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Organoleptic Evaluation of Bread Prepared by Composite Wheat Flour and Corn Flour

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ABSTRACT

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Composite bread is a baked product that incorporates a mixture of flours containing high starch and protein content, such as wheat and corn flour, to enhance its nutritional value. This study aimed to develop and assess composite bread using various ratios of wheat and corn flour, following standard proportions. Four formulations of composite bread were created, substituting different levels of corn flour, while a 100% wheat bread was used as a control sample. Proximate composition analysis of the wheat and corn flour was performed in the laboratory. The bread was prepared using the straight dough method, and sensory evaluation was conducted to determine consumer acceptability. Results indicated that the sample with a ratio of 90% wheat flour and 10% corn flour (sample B) exhibited the highest overall acceptability, closely resembling the 100% whole wheat bread. Furthermore, sample C, with a ratio of 80% wheat flour and 20% corn flour, could be more acceptable if supplemented with additional ingredients such as fats, natural and chemical improvers, emulsifiers, and flavors. Incorporating 20% corn flour in the bread formulation proved to be cost-effective, leading to a 20% reduction in wheat importation, equivalent to 1.2 million metric tonnes of imported wheat.

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INTRODUCTION

Bread, biscuit, cake, doughnut, noodles and other wheat flour based products are popular in Nigeria and indeed all parts of the world. Bread is the most popular among all the wheat-based products. Bread is a fermented confectionary product primarily made from wheat flour, water, yeast, and salt through a

series of processes involving mixing, kneading, proofing, shaping, and baking (Dewettinck *et al.*, 2008). To ensure the production of high-quality bread, the dough must possess specific characteristics. It should be extensible enough to relax and expand during rising, elastic enough to retain the gases produced, and stable enough to maintain

its shape and cell structure. Several conditions contribute to the production of large, well-textured loaves of bread. The main objective of composite flour is to enhance the nutritional value of wheat flour by addressing its deficient components, such as essential amino acids and minerals, through the addition of other cereal flours. Shittu *et al.* (2007) also emphasized the use of composite flours, which consist of binary or ternary mixtures of flours from various crops, with or without wheat flour, offering advantages such as saving hard currency, supporting native plant species, improving protein supply for human nutrition, and optimizing domestic agricultural production (**Bergho fer, 2000; Bugusu *et al.*, 2001**). Cereal grains, while sharing similar proximate compositions, differ in their ability to retain gas during proofing and baking. Wheat flour dough, characterized by gluten protein, forms a typical aerated foam structure that produces bread (**Dobraszczyk, 2001**).

MATERIALS AND METHODS

Flour, the primary ingredient in bread production, is influenced by the properties of the grains used. The degree of milling affects the chemical composition of the flour, with increased milling reducing starch content and increasing the presence of inorganic ingredients, insoluble fiber, and vitamins found in the bran. In this study, the maize grains underwent a process of sorting, cleaning, and proper sun drying before being milled using a locally fabricated attrition mill. Subsequently, composite flours were prepared by combining different ratios of wheat and maize, specifically 100:0, 90:10, 80:20, 70:30, and 60:40. These mixing ratios were selected in accordance with the Nigeria Wheat Policy, which recommends a 40% inclusion of agro-based composite material in wheat.

SENSORY ANALYSIS

Sensory analysis evaluates and understands the sensory characteristics of food and other products. It involves assessing attributes such as taste, smell, appearance, texture, and sound. Trained panellists or consumers participate in standardized tests to describe sensory properties or provide feedback on overall liking. Sensory analysis helps in optimizing product formulation, detecting quality issues, assessing stability, and making informed decisions in product development and marketing. Its goal is to understand consumer preferences and create appealing products that meet their expectations. Statistical analysis of the sensory scores was obtained from 12 semi-trained panelists using 9-point hedonic rating scale (9=like extremely, 1 = dislike extremely) for composite bread formulations as in appendix A. The parameters for sensory evaluation were crumb appearance, colour, texture, flavour and overall acceptability.

