respondents. Sensory analysis was used to assess all six samples of bread made from wheat bran, tiger nuts, dates, coconuts, and ginger, and the combined four fruits and vegetables (TDCG), together with frequencies, percentages, mean, and standard deviation. Formulation ratio for the six breads production varied, most especially, the liquid used, proofing period, and baking time. Most respondents preferred butter bread to wheat bread revealing that wheat bran bread being assumed as the most popular bread consumed by adults was untrue. Sensory analysed breads were rated high in taste, colour, texture, aroma, and appearance. As bread was tasty and soft, appearance was attractive with good smell. Most consumers confirmed that they had never consumed tiger nuts and dates bread. In all, TDCG bread scored the highest on the sensory assessment of the bread. Fruits and vegetables used for the varying breads concludes that after 2 days all of them should be stored in a refrigerator. Finally, all bread samples regarded as healthy for human consumption and aiding digestion should be mass-produced.

INTRODUCTION

Bread and other baked items get their structure from flour, which is generally made from wheat, rye, corn, and rice, pantry staples. Products of milling or grinding cereals, legumes, or other seeds are called flours (Thakur, *et al.,* 2019). Depending on the goal and intended result, flour can have a variety of protein contents to provide structure to baked items such as bread, cakes, biscuits, and pastries (Hughes *et al.,* 2021; Thakur *et al.,* 2019). More excellent protein content and a more robust dough for baked goods like bread, cakes, and biscuits are provided by higher-protein flours.

Bread is considered to be among the oldest foods and is commonly enjoyed by humans in all of its forms (Wang & Zian, 2022). Bread comes in various types such as whole grain bread, rye bread, sprouted grain bread and multigrain bread which is eaten every day and at any time. The constituents of bread include flour, water, salt, and yeast. Bread is a baked good. Many components are employed in a bread formulation to meet the unique needs of the type of bread and the manner of bread production. The elements of making bread are typically divided into two categories: necessary and optional. The four main components are yeast, water, salt, and flour. Although oil, sugar, malt, surfactants, milk and milk products, oxidizing agents, and enzymes (Barbarisi, *et al.,* 2019). These affect the texture and crumb of the dough. The integration of fruit and vegetable ingredients into bread production as a replacement for wheat bran has become increasingly popular due to their potential nutritional benefits and contribution to sensory qualities (Santos *et al.,* 2022). These ingredients, such as tiger nuts, dates, coconut, ginger, banana peels, carrot fibre, and pumpkin, provide a rich source of dietary fiber, vitamins, and antioxidants, offering a healthier alternative to traditional wheat bran (Ayo, *et al.,* 2024). In this study, tiger nuts, dates, coconut and ginger were used in the study.

LITERATURE REVIEW

The term "tiger nuts" describes the tuber of the bigger plant, which is extensively grown in Spain but is regarded as a weed in many other nations. Tiger nuts can be found in a variety of forms, such as flour, milk, and oil. Due to their high content of vital amino acids, tiger nuts are an excellent natural source of vitamins and vegetable proteins (Gambo & Da'u, 2014). Tiger nuts are grouped into various types. Based on size tiger nuts are classified into micro tiger nuts of about 6-7 mm, standard tiger nuts of about 8- 11 mm and large tiger nuts of 12-16 mm. Furthermore, classification is based on colour and type. These include brown tiger nuts, yellow tiger nuts, and black tiger nuts (Malashree *et al.,* 2024). However, the current study only concentrated on the colour of the tiger nuts with specifications on brown tiger nuts. Above all, the researcher used the brown tiger nuts as a substitute which have a similar colour to the wheat bran bread popularly known as brown bread. Tiger nut tubers can be used to make flour, starch, cakes, and biscuits, as well as snack on, roasted, fried, or baked.

