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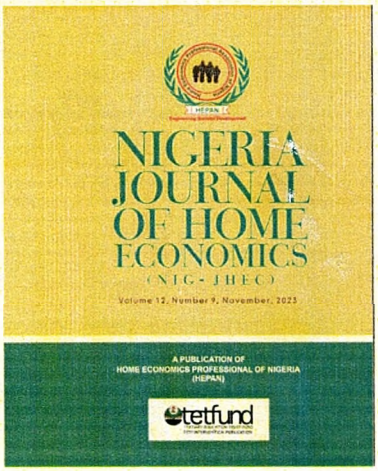

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PROXIMATE AND ORGANOLEPTIC ANALYSIS OF CARROT-FORTIFIED AND VANILLA FLAVOURED CAKES

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Abstract

This study investigated the proximate and organoleptic properties of carrot-fortified and vanilla flavoured cake. Specifically, it determined: proximate composition of carrot-fortified and vanilla flavoured cake; and organoleptic properties of carrot-fortified and vanilla flavoured cake. Samples of the products were prepared using standard methods. The product was divided into two parts, one part was subjected to proximate analysis while the other part was subjected to sensory evaluation. Proximate analysis of carrot-fortified and vanilla flavoured cake was carried out using standard methods. Twenty panellists were involved in the sensory evaluation of the products. A 7-point hedonic scale was used to collect data on the organoleptic properties of the samples. Data for sensory evaluation were analysed using percentages (%). Result of proximate analysis showed that carrot-fortified cake had the highest content of protein (15.6%), Moisture Content (15.6%), ash (2.4%), crude fibre (1.2%), Tannins (55mg/100g), Saponins (35mg/100g) 35, Ascorbic Acid (14.5mg/100g), Carotenoids (350µg/100g), Thiamine (0.21mg/100g), Riboflavin (0.17mg/100g), Niacin (2.65mg/100g) and lowest content of fat (25.0%), carbohydrate (42.2%) when compared to vanilla-flavoured cake. Also, the organoleptic result showed that carrot-fortified cake was ranked higher and accepted by the panellists when compared to vanilla flavoured cake based on the 7-point hedonic scale rating. Based on these findings it was recommended that: further research could be carried out on the shelf life of carrot cake and mode of preservation with the use of natural preservatives such as vinegar and physiochemical analysis of the cakes during different stages of storage.

Keywords: acceptability, cake, carrot fortified, organoleptic, vanilla flavoured

Introduction

Food fortification is defined according to Food and Agriculture Organization (2010) as the addition of one or more essential nutrients to a commonly eaten food or processed foods for the purpose of improving the nutritional qualities of food and preventing or correcting a demonstrated deficiency of one or more nutrients with minimum health risk to the people. Fortification of food with micronutrients is an essential part of a nutritional strategy to minimize micronutrient deficiencies. It is a dynamic area developing in response to the needs of population groups and industry (Hoang and Gottleib, 2016). Examples of foods usually fortified include infant formular, roots and tubers, cereal, and cereal products. Fortification of bakery products is possible and given priority now as it is widely liked and consumed among people presently. To bridge the micronutrient deficiency, dehydrated carrots are remarkable foods and since beta carotene in food is better absorbed than other carotenes (Srilakshmi, 2016).

A snack is a portion of food often smaller than a regular meal, which is generally believed to be eaten between meals (Oluwalana 2014). Snacking is an effective way to supplement one's diet with extra nutrients and prevent over-eating at mealtimes. Not all nutrients which are required by the body for growth are gotten from the three-course meals (Lobstein, 2004). However, Snack consumption between regular meals is necessary to supplement nutrients which is the reason why snacking on nutritious snacks is advisable and required. The "ready-to-eat" nature of bakery products and pastries makes them convenient foods and has become essential to the survival of the hospitality and tourism sectors in Nigeria and the world at large. They can be made from different food items including wheat flour, cassava and so on. Cakes are flour-based snack.