RESULTS AND DISCUSSION

This work was carried out for the preparation of different bread formulation with varying proportion of wheat flour and corn flour. Five formulations incorporating different proportion of wheat flour along with corn flour in varying samples namely A (100% wheat flour), B (90% wheat flour and 10% corn flour), C (80% wheat flour and 20% corn flour), D (70% wheat flour and 30% corn flour), E (60% wheat flour and 40% corn flour) were prepared. As bread is the product widely consumed by general population, wheat flour and corn flour incorporated bread adds value to the nutritional profile along with price compatibility. At first, the major raw materials were subjected to physio-chemical proximate analysis.



Fig 1: Sample A -100% whole



Fig 2: Sample B – 90% WF : 10% CF



Fig 3: Sample C – 80% WF : 20% CF



Fig 4: Sample D – 70% WF : 30% CF



Fig 5: Sample E – 60% WF : 40% CF



Fig 6: Collected baked samples

3.3 SENSORY PROPERTIES OF BREAD

Statistical analysis of the sensory scores was obtained from 12 semi-trained panelists using 9-point hedonic rating scale (9=like extremely, 1= dislike extremely) for composite bread formulations. Sensory

analysis was performed with the aid of different panelists evaluating crumb appearance, color, texture, taste, flavor and overall acceptability of wheat flour and corn flour incorporated bread against the blank.

EFFECT OF FORMULATION ON AROMA

The mean sensory score for aroma of bread samples of different formulations are shown in Fig.7. The statistical analysis showed that the partial substitution of wheat flour with corn flour had significant effect on the aroma of the

different bread formulation. Product B got highest score which was significantly different from other formulation. Product E got lowest score. The aroma of the 10% wheat flour incorporated bread was found to be significantly superior. Also the product C was appreciated as the control product A.

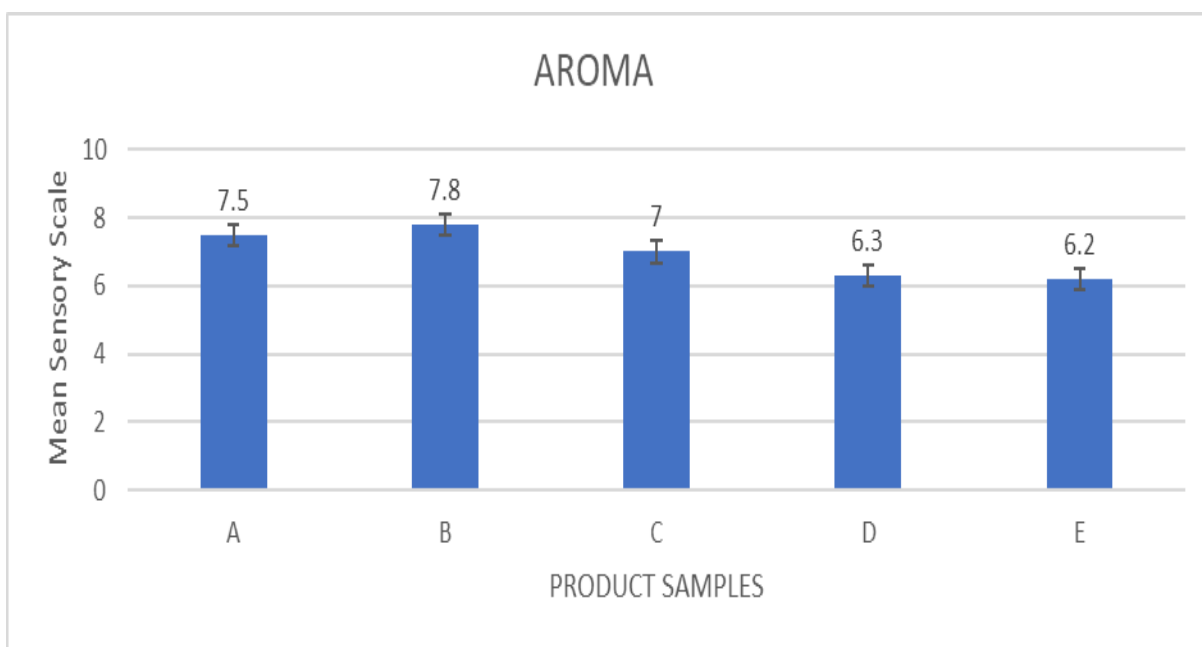


Fig. 7. Mean sensory scores for aroma of bread of different formulations.