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The by-product of stone dates is date seeds, which are used to make date paste or pitted dates (Mamatha, 2023). Date seeds are a by-product of stone-dating dates, which are used to make dates pasted or pitted dates separately. Traditionally, animal feed has been made from date seeds (Hossain *et al.,* 2014). They can also be used as an alternative to coffee, as a source of oil (which has antioxidant qualities that are beneficial in cosmetics), as a raw material for activated carbon, or as an adsorbent for waters that contain colour (Skorupa *et al.,* 2022). The current study made use of the golden brown colour produced in Algeria which is usually sold on the Ghanaian market (Egbadzor *et al.,* 2023). These Dates are dry, semi-sweet and peanut-like with nutty flavours and have a soft and chewy texture (Yousuf *et al.,* 2023). Also, golden brown dates are used as a substitute since it has a similar colour to wheat bran bread (brown bread). According to Khalil *et al.* (2023), dates are typically eaten either straight away or combined with other foods and drinks, such as cake, pancakes, pies, puddings, sauces, ice cream, date stew, syrup, jam, tea, and juice.

Coconuts are believed to have originated in the Indo-Pacific region, particularly in Southeast Asia and the Pacific Islands (Bellwood, 2023). The Volta, Western, Central, and Greater Accra areas of Ghana are home to the majority of the country's coconut plantations, which produce 224 million nuts annually from an estimated 36,000 hectares of land (Amoah, 2020). Food, fuel, cosmetics, building materials, traditional medicine, and many other applications can all be derived from the coconut tree (Ahuja *et al.,* 2014). Several people in the tropics and subtropics regularly consume the interior flesh of the ripe seed and the coconut milk that is extracted from it. The vast amount of clear liquid found in the endosperm of coconuts sets them apart from other fruits. This liquid is utilized to produce products that humans eat, such as coconut bread, coconut oil, coconut water, coconut juice, and coconut toffee (Chaban *et al.,* 2022). Coconut is used for making "kube" toffee, "kube" cake with sugar used as a binder, poloo, meat or fish in combination with breadcrumbs, as well as sprinkling on top of products (Ares, 2021). Likewise, they are again used for jellies, juices and smoothies. It is also used for confectionary dishes, desserts, and appetizers and then as a composite for cereal, and tuber dishes.

The main producers of ginger are India, China, Nigeria, Indonesia, Bangladesh, Thailand, the Philippines, and Jamaica, according to Salariya *et al.* (2017). For millennia, ginger, a well-known herbaceous plant, has been used extensively as a flavouring and herbal remedy (Phillips, 2023). Ginger rhizome use is a widespread traditional cure for common health issues like pain, nausea, and vomiting. In addition to other less frequent substances including terpenes, vitamins, and minerals, ginger's main compounds are gingerol, shogaols, zingiberene, and zingerone (Zhukovets & Ozcan, 2020). Ginger is traditionally used in Ghana as a paste. The rhizome or root is ground, and the resulting combination is either swallowed or applied topically to treat brain and stomach cancer. Another recipe calls for ground ginger and blended honey to be eaten orally, along with ginger toffee, drink, cake, cookies, and ginger root (Mahomoodaly *et al.,* 2021). Bacterial infections can be treated with yellow ginger due to its direct anti-microbial activity, the researcher find it similar colour with the wheat bran for the production of bread.

Sensory assessment, which involves evaluating factors like taste, texture, appearance, flavour/aroma, colour and overall acceptability, is crucial for determining consumer preferences (Sharif, 2017). This process ensures that the modified breads not only meet nutritional standards but also maintain a desirable sensory appeal that attracts consumers (Song *et al.,* 2018). The addition of fruit and vegetable-based ingredients can significantly influence the sensory properties of bread, such as its flavour, texture, colour, appearance and taste. As taste and texture are key determinants of consumer acceptance, optimizing the formulation of fruit and vegetable-enriched breads is essential to ensure their success in the market (Amoah, 2020).

The appearance of bread, including its colour, shape, and size, is a key indicator of its quality and freshness (Owusu-Apenten & Vieira, 2022). Uniform shape and colour, typically white or brown depending on ingredients and baking methods, are essential for a well-baked product (Akinoso *et al.,* 2021; Bocher *et al.,* 2021). Texture is an important factor in assessing food quality, with bread often being dense and compact, yet having a smoother, softer outer layer (Kim & Lee, 2023). The contrast between the bread's exterior and interior texture influences its overall appeal (Wambui, 2017).