Carrot (*Daucus carota* L.) is the most important crop of *Apiaceae* family which is a root vegetable widely distributed over the world. Carotenoids and anthocyanins are the main antioxidant pigments in carrots. Carotenoids are yellow, orange or red phytochemicals found in most cultivars with yellow and orange flesh (Silva Dias, 2014). The widely used orange carrot is rich in α- and β-carotene and is a rich source of vitamin A. Carrot provides high amounts of vitamin A due to the high bioavailability of carrot carotene in the human diet when compared with other vegetables (Silva Dias, 2014). Carrot is a good source of carotenoids, vitamins, and dietary fibre and rich in minerals and antioxidants. It can be eaten raw, chopped, grated, or included to salads for colour or texture and as a healthy drink: carrot juice. With increasing health awareness, carrots are becoming more popular due to their abundant nutrients and benefits for human health. It can be added to wheat flour to produce *carrot cake*.

Cakes are high in sugar and rich in carbohydrates and fat but low in other nutrients, including protein, minerals, and vitamins (Roni *et al.*, 2021). The World Health Organization (WHO, 2020) reported snacks with high sugar and fat content as unhealthy. In this context, the demand for functional food with higher nutrients and minerals has risen, hence, the fortification of cake using locally available nutritionally rich root vegetable (carrot) to enhance the micronutrient content of cakes. It comes in handy at home, in the office, at parties, in reception halls, tourist canters, on aircraft and at schools among others.

The organoleptic analysis is a scientific discipline used to evoke, measure, analyse and interpret the acceptability of products consisting of appearance, texture, colour, shape, aroma, and taste of the product that are perceived by the senses of sight, smell, touch, taste, and hearing (Lawless & Heyman, 2010). The characteristics of food/products are perceived through human sense organs. Organoleptic properties can be differentiated based on the purpose of organoleptic assessment which is the differentiation test (discriminative test), acceptance test (affective test) and description test (descriptive test) is stated by Lawless and Heymann, (2010) and Gengler (2009).

The acceptance or rejection of food in which snacks are included, entirely depends on whether it meets consumer expectations and needs and the degree of satisfaction that can provide (Mosca *et al.*, 2015). *Carrot cake* which is made from wheat flour fortified with Carrot rich in Vitamin A has however not gained a high level of acceptance from the public compared to other snacks (such as vanilla cake, red velvet cake, chin-chin, potato chips, buns) as only a minimal percentage of people know about the snack, its nutritional benefits and has only started gaining acceptance. However, studies on the chemical composition and organoleptic properties of carrot-fortified cake are scarce. Therefore, there is great need for comprehensive documentation of the proximate composition and organoleptic properties of carrot-fortified cake which would provide useful information that could further create awareness of its potentials for healthy snacking & nutrition, also promote its consumption. The study investigates the proximate and organoleptic analysis of *carrot-fortified cake* and *vanilla flavoured cake*, comparing the acceptability level with each other.

Objective of the Study

The general objective of this study was to investigate the proximate and organoleptic analysis of Carrot-fortified Cake and Vanilla flavoured Cake. Specifically, the study:

1. determine proximate analysis of Carrot-fortified Cake and Vanilla flavoured Cake;
2. determine organoleptic analysis of Carrot-fortified Cake and Vanilla flavoured Cake; and
3. compare the level of acceptability of Carrot-fortified Cake and Vanilla flavoured Cake.

Materials and Methods

Study area: This research was carried out within the Botanical Garden, University of Ibadan. It is located within the University of Ibadan campus which was founded in 1948 and situated 6 kilometres to the North of the city of Ibadan (7°26'N and 3°54'E) covering a total land area of 1,032 hectares (over 2,550 acres of land. Attractions found within Botanical Garden include different floral species, restaurants, picnic spots, a waterfall fountain, and a playing ground for children. Other activities that are been carried out with the garden include Photoshoots, picnics, outdoor events, garden parties and excursions.

Design of study: It is an experimental study. It involved the use of primary data and secondary data to gather information relating to the study. The primary data involved the use of questionnaires, sensory evaluation forms and laboratory experiment.

