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SENSORY EVALUATION AND CONSUMER ACCEPTABILITY OF BREAD PRODUCED FROM COMPOSITE FLOUR CABBAGE AND CARROTS

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ABSTRACT

This study determined the sensory evaluation, consumer acceptability and proximate composition of bread produced from composite flours made from cabbage and carrots, compared with 100% wheat flour (control). Bread samples were formulated with varying ratios of cabbage (50:50, 60:40, 70:30) and carrot (50:50, 60:40, 70:30) flour blends. Sensory evaluation tested attributes such as appearance, color, taste, flavor, texture, mouthfeel, and overall acceptability using a 9-point hedonic scale, while proximate analysis assessed moisture, protein, fat, fiber, carbohydrate, and ash contents. Fifty panelists, staff and students from Federal Polytechnic, Ilaro, participated in the evaluation. Sensory scores ranged as follows: appearance (6.82–7.87), color (6.85–7.68), taste (6.75–7.52), flavor (6.77–8.22), texture (6.90–7.60), mouthfeel (6.68–7.60), and overall acceptability (6.95–7.90). Sample CAB1 (70% cabbage flour: 30% wheat flour) scored highest in appearance (7.87 ± 0.95) and overall acceptability (7.85 ± 1.69). CAR2 (60% carrot flour: 40% wheat flour) excelled in flavor (8.22 ± 4.91) and texture (7.60 ± 1.63), while the control sample performed well in taste (7.52 ± 1.24) and color (7.68 ± 1.21).Proximate analysis showed moisture content ranging from 22.55% (control) to 42.30% (CAB3), protein content from 11.35% (CAB3) to 14.21% (CAR2), and carbohydrate content from 32.01% (CAB2) to 47.22% (control). The study concludes that carrot and cabbage flours can enhance both sensory and nutritional qualities of bread. CAR2 stood out as the most nutrient-dense option, making it ideal for functional bread products. It is recommended that food industries adopt composite flours like CAR2 for healthier bread innovations.

Keywords: Bread, Composite Flour, Sensory Evaluation, Proximate Analysis, Consumer Acceptability

INTRODUCTION

One of the most widely consumed foods in the world is bread (Guzmán, *et al*., 2022; Fabijańska, Fronczyk, 2023, 2015) Bread comes in "ready-made" form and is a great source of nutrition. Özcan, 2023). Bread has traditionally been made using wheat flour due to the unique gluten forming proteins that give it the desired viscoelastic characteristics needed to develop the dough as well as the preferred bread structure. Nevertheless, the rising price of importation of wheat, especially in developing nations, has pushed the need to seek other raw materials as alternatives like composite flours (Sampson, 2020). The concept of composite flour technology is a blend of wheat flour with non-wheat flours of cereals, legumes, roots, tubers, and vegetables, to improve nutritional value and to diminish the reliance on imported wheat. Composite flours have been documented to enhance functional and nutritional characteristics of bakery products, such as higher dietary fibre, vitamins and minerals (Mamat, *et al.,* 2025). Over the past few years, the focus has been on the use of vegetable-based flours like cabbage and carrot since these are highly nutritionally balanced and promote health.

Cabbage (*Brassica oleracea*) contains a good amount of dietary fibre, vitamin C as well as bioactive compounds like glucosinolates which are antioxidant compounds. Likewise, carrot (*Daucus carota*) is a good source of beta-carotene, dietary fibre, and essential vitamins and therefore, a useful source of food fortification. There is a potential to enhance nutritional quality and functional properties of the end product by incorporating these vegetables into the bread production process (Compaore-Sereme *et al.,* 2023). Sensory assessment is thus vital in defining the quality and acceptability of food products as it is a direct representation of the consumer preference and perception (Irigoytia *et al.,* 2024). It has been established that crumb structure, flavour, and texture of a composite flour bread can change with a rise in the level of substitution, and this can have a positive or a negative impact on consumer acceptance (Parmigiani *et al.*, 2025). The success of any new food product is very critical to the consumer acceptability. It is also affected by the sensory attributes and how well the product satisfies the consumer. Moving levels of non-wheat flours have been reported to make bread with satisfactory sensory properties similar to traditional wheat bread, and too much substitution can cause a decrease in acceptability (Malik, Sindhu, & Yadav 2025; Sampson, 2020). Thus, sensory analysis and consumer acceptability of bread made of composite flour which includes cabbage and carrot are significant to determine whether this can be produced and consumed in large quantities. This study therefore aims to evaluate the sensory attributes and consumer acceptability of bread produced from composite flour (cabbage and carrots), also to access the sensory characteristics (such as appearance, aroma, texture, taste, and overall acceptability) of bread made from composite flour and investigate the influence of varying proportions of cabbage and carrots in composite flour on the sensory properties of bread.