The flavour/aroma of bread is a significant sensory characteristic, influenced by the ingredients and baking process (Romani & Rodriguez, 2016). The combination of sour and other distinct smells gives bread its unique, appetizing fragrance (Abidin *et al.,* 2015; Yeboah *et al.,* 2023). Bread's taste profile consists of savoury, tangy, and slightly acidic flavours, with natural sweetness balancing the sourness from fermentation (Wambui, 2017). The flavour is shaped by the ingredients and the fermentation process, offering a distinctive taste experience (Panda & Ray, 2016). The colour of bread plays a crucial role in consumer perception, with a golden-brown crust being particularly desirable as it signals proper baking (Ares *et al.,* 2021). Darker types are often linked to a richer flavour, enhancing the sensory experience (Smith, 2020).

The growing demand for healthier bread alternatives has prompted extensive research into the sensory evaluation of breads made with fruit and vegetable ingredients. Understanding the balance between enhancing the nutritional profile and maintaining sensory qualities is critical as consumers seek options that are both healthful and palatable (Lester *et al.,* 2022). This has led to the exploration of various fruit and vegetable fibre as replacements for wheat bran, aiming to produce breads that retain consumer appeal while offering added health benefits.

MATERIALS AND METHODS

According to Ofori & Dampson (2011) and Driscoll (2010), an experimental research design was an examination in which a controllable factor was given specific treatment. Here, TDCG a combination of Tiger nuts, Dates, Coconuts and Ginger is the controlled variable that was maintained throughout the experiment. Because the study was conducted as a cross-sectional survey, the data on x, y, and z only captured the state of affairs at one particular moment in time. This research evaluated the composite fibre TDCG utilized in bread manufacture using a cross-sectional survey. Members of the Assemblies of God Central Church, Takoradi in the Western Region, Ghana were sampled where 198 respondents were used. The study used a sample size of 208 respondents based on the Cochran sample size formula. The sample size was calculated using a population of 450, a 95% confidence level, and a margin of error proportion p of 0.5.

From the above, the sample size of the study was 208 respondents, however from the field work, 198 respondents responded to the study. The researcher used a convenience sampling technique to select respondents for the study. Convenience sampling was used because only those who were willing to participate were the respondents for the study. This survey included yes/no, open-ended and closed-ended items, plus a 5-point hedonic scale to indicate evaluation preference. There were three primary sections of the questionnaire. The first segment collected some basic demographic information from the participants. The general concept of the use of composite fibre in bread making came next. In the later part, respondents sensory analysed the two breads using a 5-point hedonic scale. Products were developed periodically until a standardized recipe was achieved. In all, unique recipes were developed using Tiger nuts, Dates, Coconuts and Ginger. Raw materials for the study were purchased from the Takoradi New Market and the Beposo Market. The process of creating bread ratios is figuring out how much flour, water, yeast, and salt to add in order to get the right texture, flavour, and rise. A standard bread recipe calls for 4 flour and 1 fat (4:1), with minor additions of salt and yeast. Changes in these proportions can produce a variety of bread with changing crumb structure, moisture content, and flavour profiles.