Materials: The materials used to produce samples include wheat flour, carrots, and vanilla extract purchased from Bodija market, Ibadan, Oyo state including other ingredients.

Preparation of carrot cake:

Recipe

1. 1000 grams of all-purpose flour
2. 250 grams of margarine (3)
3. 2 teaspoons baking powder
4. ¼ teaspoon nutmeg
5. ½ teaspoon salt
6. 10 large eggs at room temperature
7. 100 grams granulated sugar
8. 1 teaspoon vanilla extract
9. 300 grams of grated carrots.

Procedure for preparation: The *carrot cake* samples were prepared using the method described by Aruna & Sowiya (2014). with slight modifications. The procedure used in carrot cake preparation was according to the following steps:

1. In a large mixing bowl, the dry ingredients; 1000g flour, 2tsp baking powder, ¼ tsp nutmeg and pinch of salt were measured and mixed until well combined and then set aside.
2. Three 250g margarine and 100g sugar were measured into a bowl and mixed using mixer until it is thoroughly mixed.
3. In a separate mixing bowl, 10 eggs were whisked together, and 1 tsp of vanilla extract was adde
4. The fresh carrots were then grated using grater and squeezed out using hands to remove the water content. Then 300g of the grated carrot was added into the wet ingredients and mix until well combined.
5. Thereafter, bit by bit the wet ingredients were added to the mixed butter and sugar.
6. The Dry ingredients and wet ingredients were then mixed with a whisk or rubber spatula until just combined to form a batter, making sure not to overmix the batter.
7. The oven was preheated at 180°C.
8. The cake pans were then well greased with margarine or butter to make it non-stick and set aside.
9. The cake batter was evenly poured into the prepared cake pans and baked in the oven for 40-45 minutes until the tops of the cakes are set, and a toothpick was inserted into the canter to check the inside.
10. It was then removed from the oven and allowed to cool in the pans for about 20-25 minutes.
11. Once the cake was cooled, it was removed from the pans and the cake was allowed to finish cooling.
12. After cooling it was then cut into a square shape and packaged

Proximate Analysis

The parameters checked include Moisture Content, protein, ether extract (fat), ash, crude fibre, carbohydrate, Tannins, Saponins, Ascorbic Acid, Carotenoids, Thiamine, Riboflavin and Niacin. The moisture, protein, fat, crude fibre and ash content of the samples were determined using the methods outlined in Association of Official Analytical Chemist (2010). Moisture content was determined using the air oven method. Petri Dishes were washed and dried in an oven. Then it was cooled in the desiccators after weight has been taken. A known weight of samples was afterward transferred into the crucibles and dried at a temperature between 103ºC- 105°C. The dry samples were cooled in the desiccator and the weight noted. They were later returned to the oven and the process continued until constant weights were obtained. The crude protein content was determined using micro Kjeldahl method as described in AOAC (2010).

For Ash content Determination, a known weight of finely ground sample was weighed into clean, dried previously weighed crucible with lid (W1). The sample was ignited over a low flame to char the organic matter with lid removed. The crucible was then placed in muffle furnace at 600oC for 6h until it ashes completely. It was then transferred directly to desiccators, cooled and weighed immediately (W2). The soxhlets extraction method as described in AOAC (2010) was used to determine ether extract (Fat).

Crude fibre was determined using 1.25% diluted solution H_2SO_4 and NaOH solution added to a known weight of the residue from fat extraction, after the residue was boiled and the loss recorded as crude fibre. The carbohydrate content was calculated by difference (Egbedike *et al.*, 2023).

% CHO = 100 - (Sum of the percentages of moisture, ash, fat, protein and crude fibre).

Antinutrient composition (saponin and tannin), saponin content of the sample was determined by double solvent extraction gravimetric method as described by (Harbone, 1973) and Tannin was determined using the Folin-Dennis Spectrophotometric method described by Person (1976).