EFFECT OF FORMULATION ON TASTE

The mean sensory scores for taste of bread samples of different formulations are shown in Fig. 8. The mean sensory score of product B was highest compared to all other composite products but was not significantly different from product A and C. Product E is the lowest scoring formulations of all which

indicates that higher amount of corn flour in the formulations could lower the score and acceptability of the product. Formulation containing 10% corn flour got high score which may be due to optimum amount of corn flour. The taste of the 10% and 20% corn flour incorporated bread was found to be significantly superior as judged by panelist.

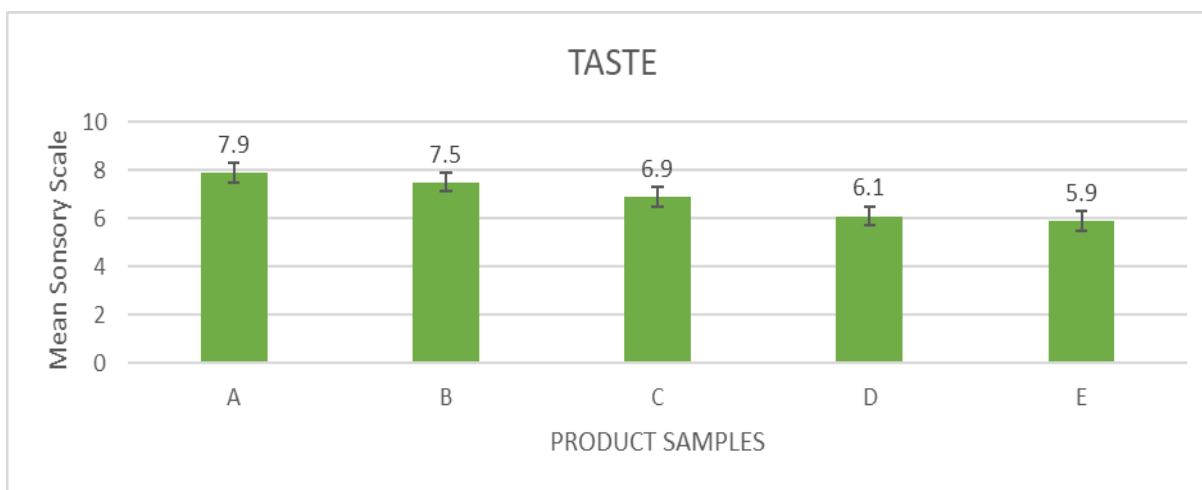


Fig. 8. Mean sensory scores for taste of bread of different formulations.

EFFECT OF FORMULATION ON COLOUR

The mean sensory score for colour of bread samples of different formulation are shown in Fig. 9. Statistical analysis showed that the partial substitution of wheat flour along with constant maize flour had significant effect on the colour of the different bread formulation. Product B got highest score may be due to the

appropriate amount of corn flour (10%). There is no significant difference in the colour of product B and product A. reduced sensory acceptability of composite flour bread for colour with increase in percentage of other flour has been reported. With additional comment made on product sample C as also having an acceptable colour.