MATERIALS AND METHODS

Flour, carrot, cabbage, butter, sugar as well as other ingredients used was purchased from Sayedero Market in Ilaro, Yewa South Local Government Area of Ogun State, Nigeria. All data was collected using a primary data hedonic scale ranging in descending order (9,8,7,6,5,4,3,2,1) to gather essential information on the prepared samples respectively. Attributes evaluated includes appearance, colour, aroma, taste, texture, flavor and overall acceptability majorly to

determine the most preferred among the samples. Data was collected from both primary and secondary source. Primary data was sourced from sensory evaluation form to gather necessary details while secondary was through the internet, textbooks, magazines, journals, articles, etc.

The research population for this study was based on selected students of Department from ND and HND classes (total of 50 panelists). The target population was based on the convenience sampling techniques. The instrument used for this study was the sensory evaluation assessment form which was given to the taste panelists after assessing the sensory attributes of the products. The sample's sensory attributes (appearance, colour, aroma, taste, texture, flavor and overall acceptability) were evaluated using a 9-point hedonic scale, where a score of 1 is "dislike extremely", 2 is "dislike very much", 3 is "dislike moderately", 4 is "dislike slightly", 5 is "neither like nor dislike", 6 is "like slightly", 7 is "like moderately", 8 is "like very much" and a score of 9 is 'like extremely". The panelists were given a glass of water to rinse their mouth before tasting each sample. The panelists assessed the sensory attributes of the all the varieties of bread samples to compare their attributes. The data collected for this study was examined using descriptive and inferential statistical analysis method (Including mean, median, percentage, mean deviation standard deviation and correlation. SPSS (Statistical Package for Social Sciences) and Analysis of Variance (ANOVA) was employed to ascertain significant mean differences among the diverse samples based on sensory attributes. The Multiple Duncan Range System and least significant differences (LSD) analysis ($P \leq 0.05$) were used to differentiate means in treatments.

RESULTS AND DISCUSSION

Appearance

The highest appearance score was for sample CAB1 (7.87 ± 0.947) due to its superior appearance, which was most appealing to the panelists. The control (100%) scored the next highest with 7.77 ± 1.170, displaying its characteristic natural, even and consistent crust. CAB2 scored the least in appearance (6.82 ± 1.334), which may have been due to its inconsistent surface, non-uniform crust, or less visually attractive appearance. These results are supported by the studies of Adeola, Ogundele, and Ajayi (2021), who noted that appearance (such as crust consistency, uniformity or surface appearance) is a key factor driving consumer acceptance of bread. They reported that enriched bread products often have unique appearances, such as the orange colour of carrot bread, making them more appealing. This indicates that for CAB1, cabbage not only improved its nutritional value but also its appearance, making it visually more appealing and a preferred product for panelists.

Color

The control (100%) sample scored the highest for color (7.68 ± 1.214), followed by CAB1 (7.60 ± 1.182), which was likely improved by the orange colour of carrots. By contrast the lowest score (6.85 ± 1.325) was recorded for CAB2, which may have been due to a white colour or less consistent appearance due to cabbage, which may have been less preferred by the panelists. The research by Bello, Oloye, and Adebayo (2022) shows that the addition of vegetable ingredients to bread can lead to distinct colour properties, depending on the ingredient used and its concentration. For example, bread made with carrot has a more attractive appearance due to the pigment beta-carotene. The scores of the control sample and CAB1 indicate that these bread variants had a consistent and attractive colour, which is important for acceptance and perceptions of quality and freshness.