Vitamin contents of the cakes was estimated using the method described by Roni *et al.*, (2021). The cake sample (5 g) was mixed with 10 mL acetone and few anhydrous sodium sulfate crystals for settling; then, the supernatant was decanted into a beaker and poured into a separator funnel. Afterward, 10 mL petroleum ether was added, well mixed, and the layers were allowed to separate. The top layer was collected in a 100 mL volumetric flask, which was then filled with petroleum ether to reach the desired volume. Using petroleum ether as a blank, the optical density (OD) of the solution was measured at 452 nm.

Sensory Evaluation

Selection of panel of judges: A seventy (70) panel of judges/consumers made up of visitors within the Botanical Garden, University of Ibadan were selected using purposive sampling techniques. Respondents selected were duly trained before participating in the study to rate the products and whether they meet food standards and requirements.

Data collection instrument: A 7-point hedonic scale was used for the study were panellists ranked their preference ranging from 1 = dislike extremely, 2 = dislike moderately, 3 = dislike slightly, 4 = neither like nor dislike, 5 = like slightly, 6 = like moderately, 7 = like extremely. The instrument was appropriately validated.

Data collection method: The sensory attributes evaluated were appearance, taste, flavour, aroma, texture, and overall acceptability. Panellists were served the *carrot-fortified* and *vanilla flavoured* samples in coded plates labelled T_1 and T_2. Panellists rinsed their months with water after testing sample one before moving to the next sample.

Data analysis: Data was analysed using statistical package for social sciences. Data were subjected to descriptive statistics in form of frequency and percentages. Frequency and percentages were used to represent the

percentage distributions of some variables related to the research work.

Results of the Study

Table 1: Proximate Analysis of carrot cake and vanilla cake

Parameter	Carrot Cake	Vanilla Cake (Control)
Moisture Content %	15.60	13.90
Protein %	15.60	15.00
Ether Extract (Fat) %	25.00	26.30
Ash %	2.40	1.90
Crude Fibre %	1.20	0.60
Carbohydrates/NFE (By Difference) %	42.20	42.30
Tannins (mg/100g)	55.00	25.00
Saponins (mg/100g)	35.00	15.00
Ascorbic Acid (mg/100g)	14.50	2.30
Carotenoids (µg/100g)	350.0	65.00
Thiamin (mg/100g)	0.21	0.12
Riboflavin (mg/100g)	0.17	0.09
Niacin (mg/100g)	2.65	1.96

Table 1 shows the result of the proximate composition of *carrot cake* and *vanilla cake*. The experiment revealed that the dominant components of both products in no particular order are Moisture Content (15.6% - *carrot cake*; 13.9% - *vanilla cake*), protein (13.6%- *carrot cake*; 15.0% - *vanilla cake*), fat (25.0% - *carrot cake*; 26.3% - *vanilla cake*), ash (2.4% - *carrot cake*; 1.9% - *vanilla cake*), crude fibre (1.2%- *carrot cake*; 0.6% - *vanilla cake*), carbohydrate/NFE (42.2%- *carrot cake*; 42.3% - *vanilla cake*), Tannins (mg/100g) (55 - *carrot cake*; 25 - *vanilla cake*), Saponins (mg/100g) (35 - *carrot cake*; 15 - *vanilla cake*), Ascorbic Acid (mg/100g) (14.5 - *carrot cake*; 2.3 - *vanilla cake*), Carotenoids (µg/100g) (350- *carrot cake*; 65 - *vanilla cake*), Thiamine (mg/100g) (0.21- *carrot cake*; 0.12 - *vanilla cake*), Riboflavin (mg/100g) (0.17- *carrot cake*; 0.09 - *vanilla cake*), Niacin (mg/100g) (2.65- *carrot cake*; 1.96% - *vanilla cake*).