Flow Chart for A. Basic Wheat Bread Production Ingredients/ Recipe

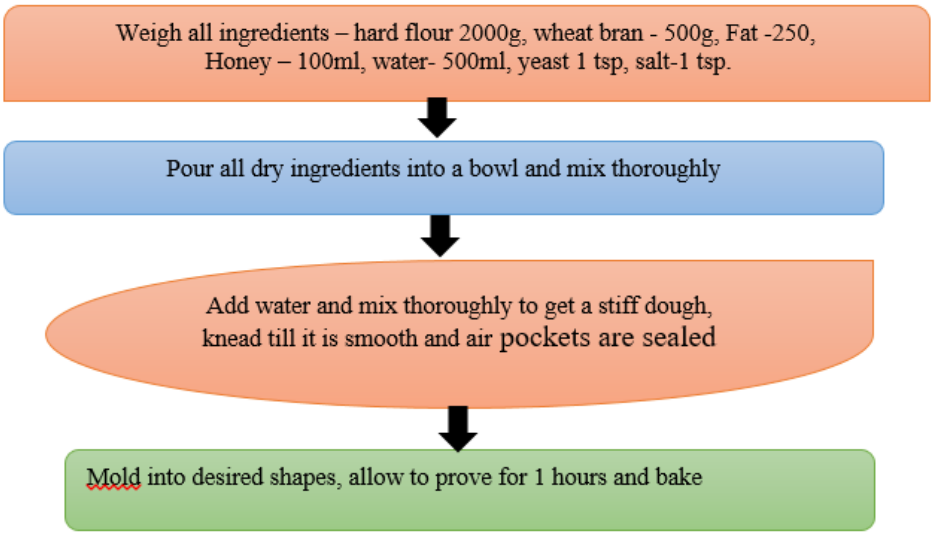


Figure 1: Wheat Bread Recipe
Source: Recipe adapted from Mill & Fleischmann, (2024)

Sample "B" Tiger Nuts, Dates, Coconuts and Ginger (TDCG) Bread

Hard Flour-1500g (3 pounds)
Tiger nuts fibre-250g (1/2 pound)
Dates fibre-250g (1/2 pound)
Coconut fibre-250g (1/2 pound)
Fresh Ginger fibre-250g (1/2 pound)
Margarine-250g (1/2 pound)
Honey-100 millilitres
Yeast-1 teaspoon
Salt-1 teaspoon
Water-450 millilitres

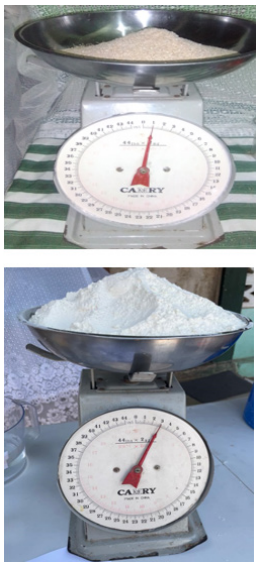
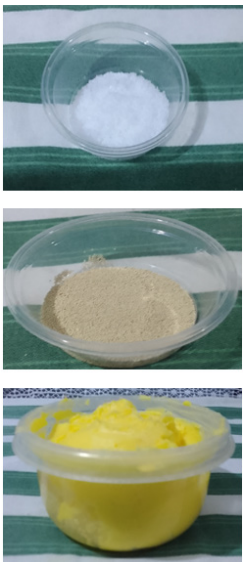
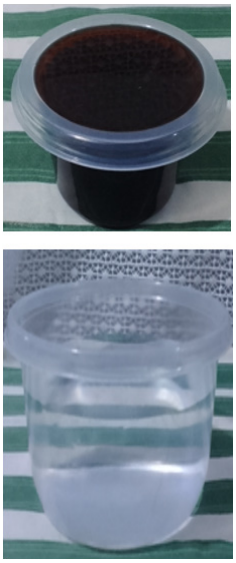
Instructions

1. Combine salt and flour in the large mixing bowl, combine the flour and salt.
2. Add all liquid ingredients (tiger nuts fibre, dates fibre, coconut fibre and fresh ginger fibre) to the dry mixture and knead until a stiff dough is attained.
3. Knead the dough on a floured surface for about 25-30 minutes until it becomes smooth and elastic. Mould the dough into the desired shapes.
4. Place the shaped loaf into a greased 15x8-inch loaf pan. Cover it and let it prove for about 1 hour 30 minutes.
5. Preheat your oven to 320°F (150°C). Bake the bread for about 1 hour and 14 minutes or until it is golden

brown on top, and it sounds hollow when tapped on the bottom.