Texture

The 100% sample was rated highest in texture (7.77 ± 1.047) which means a desirable soft, springy and well-structured crumb is preferred in bread. This was followed by CAB1 (7.58 ± 1.139) which also indicates a similarly preferred structure. This implies that the addition of cabbage to CAB1 did not impact the texture, and that it still had a good crumb structure. Conversely, CAR2 (7.60 ± 1.628) while being high in texture, had the highest standard deviation among the baking mixes, which may suggest an inconsistent crumb structure, but still reflects a good texture. At the lower end, CAB2 received the lowest texture rating (6.90 ± 1.362) which may be due to a heavy or dense crumb, or insufficient fermentation, possibly arising from the cabbage used. This finding agrees with the results reported by studies like Adeyemi, Aluko, and Oladunjoye (2020), who highlighted the importance of texture in bread products, such as a softer crumb with enough elasticity, for consumer acceptability.

These results indicate the addition of ingredients like cabbage and carrots, which could have moisture retention and structural impacts, affected the texture scores. However, the 100% sample, being a control, had the best crumb texture, and was the most preferred in terms of texture**.**

Taste

The control sample had the highest taste score (7.52 ± 1.242), followed by CAB3 (7.48 ± 1.642) and CAB1 (7.39 ± 1.474). CAB2 has the lowest taste score (6.75 ± 1.547), which could have been impacted by the cabbage's unbalanced flavor. For bread consumers, taste is the most significant sensory factor (Olaniyi, Fakoya, and Yusuf 2021). Vegetable enrichment must be balanced to prevent changing or masking the taste. Panelists were pleased with their taste, as evidenced by the excellent scores of the control sample and CAB1. The sweetness of the carrot may have enhanced the taste of CAB1.

Flavor

For flavor, the highest score was 8.22 ± 4.913 for CAR2, followed by 7.39 ± 1.543 for CAB1 and 7.23 ± 1.555 for CAB3. CAB2 had the lowest score (6.77 ± 1.307), which may be due to reviewers not enjoying the cabbage taste. Addition of vegetables to bread requires a balance of flavors to enhance the bread's taste while not masking the original taste, according to Alade, Adedokun and Omole (2020). The success of CAR2 shows how carrot enrichment can add to the sensory experience by adding complexity to the taste.

Mouthfeel

Sample CAB1 had the greatest mouthfeel score (7.60 ± 1.291), followed by the control sample (7.43 ± 1.533). CAB2 received the lowest score (6.68 ± 1.396), perhaps as a result of its less cohesive texture or abrasive crumb structure. A smooth and cohesive mouthfeel enhances the sensory qualities of bread products, especially those enriched with natural substances, according to earlier research by Bello, Oloye, and Adebayo (2022). These results imply that the CAB1 formulation produced an excellent mouthfeel and a desired crumb structure.

Overall Acceptability

The highest overall acceptability score (7.90 ± 1.020) was given to CAR2, which indicates that the panel liked it. This sample was believed to be suitable because it satisfied the panel's expectations for taste, texture and appearance. After

overall acceptability, the next preferred was CAB1 (7.85 1.686) and CAB3 (7.68 1.157). These samples were also the most preferred by panel members and contain cabbage, so the addition of the cabbage itself did not have an effect on overall acceptability. However, CAB2 scored the lowest (6.95 1.466) for overall acceptability, thus showing that despite having a denser texture, it was lacking in at least one other sensory characteristic (taste or mouth feel).

These results corroborate the findings of Nwachukwu, Okoro, and Ogundipe (2023), who highlighted that the harmonious integration of various sensory qualities is essential to overall acceptability. In many instances, adding carrot or cabbage to other ingredients seemed to greatly improve overall acceptance; among the studied samples, CAR2 was the most popular choice.