Table 2: Organoleptic properties of *carrot-fortified cake*

Variables	A(%)	T(%)	Ar(%)	TE(%)	P(%)	O(%)
Dislike extremely	0	0	0	0	0	0
Dislike moderately	0	0	1	0	0	0
Dislike slightly	1	0	0	2	4	3
Neutral	7	9	7	8	11	9
Like slightly	53	44	46	37	33	39
Like moderately	29	46	27	43	25	35
Like extremely	10	1	19	10	27	14
Total	100	100	100	100	100	100

A – Appearance; T – Taste; Ar – Aroma; TE – Texture; P- Packaging; O – Overall acceptability; % = Percentage

Table 2 shows the result of the organoleptic analysis of *carrot-fortified cake* using the 7-point hedonic scale rating. Variations were observed in the percentages of the rating of the variables. The Table shows that none of the properties was rated as being disliked extremely (score = 0.0%). There were variations in their ratings for "being liked" as shown in the Table above.

Table 3: Organoleptic properties of *vanilla flavoured cake*

Variables	A(%)	T(%)	Ar(%)	TE(%)	P(%)	O(%)
Dislike extremely	0	0	0	0	0	0
Dislike moderately	0	0	0	0	0	0
Dislike slightly	1	4	3	3	13	9
Neutral	5	2	5	6	26	13
Like slightly	19	21	28	36	28	30
Like moderately	44	39	38	33	20	28
Like extremely	31	34	26	22	13	20
Total	100	100	100	100	100	100

A – Appearance; T – Taste; Ar – Aroma; TE – Texture; P- Packaging; O – Overall acceptability; % = Percentage

Table 3 shows the result of the organoleptic analysis of *vanilla flavoured cake* using the 7-point hedonic scale rating. Variations were observed in the percentages of the rating of the variables. The Table shows that none of the properties was rated as being disliked extremely and moderately (score = 0.0%). There were variations in their ratings for "being liked" as shown in the Table above.

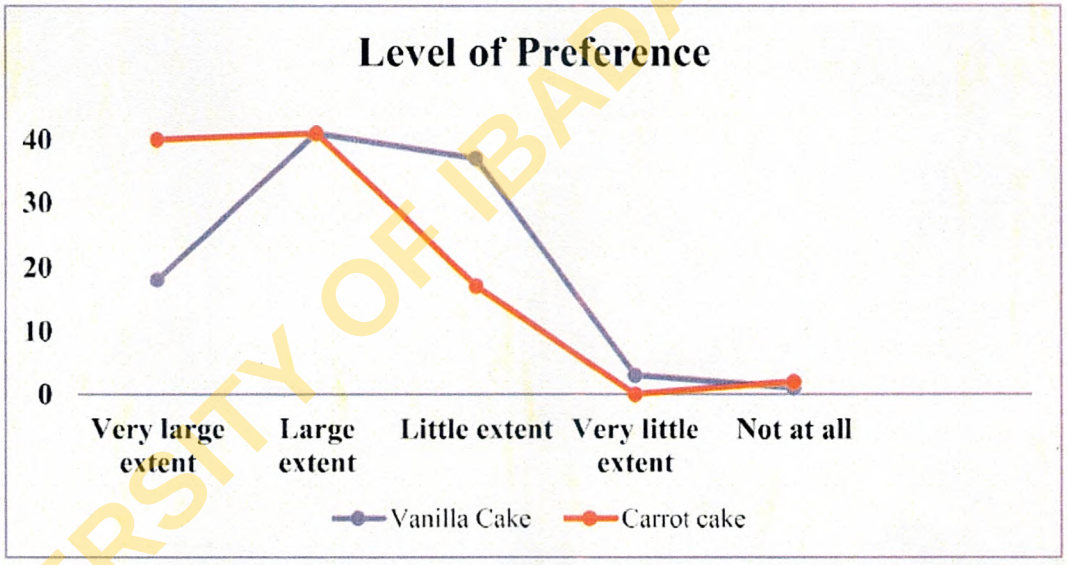

Figure 1: Percentage distribution of respondents' level of preference for carrot and vanilla cake

Figure 1 shows the level of preference for the consumption of carrot-fortified cake and vanilla flavoured cake. It showed that 40% preferred *carrot-fortified cake* to a very large extent, 41% large extent, 17% little extent and 2% do not prefer at all, while for *vanilla flavoured cake*, 18% preferred to a very large extent, 41% large extent, 37% little extent, 3% very little extent and 1% do not prefer vanilla cake at all. *Carrot-fortified cake* had the highest level of acceptability.