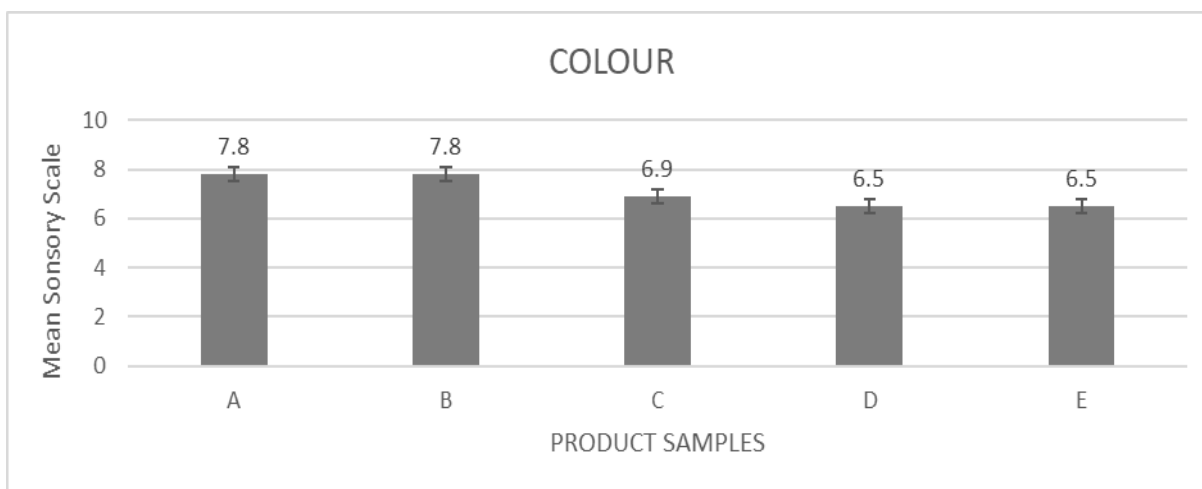


Fig. 9. Mean sensory scores for colour of bread of different formulations.

EFFECT OF FORMULATION ON TEXTURE

The mean sensory score for texture of bread samples of different formulations are shown in Fig. 10. The mean score was found to be highest for product B which was significantly different with other formulation with little significant difference with product sample C. As proportion of corn flour increases texture score decreases which may be due to increase

in firmness of bread. Fresh corn bread was firmer (stiffer) than fresh wheat bread. This may be attributed to the lack of gluten network formation and smaller air cell structure of bread after corn flour addition as confirmed by the higher density of the cornbread. A perfect texture should be free from lump and hardness and should present a smooth silky surface.

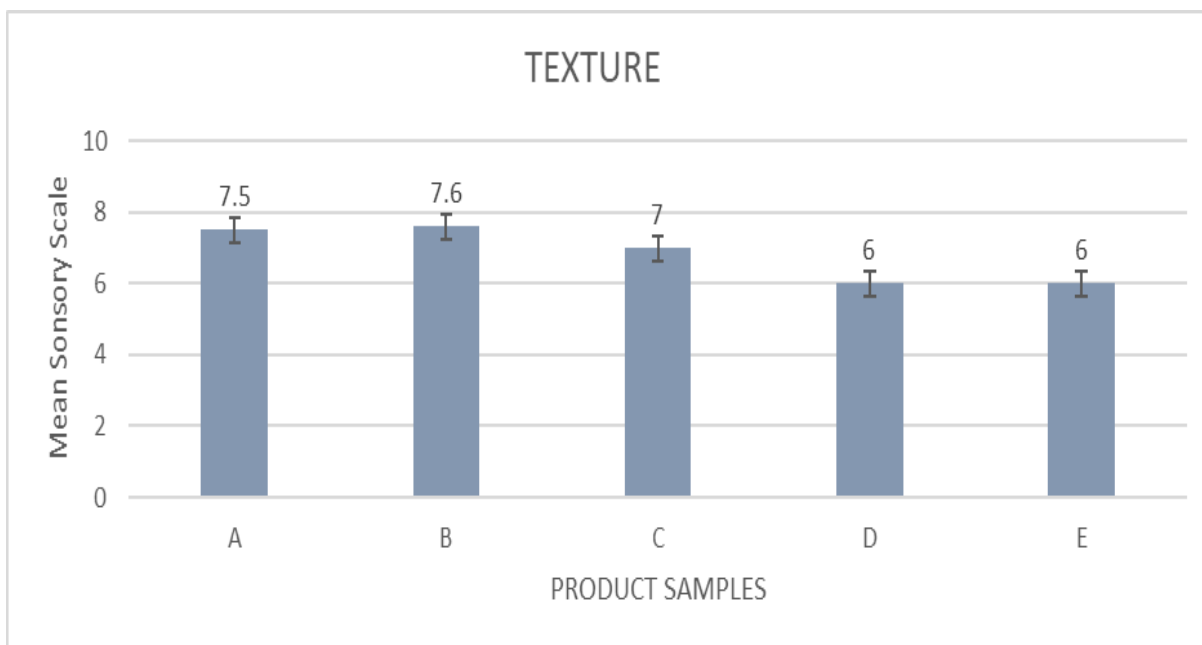


Fig. 10. Mean sensory scores for texture of bread of different formulations.