6. Remove the bread from the oven and transfer it to a wire rack to cool completely

Table 1: Pictorial View of Wheat Bread and TDCG Bread Production

			
Wheat Flour (500g) Hard Flour (2000g)	Salt (1 tsp) Yeast (1 tsp) & Fat (250g)	Honey (100ml) Water (500ml)	Mixing of dry & Liquid ingredients
			
Kneading bread (20-25 minutes)	Bread in a loaf tin allowed to prove	Proved wheat bread (Duration 1.35mins.)	Baked Wheat bread (Duration 45 minutes)
			
Wheat Bran Bread (Brown Brea)		TDCG Bread	

Wheat Bran Bread (Brown Bread)

TDCG Bread

Researcher Educating Respondents

Respondents Assessing the Products

Source: Fieldwork, 2024

Two different samples were pre-packaged and labelled as seen in the pictorial view. The assessment took place from 11:00 am to 2:00 pm. As respondents were seated, they were given specific samples, water, questionnaire and a pen for writing. After filling the sections A and B, respondents were encouraged to assess each sample and fill in their comments before moving on to the next sample. Data was analyzed using Microsoft Excel version 16 and results presented in frequencies and percentages.

RESULTS AND DISCUSSION

Formulation Ratio for the Production of Fibre Breads

All two bread samples made use of a formulation ratio of 4:1, whereby fat, honey, yeast, salt and water. From Table 2, wheat bran bread made used of formulation ratio which is 4:1 where by the hard flour was 2000g and wheat bran was 500g. Again, the TDCG bread made use of a formulation ratio 3:2 which is made up of hard flour 1500g and then Tiger nuts (250g), Dates (250g), Coconuts

Table 2: Formulation Ratio for the Production of Fiber Bread

Type of bread	Wheat bran bread	TDCG bread
Hard flour	2000g	1500g
Composite quantity	500g	T-250g, D-250g, C-250g, G-259g
Fat	250g	250g
Honey	100ml	100ml
Yeast	1tsp	1tsp
Salt	1tsp	1tsp
Water	500g	500g
Proving period	1hr. 35mins	1hr. 14mins
Baking period	45mins	1hr. 35mins

Source: Fieldwork 2024

(250g) and Ginger (250g). Also there was a difference in the proving period for wheat bran bread (1hr. 35mins) and TDCG bread (1hr. 14mins). The baking period for the wheat bran bread (45miniutes) and TDCG bread (1hr. 35mins) varied, however, the other ingredients were the same adapted from Mill & Fleischmann, (2024).

General Idea on Composite Fibre (TDCG) Used for Bread Production

The TDCG Bread was a new product to lots of respondents since they were mostly used to coconut bread and ginger bread. The results of the sensory assessment of the varying samples were presented in Table 3. It was found out that comparing TDCG Bread and Wheat Bran Bread, respondents preferred TDCG Bread in every category (appearance, texture, flavour/aroma, taste, and colour). In general the percentage that liked the TDCG Bread in relation to the sensory domains were all higher than that of the Wheat bread. As texture showed the biggest difference (31% higher), appearance showed the smallest (17% higher) for TDCG Bread and Wheat Bran Bread respectively. This aligned with the scientific research by Wambui (2017) and Akinoso *et al.* (2021) who confirmed that texture is crucial for bread quality. Meanwhile, Ares *et al.,* (2021) and Smith *et al.,* (2020) emphasized on colour importance, and here, TDCG Bread scored a notably appreciation of colour (92%) with Wheat Bran Bread attaining 64%. The research by Owusu - Apenten & Vieira (2022) on visual perception and Kim & Lee's (2023) studies on consumer preferences demonstrated that when bread excels in all sensory aspects (sight, touch, smell, and taste) as TDCG Bread did, people are much more likely to enjoy and choose it.

Table 3: Sensory Assessment of Bread Production

Percentage (%) that Liked the Product		
Sensory Domains	**Wheat Bran Bread**	**TDCG Bread**
Appearance	66	83
Texture	63	94
Flavour/Aroma	65	89
Taste	67	87
Colour	64	92

Source: Fieldwork, 2024

CONCLUSIONS

Most consumers confirmed that they had never consumed combined fruits and vegetables bread before, unlike the wheat bran bread and single-blend breads. The existence of a new recipe for the production of fibre bread is of great advantage to consumers as the formulation ratio could aid homemakers to prepare their own fruit and vegetable blend breads. After 24 hours, both Wheat Bran Bread and TDCG Bread should be stored in a refrigerator to maintain its freshness. It is therefore recommended that all bread samples regarded as healthy for human consumption should be mass-produced and commercialized.

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