Table 1: Descriptive Statistics of the Samples

Sample	Appearance	Colour	Texture	Taste	Flavour	Mouthfeel	Overall Acceptability
100 %	7.77±1.170	7.68±1.214	7.77±1.047	7.52±1.242	7.60±1.291	7.43±1.533	7.81±1.717
CAR1	7.60±1.224	7.37±1.164	7.13±1.142	7.18±1.642	7.23±1.681	7.08±1.598	7.35±1.538
CAR3	7.52±1.255	7.40±1.405	7.22±1.342	7.30±1.253	7.20±1.424	7.10±1.446	7.50±1.112
CAB3	7.52±1.408	7.42±1.406	7.40±1.278	7.48±1.642	7.23±1.555	7.37±1.518	7.68±1.157
CAR2	7.33±1.724	7.18±1.682	7.60±1.628	7.35±1.527	8.22±4.913	7.55±1.294	7.90±1.020
CAB2	6.82±1.334	6.85±1.325	6.90±1.362	6.75±1.547	6.77±1.307	6.68±1.396	6.95±1.466
CAB1	7.87±0.947	7.60±1.182	7.58±1.139	7.39±1.474	7.39±1.543	7.60±1.291	7.85±1.686
Total	7.49±1.342	7.36±1.365	7.37±1.311	7.28±1.492	7.38±2.326	7.26±1.465	7.58±1.435

Note: Means with Different Superscript within the Same Column Indicate Significant Difference ($p \leq 0.05$)
Key:
100% Wheat flour
CAR1 = Carrot Bread 70% Carrot flour :30% Wheat Flour
CAR3 = Carrot Bread 50% Carrot flour :50% Wheat flour
CAB3 = Cabbage Bread 50% Cabbage flour: 50% Wheat flour
CAR2 = Carrot Bread 60% Carrot flour: 40% Wheat flour
CAB2 = Cabbage Bread 60% Cabbage flour: 40% Wheat flour
CAB1 = Cabbage Bread 70% Cabbage flour: 30% Wheat flour

Moisture Content

The CAB3 bread sample had the most moisture (42.30 ± 0.014), followed by the CAR3 sample (41.12 ± 0.057) and the CAB2 sample (40.04 ± 0.042). The control sample (100%) had the lowest moisture content (22.55 ± 0.064) because it had less water activity, which stops microbes from growing. This suggests that it may last longer on the shelf. Also, CAR2 had a relatively low moisture content (24.42 ± 0.021), which suggests that it could last a long time on the shelf. Adebayo, Oyeleke, and Ayoola (2023) say that the amount of moisture in bread directly affects its texture and how long it lasts, with less moisture making it last longer. Olaniyi, Oguntade & Faleye (2021) reported the relationship between the moisture content of the bread crumb and its texture. The higher the moisture content, the softer the texture is likely to be, however this could result in a reduced shelf life. The presence of a high level of moisture in CAB3 suggests that while it is likely to have a pleasant and attractive soft texture, its shelf life may require an increase in appropriate packaging and storage facilities.

Dry Matter Content

The control bread contains the most amount of dry matter (77.45 0.050) the dry matter is the solid material in the bread. The second is the CAR2 with (75.58 0.035). Control contains slightly more dry matter since it is a standard bread made from wheat only. CAB3 (57.65 0.064) has the least amount of dry matter which means the bread has more moisture, which is what is expected of a vegetable-flour bread, with lots of vegetables and vegetable flour.

Ogunleye, Adeniran and Kolawole (2022) states that vegetable breads with increased vegetable content would yield lower dry matter content due to the high moisture content in vegetables. This has also occurred with CAB3 and CAR3, as they both contain low dry matter. Bread with higher dry matter content like the control and CAR2 would have firmer bread and would appeal to more customers that would like products with lower moisture content.

