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RESEARCH ARTICLE

Development and Sensory Evaluation of High Fiber Bread Incorporated with Cacao (Theobroma cocoa L.) Pod Husk Flour

Myleen R. Corpuz*

Cagayan Valley Cacao Development Center, Isabela State University, San Fabian, Echague, Philippines

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***Corresponding Author:**

myleencorpuz1@gmail.com

ABSTRACT

The goal of this study was to determine the acceptability of bread using four distinct formulations of cocoa pod husk flour (CPHF) and bread flour (BF), namely 35:65, 25:75, and 15:85 percent. The permissible level of CPHF in bread was determined by integrating 15 to 35% CPHF in BF and standardizing for sensory evaluation. A hedonic scale of nine points was used to determine overall acceptability. The inclusion of CPHF at 35% was found to be undesirable in bread. The appearance of the bread was impacted as it became deeper in color and tasted well at this level of CPHF inclusion, whereas 25 percent incorporation generated good outcomes. According to the data, the evaluators' overall acceptability of bread ranged from 6.5 to 8.6. This indicates that the formulation was discovered to fall into the category of "liked very much to like slightly". Finally, cacao pod husk powder, which is high in fiber, was evaluated as an ingredient in high fiber bread making.

INTRODUCTION

High fiber bread is now widely recognized as being beneficial to human health. Its consumption has been scientifically proven to reduce the risks of certain medical conditions and to be used in diets for weight loss. However, the taste and characteristics of this type of bread cause consumers to prefer white bread over high fiber bread.

Whole bread contains a lot of fiber. This bread is distinct from white bread in terms of color, taste and texture (Nadiah, et.al. 2007). Whole grain bread has a slightly brown color and is typically denser than white bread. However, a proper process and useful ingredients such as bread softener and calcium propionate may help to improve the overall texture of the whole meal bread.

Because of its acquired taste in comparison to white bread, it serves as a stepping stone for food researchers to find new alternatives in meeting consumer demands for high fiber bread in their healthy diet. Cocoa pod husk is one of the newest fiber sources. CPH contains 357.4 g/kg (dry basis), according to a previous study by Alemawor et. al. (2009). As a result, in this study, cacao pod husk, which is high in crude fiber, was evaluated as an ingredient (powder) in the production of high fiber bread.

Previously, cocoa pod husk was commonly discarded as waste. The Philippines had 33,313 ha of cultivated cacao in 2005, producing 27,964 tons of cocoa (PSA, 2016). This equates to 42% of total cacao production, which stands at 66,580.95 tones. Because cacao pod husk is composed of 56%

matured cacao pod, approximately 37,285.33 tons of cacao pod husk were produced that year, which is classified as cacao byproducts.

Despite the growing interest of specific consumer groups encouraged to adopt healthy eating habits, cacao pod husk flour is still very low in the Philippines. The growing consumer demand for food with nutritional and sensory quality as well as a functional food claim (Droval et al. 2012) has prompted researchers to conduct research to develop new products that consider not only nutritional and functional characterization but also consumer acceptance.

The research work was carried out to development, sensory evaluation and acceptability of cacao pod husk powder utilization in making high fiber bread.

MATERIALS AND METHODS

Sample Collection

The cacao pod (Theobroma cacao sp.) husk flour was obtained from Cagayan Valley Cacao Development Center, ISU, Echague Campus. Ingredients such as bread flour, sugar, and bread yeast were obtained from local supplier in Isabela Province.

Preparation of cacao pod husk flour (CPHF)

The cacao pod husk flour (CPHF) was prepared by the following steps. Firstly, the cacao pod husk (CPH) was cleaved by using a 10 inches, stainless steel kitchen knife. The wet bean (seed) including the placenta and the outer layer of the cocoa pod which is known as cacao shell was removed from the pod.

The CPH which is white in color was cleaned and cut into smaller pieces. Then, the CPH was cooked for about half an hour in order to reduce its theobromine content, as well as practicable in removing the slime layer of CPH and soften its texture. Next, the CPH was placed on a tray and dried in a cabinet dryer at temperature of 60̊C until the moisture content was 8-10%.

Finally, CPH was grinded by using warring blender and continue with milling by using a sample mill to obtain particle size of 0.12 mm. Then, CPHF produced was stored in a polyethylene bag at room temperature for further analysis. CPHF was then deployed for proximate analysis.

Preparation and formulation of bread samples

Bread flour (BF) and cacao pod husk flour (CPHF) were used to make the flour blends. Different flour blend product formulation (PF) ratios were created in order to determine the optimum tolerability of CPHF incorporated into the high fiber bread formulation.

Bread flour was replaced by cacao pod husk powder at 15%, 25%, and 35% in the baking process. Table 1 shows the ingredients for dough as well as the sponge mixture. In a mixer, the sponge mixture was combined with the dough ingredients to create a smooth and elastic dough. For 1 hour, the dough was allowed to rest in a proofer at 35° C and 80% relative humidity. Following that, the dough was manually formed and proofed for 1 hour in an aluminum baking pan. It was baked in an oven at 150°C for 30 minutes. The baked bread was allowed to cool for 1 hour at room temperature before being analyzed.