Discussion

Table 1 shows the proximate composition of *carrot-fortified cake* and *vanilla flavoured cake*. The experiment revealed the nutritional components of both products in no particular order are Moisture Content (15.6% - *carrot cake*; 13.9% - *vanilla cake*), protein (15.6%- *carrot cake*; 15.0% - *vanilla cake*), fat (25.0% - *carrot cake*; 26.3% - *vanilla cake*), ash (2.4% - *carrot cake*; 1.9% - *vanilla cake*), crude fibre (1.2%- *carrot cake*; 0.6% - *vanilla cake*), carbohydrate (42.2%- *carrot cake*; 42.3% - *vanilla cake*), Tannins (mg/100g) (55 - *carrot cake*; 25 - *vanilla*

cake), Saponins (mg/100g) (35 - *carrot cake*; 15 - *vanilla cake*), Ascorbic Acid (mg/100g) (14.5 - *carrot cake*; 2.3 - *vanilla cake*), Carotenoids (µg/100g) (350- *carrot cake*; 65 - *vanilla cake*), Thiamine (mg/100g) (0.21- *carrot cake*; 0.12 - *vanilla cake*), Riboflavin (mg/100g) (0.17- *carrot cake*; 0.09 - *vanilla cake*), Niacin (mg/100g) (2.65- *carrot cake*; 1.96% - *vanilla cake*).

Fortification of cake with carrot has significantly increased the nutritional content and value of cakes. It was observed that *carrot-fortified cake* has higher moisture content than *vanilla flavoured cake* which helps in digestion and waste elimination. This also shows the low shelf life of *carrot-fortified cake* as reported by Apata & Joseph (2023), that high moisture content enhances the growth of microorganisms and hence microbial spoilage of food.

The protein content in *carrot-fortified cake* is higher compared to *vanilla flavoured cake* which helps in repairing body tissues and body development. According to Wilson (2015), the presence of protein helps in oxygen transportation, hormones production like insulin and progesterone (used in reproduction) and rebuilds cells in the body.

Ether extract (fat) and carbohydrate was found to be higher in *vanilla flavoured cake*, however both samples had relatively high content of fat and carbohydrate. Ether extract (fat) provides energy to the body, serves as insulation and regulation of body temperature. Carbohydrate is primary source of energy to all part of the body. According to Food and Agricultural organization (2010), excess fat can contribute to the increase problem of overweight and obesity.

The content of crude fibre in *carrot-fortified cake* is higher compared to *vanilla flavoured cake*, helps in the reduction of heart diseases, diabetes and obesity and provides the body with weight loss, and weight maintenance which increases in plants with increasing maturity (Aruna & Sowiya, 2014). High Ash content detected in *carrot-fortified cake* serves as a source of minerals which helps in body growth according to Ogbonna *et al*., (2013).

The vitamin content is higher in *carrot-fortified cake* compared to *vanilla flavoured cake* which includes ascorbic acid, carotenoids, thiamine, riboflavin, niacin. This could be attributed to the presence of carrot in the sample which has a high content of essential vitamins especially carotenoids. Vitamins are vital for converting food to energy, support growth and development, shore up bones and boost immune system. Therefore, the presence of these nutrients makes the consumption of *carrot-fortified* cake healthy, nutritious, and safe to consume by all age groups.

Findings on organoleptic properties in table 2 and 3 revealed that the samples were significantly different in the attributes measured (appearance, taste, aroma, texture, packaging and overall acceptability). The appearance was ranked highest on the 6th rank of the hedonic scale; liked moderately at 53% for *carrot-fortified cake* and 44% for *vanilla flavoured cake*. According to Apata & Joseph (2023), appearance and colour is significant, and the first organoleptic properties seen by consumers and has influence on the choice of food acceptance or rejection. Also, the taste has high rating. Juliana (2018) stated that people are willing to accept and consume food products with their preferred taste concentration as the actual consumption, consistency and continued experience depends on it (Meludu, 2010). It can be concluded that *carrot-fortified cake* was rated higher than *vanilla flavoured cake* in terms of taste.