Fat Content

Highest fat was in CAR2 (14.01 0.014) followed by CAR1 (12.08 0.113) and then CAB1 (11.85 0.057) with the lowest being CAB3 (10.81 0.014). Bread with higher fat such as CAR2 will have a better taste, a softer texture, and be of a more solid mouthfeel. It also serves as a binder for holding moisture and extending shelf life by being readily dispersible with other ingredients. Adding more fat to recipes will improve palatability and also provide an energy-dense medium for the bread according to Ajayi, Bello, and Okafor (2022). Fat is a vital component in enhancing texture and shelf-life due to improving crumb structure as also supported by Adeyemi and Alade (2023). The high level of fat indicates CAR2 was a formula well formulated for optimal taste and nutritional values.

Ash Content

As for ash content of the bread which gives us a clear idea about its mineral content, control sample has got the highest value at 2.23 0.042 followed by CAR2 at 1.56 0.050. It was observed that the high ash content in the control bread means that the bread made with all wheat flour was abundant in minerals like calcium, potassium and magnesium. In comparison CAB3 had the least ash content with 1.16 0.085 and it suggests that the bread is less abundant in minerals due to the presence of more moisture and vegetable part. Adeyemi, Aluko and Oladunjoye (2020) has also mentioned that the addition of vegetables such as carrot increases the mineral content of the bread because it is rich in minerals. Hence higher ash content for CAR2 suggests that there is an enrichment in mineral content of bread due to addition of carrots.

Crude Fiber Content

The higher crude fiber content was obtained in CAR2 (4.12±0.141), CAR1 (3.94±0.071) and CAB1 (3.57±0.035) compared to CAB3 (2.81±0.113) which had lower fiber content. Fiber helps improve digestability and promotes fullness in consumers, thus many consumers with health related conscious consume foods high in fiber and a formulation of bread containing vegetables like carrots and cabbage increased its fiber content, which CAR2 has obtained. Ogunleye, Adeniran and Kolawole (2022) noted that, vegetables enrichment of bread could increase dietary fiber intake which was represented in the fiber content of CAR2. Bello, Fakeye and Oyewole (2023) added that the presence of fiber could increase the density of bread and improve the crumb characteristics as also evident in the low density observed in the crumb of CAR2 bread.

Crude Protein Content

The crude protein was highest in CAR2 with values of 14.21±0.071, then CAB1 with 13.12±0.057 and CAR1 with 12.86±0.064, whereas CAB3 had the least with a protein content value of 11.35±0.042. Protein is important because it enhances the nutritional value of bread, as well as strengthening its structure resulting in improved crumb texture and elasticity. Ezeocha, Onwubiko, and Okwudili (2023) identified that breads fortified with vegetables especially using high-protein vegetables like carrots could increase protein content which would enhance nutritional value and consumer acceptance. Adeyemi and Alade (2023) also suggested that higher protein content helps build a strong crumb matrix in the fortified bread making it appealing for the health conscious looking for protein.

Carbohydrate Content

Carbohydrates were most concentrated in the control (47.22 0.028), while CAR2 had the next highest carbohydrate content (44.13 0.064). The bread with the lowest carbohydrate content was CAB3 (38.37 0.064). Carbohydrates in bread act as a primary energy source. A large amount of carbohydrate is present in the control because 100% wheat flour is a good source of starch. The fact that CAR2 contains more carbohydrates than CAB1 or CAB3 suggests that the inclusion of carrot flour does not make the bread less calorie-dense. As shown by Bello, Fakeye and Oyewole (2023), carbohydrate amounts might be lowered when vegetable-enriched breads are created due to the addition of protein-rich or fiber-rich vegetables, but CAR2's level of carbohydrate suggests the bread still maintains its calorie-density.