Table 1. Formulations of High Fiber Bread

Ingredients	PF1 control	PF2 15% CPHF	PF3 25% CPHF	PF4 35% CPHF
Sponge Formulation				
Powdered sugar (g)	20	20	20	20

Bread flour (g)	50	50	50	50
Bread yeast (g)	6	6	6	6
Water (ml)	100	100	100	100
Dough Formulation				
CPHF (g)	0	45	75	105
BF (g)	300	255	225	195
Sugar (g)	20	20	20	20
Milk powder (g)	15	15	15	15
Bread improver (g)	7	7	7	7
Salt (g)	5	5	5	5
Shortening (g)	25	25	25	25
Water (ml)	150	150	150	150

Sensory Evaluation

A sensory evaluation of freshly baked breads was carried out by 50 individuals from Isabela State University Echague Campus, Philippines, comprising students and staff (both male and female) aged 25-60. The assessment employed a 9-point hedonic scale, following the guidelines outlined by Lawless and Heymann in 2013. The untrained panelists provided feedback on the bread samples, indicating their preference on a scale from 1 to 9, where 1 denotes extreme dislike and 9 signifies extreme liking.

Statistical Analysis

The samples underwent analysis, and the outcomes were averaged. Statistical analysis was conducted utilizing SPSS. To ascertain significant distinctions between mean values, an independent t-test was applied with a significance level set at $p<0.05$. Additionally, the analysis of variance (ANOVA) was employed to identify significant differences between mean values, followed by Duncan's multiple range test at a significance level of $p<0.05$.

RESULTS AND DISCUSSIONS

Proximate composition

The compositions of commercial bread flour (BF) and cacao pod husk flour (CPHF) are shown in Table 2. According to the obtained results, all the parameters were significantly different. The CPHF had a significantly higher content of total dietary fiber (61.09g), crude fat (0.98 g), total calories (352.50g), calcium (232.18g), iron (3.37g) and total carbohydrates (81.14g) than BF.

Table 2. Proximate composition of bread flour and cacao pod husk flour

Composition	BF (g/100g of dry matter)	CPHF (g/100g of dry matter)
moisture	12.92	8.59
Crude fat	0.72	0.98
Crude protein	12.84	4.78
Total dietary fiber	0.53	61.09

Total calories	348.80	352.50
Total carbohydrates	72.74	81.14
calcium	18	232.18
Iron	2.1	3.37

However, it had a lower level of moisture (8.59g), and crude protein (4.78g). Lower protein content in CPHF (4.78g) compared to BF (12.84g) could be explained by additional steps during processing the CPH to produce the flour. For example, boiling the cacao pod husk pieces in water may cause loosing water-soluble proteins of the final sample (Rodriguez-Ambriz et al. 2008). On the other hand, higher content of crude fiber in CPHF shows that it has the potential to be applied as a high fiber source in bakery products. Generally, since the bran fractions are removed during the milling process, commercial BF is not known as a rich source of high dietary fiber (Galisteo, et. al. 2008)

The moisture content of CPHF is below10% and is within the range of standard category (FDA, 2013). This low value may indicate the suitability of CPHF for storage and processing also prevention of the triglycerides degradation during the storage (Rodge et al. 2012).

Sensory Evaluation

The mean scores of hedonic sensory evaluation for color, aroma, taste, texture, and overall acceptability of bread samples were summarized in Table 3. As shown, replacing BF with 15%, 25%, and 35% CPHF had a significant (p0.05) effect on all sensory parameters of the bread samples.

The addition of CPHF resulted in a darker color and denser texture, which at a level of 25% appears to be acceptable to consumers. However, increasing CPHF incorporation to 35% appears to have a negative effect on consumer acceptability. Color of bread is an important factor in sensory evaluation for consumers, depending on their perception of bread type (Stanley and Linda, 2006). Average scores of bread aroma, as determined by the sense of smell, were significantly (p0.05) higher in PF3 compared to PF2, PF4, and PF1 (control), indicating that adding more than 15% CPHF has a positive effect on final product aroma. The texture attribute scores were consistent with the texture analysis results, which revealed an increase in CPHF of bread formula (PF4) can result in tougher breads.

Table 3. Average scores of sensory evaluation of bread samples

Parameters	PF1 Control 100% BF	PF2 15% CPHF	PF3 25% CPHF	PF4 35% CPHF
Color	7.06 ± 0.55^{b}	6.03 ± 0.46^{b}	7.50 ± 0.94^{a}	4.43 ± 0.22^{c}
Aroma	7.63 ± 0.25^{b}	6.06 ± 0.15^{d}	8.56 ± 0.33^{a}	4.86 ± 0.20^{c}
Taste	7.20 ± 0.90^{b}	6.93 ± 0.45^{c}	8.80 ± 1.99^{a}	5.10 ± 0.20^{d}
Texture	7.03 ± 0.08^{c}	6.03 ± 0.35^{b}	8.53 ± 0.60^{a}	4.96 ± 0.19^{c}
Overall acceptability	7.11 ± 0.62^{b}	6.03 ± 0.33^{c}	8.86 ± 0.84^{a}	5.06 ± 0.17^{d}

Values in the same row with different superscripts are significantly different ($p<0.05$).

CONCLUSION AND RECOMMENDATIONS

According to the findings, the incorporation of CPHF in various ratios had a significant impact on bread color, taste, aroma, and texture attributes. In addition, the amount of CHPF incorporated into BF increased the hardness and darkness of bread samples significantly (p0.05) compared to the control (bread flour). Bread samples containing 25% CPHF had the highest mean overall acceptance scores of all samples. As a result, this knowledge can be applied to commercial products such as high fiber bread. The implementation of such new technology would improve overall economic, social, and societal health and well-being. The findings of this study may be useful in developing dietary and waste interventions to combat community malnutrition and environmental pollution.

Author's Contribution

The author contributed by designing the research framework, gathering and analyzing data, and interpreting findings. They provided insights into the study's objectives, ensuring methodological rigor and accuracy, and contributed to the development of practical recommendations based on the results.

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