3.3.5 EFFECT OF FORMULATION ON CRUMB APPEARANCE

The average mean scores of crumb appearance are shown in Fig. 11. The product B got highest score while D and E ranked lowest score because incorporating high levels of corn flour protein depresses loaf volume, gives poor crumb characteristics and decreases acceptability. Upon hydration and during processing, gluten interact to a unique

viscoelastic gluten network, for holding the gases and for producing light porous crumb textured bread. An appropriate balance in the amount of these two major protein components of wheat gluten is required for achieving the desired bread quality. Fat coats the proteins to interfere with gluten development. Corn flour weakened wheat flour dough by increasing ash concentration. Substitution of gluten proteins by non-gluten-forming proteins causes a dilution effect and consequently weakens the dough. Corn flour

proteins interfere with gluten formation in both a direct and an indirect way, the direct effect is related to an interaction between corn proteins and gluten proteins and the indirect

effect is related to water availability of wheat proteins (Maforimbo *et al.*, 2008).

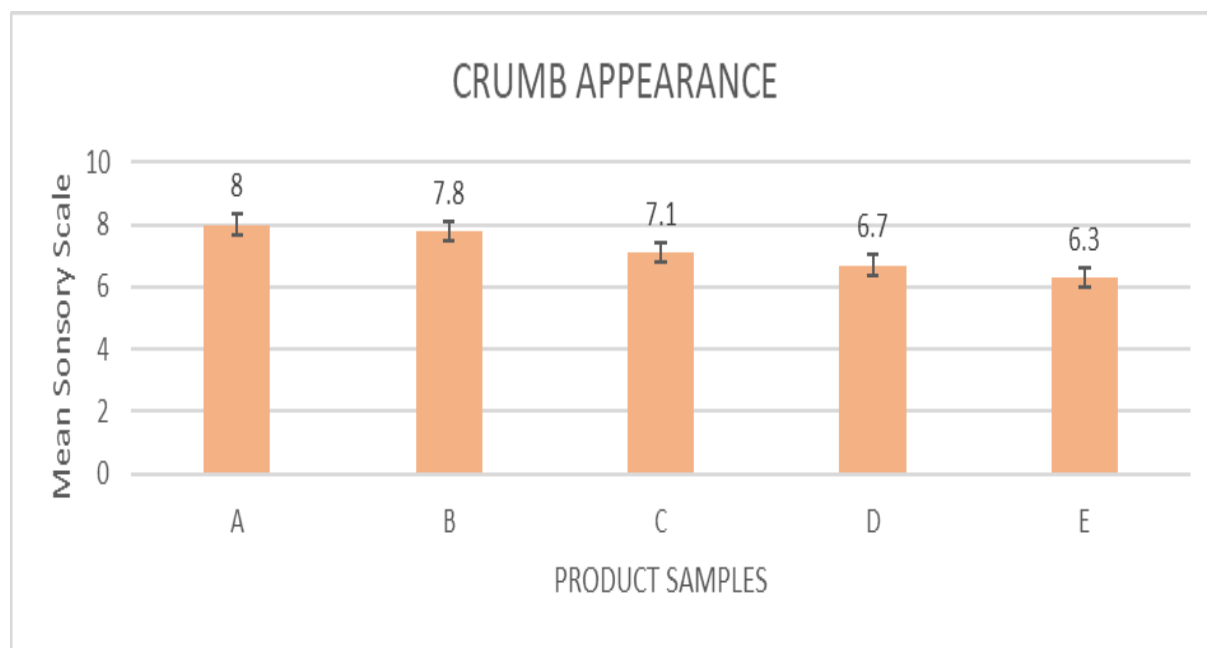


Fig. 11. Mean sensory scores for crumb appearance of bread of different formulations.