Table 2: Proximate Properties of the Samples

Sample	Moisture Content	Dry Matter Content	Fat Content	Ash Content	Crude Fiber Content	Crude Protein Content	Carbohydrate Content
100 %	22.55±0.064	77.45±0.050	9.88±0.021	2.23±0.042	5.15±0.057	12.15±0.064	47.22±0.028
CAR1	31.44±0.035	68.56±0.021	12.08±0.113	1.30±0.113	3.94±0.071	12.86±0.064	30.67±0.042
CAR3	41.12±0.057	58.82±0.028	10.93±0.050	1.20±0.014	3.43±0.035	12.01±0.014	32.05±0.014
CAB3	42.30±0.014	57.65±0.064	10.81±0.014	1.16±0.085	2.81±0.113	11.35±0.042	38.37±0.064
CAR2	24.42±0.021	75.58±0.035	14.01±0.014	1.56±0.050	4.12±0.141	14.21±0.071	44.13±0.064
CAB2	40.04±0.042	59.92±0.021	11.30±0.014	1.26±0.028	3.01±0.014	11.72±0.042	32.01±0.042
CAB1	34.84±0.028	65.13±0.042	11.85±0.057	1.31±0.007	3.57±0.035	13.12±0.057	40.92±0.050

Note: Means with Different Superscripts within the Same Column Indicate Significant Differences ($p \leq 0.05$).
100% Wheat flour
CAR1 = 70% Carrot flour: 30% Wheat Flour
CAR3 = 50% Carrot flour: 50% Wheat flour
CAB3 =50% Cabbage flour: 50% Wheat flour
CAR2 = 60% Carrot flour: 40% Wheat flour
CAB2 = 60% Cabbage flour: 40% Wheat flour
CAB1 = 70% Cabbage flour: 30% Wheat flour

Discussion

This research assessed the sensory characteristics, acceptability, and proximate composition of breads fortified with different levels of carrot and cabbage flours, compared to a control bread prepared from 100% wheat flour. Sensory analysis was conducted on appearance, colour, taste, texture, flavour, mouthfeel, and acceptability. The samples were determined for moisture, dry matter, fat, ash, fiber, protein, and carbohydrate using proximate analysis. The 100% wheat flour (control) proved to be the highest scoring sample for texture (7.77 ± 1.047) and overall acceptability (7.81 ± 1.717). Its soft crumb and proper structure, along with its consistent texture and mouthfeel, satisfied the judges, showing its potential to be acceptable to consumers. Research conducted by Akinmoladun *et al*., (2020) and Olawale *et al*., (2023) has demonstrated that consumers prefer bread with a soft, springy texture and good texture. The second-most-preferred sample was CAB1 (70% cabbage flour: 30% wheat flour) with high acceptability in texture (7.58 ± 1.139) and overall acceptability (7.85 ± 1.686). A good balance of all sensory attributes, particularly in mouthfeel, and its added nutritional value, including protein, demonstrated the product's potential for consumer acceptability. The acceptance of CAB1 adds to the research of Akinmoladun and Aluko (2021) who found mouthfeel and flavour balance play an important role in the consumer acceptability of bread. While the highest overall acceptability (7.90 ± 1.020) was achieved in the CAR2 (60% carrot flour: 40% wheat flour), it was not the highest in texture (7.60 ± 1.628). This suggested a degree of inconsistency in crumb structure, which could have impacted its texture. But the overall sensory acceptability of CAR2 is consistent with findings by Sanni *et al.,* (2022) that carrot bread tends to be highly acceptable in terms of flavour and overall acceptability because of the mild sweetness and high nutritional value of the carrot. The lowest texture (6.90 ± 1.362) and overall acceptability (6.95 ± 1.466) scores were for CAB2 (50% cabbage flour: 50% wheat flour), possibly because of a denser crumb structure, which may be a result of cabbage flour. This finding is in line with the work of Olawale *et al*., (2023), who observed that increased levels of cabbage flour in bread might lead to a denser texture, which consumers do not prefer.

The result of proximate analysis showed interesting things about these bread samples composition. As expected, the 100% wheat bread was the most nutritious in terms of the

levels of dry matter (77.45 0.050), ash (2.23 0.042) carbohydrate (47.22 0.028) and crude fiber (5.15 0.057) indicating its balanced nutrition compare to others. It means the traditional wheat bread has a better nutritional composition in terms of calories and minerals and it is a very good reference. However, in terms of crude fiber (4.12 0.141) and ash (1.56 0.050) it was noted that the CAR2 bread (60% carrot flour: 40% wheat flour) contained high percentage than others and it was seen that addition of carrots can provide better source of fiber and minerals.