The texture for *carrot-fortified cake* and *vanilla flavoured cake* on the 7 hedonic scale was rated highest at scales 5 to 7 for like slightly: 18% - *carrot-fortified cake*, 36% - *vanilla flavoured cake*; like moderately: 37% - *carrot-fortified cake*, 33% - *vanilla flavoured cake*; and like extremely: 43% - *carrot-fortified cake*, 22% - *vanilla flavoured cake*; respectively. The texture of food is interpreted in different ways such as fluffiness, thickness, creaminess, crunchiness and smoothness which is a strong indicator of food quality and affects food acceptability (Juliana, 2017).

Aroma is an organoleptic parameter used in denoting the sensations of odour. Aroma of the two samples was rated highest from scale 5 to 7

on the 7 hedonic scale for like slightly: 19% - *carrot-fortified cake*, 28% - *vanilla flavoured cake*; like moderately: 46% - *carrot-fortified cake*, 38% - *vanilla flavoured cake*; and like extremely: 27% - *carrot-fortified cake*, 26% - *vanilla flavoured cake*; respectively. Packaging was also rated, which is an important aspect of product attributes that improve consumers' perception to consume the products which can either attracts or repels the consumer (Apata *et al.*, 2021). Two different packaging was used for each sample to know which of the packaging material is best and acceptable by the consumers. White sealable transparent nylon was used to package *carrot-fortified cake* and cling film for *vanilla flavoured cake*. From the research, in terms of packaging *carrot-fortified cake* which was ranked highest at the 6th (33%) is higher than *vanilla flavoured cake* which was ranked highest at the 5th (28%). It can then be concluded that the most preferred packaging material is white sealable transparent nylon.

Figure 1 show the distribution by respondents' level of preference for the samples which shows variations in the rating of *carrot-fortified* and *vanilla flavoured cake* based on overall acceptability. Overall acceptability comprises all the organoleptic properties – appearance, taste, aroma, texture, and packaging of the two samples studied. As reported, *carrot-fortified cake* was ranked higher when compared to *vanilla cake* based on the 7-point hedonic scale rating. The organoleptic properties are important factors in determining food acceptability as consumers want food with certain organoleptic properties (Juliana, 2018). Overall, the sensory assessments indicated that the *carrot-fortified cake* sample had the highest consumer acceptance compared with *vanilla flavoured cake*. The taste, appearance and texture had positive correlation to the consumption preference and overall acceptability of the fortified cakes by the panels. In other words, an improvement in the taste, appearance and texture of the *carrot-fortified cake* will translate to an increased acceptability of the product.

Conclusion

In this study, fortifying cake with carrot to produce *carrot-fortified cake* significantly improved the nutritional value compared to *vanilla-flavoured cake*. Findings showed that the *carrot-fortified cakes* were rich in micronutrients and antinutrients. It was observed that *carrot-fortified cake* had higher contents of protein, moisture content, ash, crude fibre, tannins, saponins, ascorbic acid, carotenoids, thiamine, riboflavin, niacin in comparison with *vanilla-flavoured cake*. On the other hand, *vanilla-flavoured cake* contained a higher proportion of carbohydrate and fat. The taste, appearance and texture were found to be highly rated in the organoleptic properties having influence on the overall acceptability of *carrot-fortified cake*. An improvement in these attributes will lead to a greater acceptability of the product. The study concludes that fortification of cake with carrot is necessary to produce bakery products of good nutritional, functional and sensory properties improving healthy consumption.

Recommendations

Based on the findings of the study, it was recommended that further research be carried out on:

1. the physiochemical analysis of the cakes during different stages of storage.
2. nutritional education and awareness be given to the public on fortification and use of locally available products such as Moringa fruits.
3. the shelf life of carrot cake and mode of preservation without the use of artificial preservatives. Natural preservatives such as vinegar, lemon and sea salt can be introduced.

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