EFFECT OF FORMULATION ON OVERALL ACCEPTABILITY

The mean scores of overall acceptability of breads of different formulations are shown in Fig. 12 which shows the significant effect ($p < 0.005$) on overall acceptability of the different bread formulations with partial substitution of wheat flour with corn flour. Product B got higher score which was significant different to all bread formulation. Color, crumb appearance, texture, taste and aroma of product B was very much liked similarly product C. Therefore, product B and product C got high score in terms of overall acceptability. The overall acceptability of the 10% corn flour along with 20% corn flour incorporated composite bread was found to be

significantly superior, generally edible and acceptable. It's generally estimated that the 90:10 (wheat flour: corn flour) sample B is best and most edible for consumption in a simple mixture of flour, yeast, sugar, salt and water resulting in no significant difference with the 100% whole wheat. And the 80:20 (wheat flour: corn flour) sample C would be more edible if other ingredients such as fats, natural improvers (eggs, milk), chemical improvers (ascorbic acid, lactic acid), emulsifiers, flavours which will all be provided by the Nigerian government according to the wheat policy act.

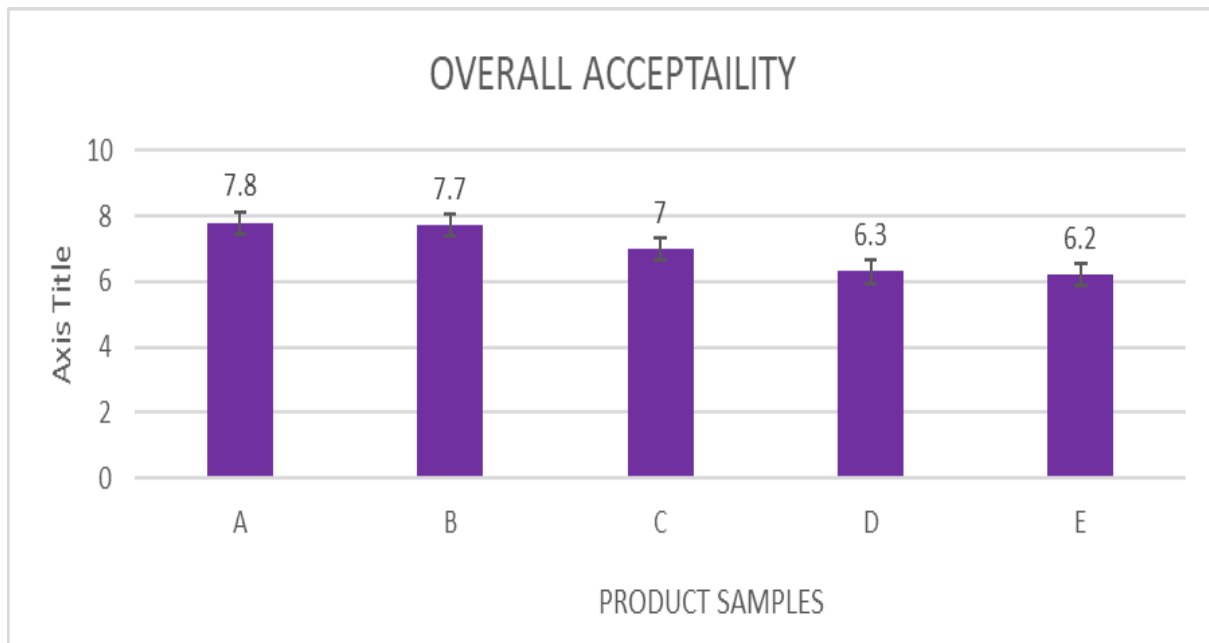


Fig. 12. Mean sensory scores for overall acceptability of bread of different formulations.

CONCLUSION

Based on these findings, it can be concluded that composite bread can be successfully prepared using a combination of wheat flour and corn flour. The statistical analysis indicated that the formulation with a ratio of 90% wheat flour and 10% corn flour exhibited superior characteristics in terms of color, crumb, flavor, texture, taste, and overall acceptability compared to other formulations. The inclusion of both 10% and 20% corn flour in the bread was found to be acceptable for consumption. Furthermore, the production of composite bread offers cost advantages, as it is relatively cheaper, more economically viable, and helps save foreign exchange in the Naira market.

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