On the contrary, CAB3 (50% CAB flour, 50% wheat flour) exhibited the greatest moisture value (57.65 0.064) and also the smallest values for other nutrition values, such as dry matter, crude fiber and carbohydrate. This might suggest that with the increase in CAB content, the resultant bread can provide more moistness but less nutrient density compared to the control and CAR breads. The conclusion on the effect of formulation particularly adding vegetables like CAR and CAB to the bread properties based on the result is indeed interesting, in which the control bread was the most nutrient-richbread.CAR2, though not superior in all nutritional parameters compared to the control bread, it shows possibility for the production of a functional bread with increased fiber and minerals. These findings support the findings of Adeyemi *et al*., (2021) and Adekunle *et al*., (2022) who pointed out the advantage of using vegetables (carrots) in bread formulation, leading to an improvement of sensory and nutritive properties of the breads. The feasibility of these vegetable-fortified breads (CAR2 and CAB1) for fulfilling consumer demands on functional food were demonstrated. CAR2 was found to be the best among breads as it had favorable sensory properties and also nutritious. CAB1 also revealed it can be accepted particularly by consumers who wanted breads that were high in protein.

CONCLUSION

Finally, the most preferred sample was CAR2 (60% carrot flour: 40% wheat flour) and it was the most acceptable by panelists regarding the sensory parameters: taste, texture and acceptance. These aspects are fundamental when a food product is assessed by the consumer and CAR2 fulfilled them in terms of what panelists had predicted to perceive in the samples. The soft, flexible and elastic crumb structure, rounded flavor and nutrient-richness compared to the other samples made the sample special and confirmed the role of carrots in the recipe as it improved the sensory and nutritional properties of the bread due to their natural sweetness and water content. In the control sample (100% wheat flour), carbohydrate was the highest and the appearance and taste characteristics also showed good result thus, confirming the validity of it as reference bread. Meanwhile, the enriched bread products especially CAR2 and CAB1 (70% cabbage flour: 30% wheat flour) proved the significance of using vegetables for production of functional bread with nutrition enrichment values. For theCAB1, it had excellent mouthfeel and protein contents revealing that cabbage addition is beneficial in improving the crumb characteristic of bread and also good for those consumers looking for protein-enriched bread.

As for the nutritional composition, CAR2 exhibited high contents of dry matter, crude fiber and carbohydrate, and was proved to be nutrient-dense among all samples, therefore, a potential functional food choice for health-conscious consumers. In contrast, CAB3(50% cabbage flour: 50% wheat flour) had the highest moisture and the lowest amount of dry matter, protein and fiber. In other words, the sensory softness had been achieved in expense of nutrient value. This study suggests that varying ratio of ingredients and processing methods may influence the nutritional value of the final bread products. The result correlates with recent studies carried out by Adekunle et al., (2022) and Onyeka et al., (2021). Adekunle et al., (2022) carried out a research on "Influence of carrot fortified bread on sensory characteristics and nutritional composition", in which they showed the effect of adding carrots in breads and found out that carrot improves texture and sensory characteristics and hence increases acceptability of the bread. In a similar way, Onyeka et al., (2021) researched the influence of cabbage on formulated breads and found that it can enhance bread protein and tenderness. These studies demonstrate that incorporation of specific vegetables is crucial to enhance nutritional and sensory characteristics of formulated breads.

The current research highlights that vegetable-rich bread formulations, specifically carrot and cabbage, represent promising food to satisfy consumer demands for functional food. CAR2 represented good combination of sensory properties and nutrition values and it seemed to be the optimal one; whereas CAB1 may appeal some particular consumers that seek for particular texture feel, higher content of protein. These data showed great perspective of using vegetable-enrich bread in increasing food variety and satisfying consumer's demands. Industry are recommended to utilize carrot and cabbage flour as bread ingredients in order to fulfill the consumer's demand for functional and nutritive products, especially for people with weight control programs.

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