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Acceptability of a High-Calcium Prebiotic Food Formula Made from Chicken Feet, Garlic, and Banana for Stunted Children

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Stunting, or short stature, is a condition in which a person's height is not appropriate for their age. Adequate intake of both macronutrients and micronutrients is essential to prevent or reduce the risk of stunting. In addition to calcium-rich foods, the inclusion of prebiotic-containing foods is highly recommended. To ensure the intake of both calcium and prebiotics, a food formula composed of chicken feet bones, bananas, and garlic—referred to as a calcium-prebiotic food formula—was developed. The composition of the formula was based on the CODEX STAN 181-1991 standard, with an energy content of approximately 200–400 kcal to support weight management. This study aimed to evaluate the acceptability of the calcium-prebiotic food formula made from chicken feet, garlic, and bananas for children with stunting. This study used an experimental design consisting of three formulations: F1 (75%:25%), F2 (50%:50%), and F3 (25%:75%). Organoleptic tests were conducted using a panel to assess acceptability in terms of color, aroma, texture, and taste. The Friedman statistical test showed no significant differences among the three formulations in terms of color, aroma, texture, and taste. It is recommended that further laboratory testing be conducted to determine the protein and calcium content for more accurate nutritional profiling.

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1. INTRODUCTION

Stunting or short stature is a condition where a person's height does not match their age, which is determined by calculating the Z-score for height-for-age. A person is considered stunted if the Z-score for height-for-age is below -2 SD (standard deviations). Stunting occurs as a result of insufficient nutritional intake, both in quality and quantity, high morbidity, or a combination of both. This condition is often found in countries with poor economic conditions (Sutarto, Mayasari, & Indriyani, 2018).

The prevalence of stunted children nationally decreased by 6.4%, from 37.2% in 2013 to 30.8% in 2018. However, this prevalence is still higher than the prevalence of undernutrition (17.7%) (Badan Penelitian dan Pengembangan Kesehatan, 2019). Adequate nutrient intake, both macronutrients and micronutrients, is crucial to prevent or reduce the risk of stunting. Proper nutritional intake influences normal growth patterns, which can allow children to catch up in height. Providing foods rich in protein, calcium, vitamin A, and zinc can promote height growth in children (Mitra, 2015).

When feeding children with stunting, it is important to consider their physiological factors, particularly intestinal absorption. Research indicates that stunted children experience chronic inflammation in the small intestine, known as pediatric environmental enteropathy (PEE). This subclinical condition is caused by constant fecal-oral contamination, leading to increased intestinal permeability and immune cell infiltration into the intestinal epithelium. Chronic inflammation results in damaged intestinal villi, reducing the surface area for nutrient absorption. Consequently, there is a redistribution of nutrients needed for growth and development, and disruption in hormonal pathways regulating growth plate activity in long bones. Chronic inflammation and impaired nutrient absorption are also hypothesized to affect brain development, inducing negative effects on cognition, performance, and linear growth (Vonaesch et al., 2018).

Inulin can help enhance calcium absorption by increasing the solubility of minerals, thanks to the promotion of bacteria that produce short-chain fatty acids. Bacterial fermentation products, particularly lactate and butyrate, expand the surface area for absorption, which increases calcium uptake in the intestines (Nadia et al., 2019). In addition to calcium sources, foods containing prebiotics are highly recommended. Prebiotics are food ingredients containing oligosaccharides that are indigestible by the host but beneficial by stimulating the growth of beneficial gut microflora (Widanarni, Noermala, & Sukenda, 2014).

There are currently no specific food formulas for stunting, so approaches involving weight control food formulas are being considered. According to the CODEX STAN 181-1991 standard, food formulas intended to replace one or more meals per day must provide no less than 200 kcal and no more than 400 kcal per serving or meal. The minimum protein content should be 25% and the maximum should be 50% of the available energy in the food formula (CODEX Alimentarius, 1991). To ensure both calcium and prebiotic sources are included, a food formula sourced from chicken feet, bananas, and garlic was created, named the calcium-prebiotic food formula. All ingredients are processed into flour and formulated into a food product for children with stunting. The composition of this formula follows the CODEX STAN 181-1991 standard, providing an energy content to control weight of approximately 200-400 kcal per serving (CODEX Alimentarius, 1991).

One high-nutrient food that has potential for inclusion in a food formula is the banana. Bananas (*Musa paradisiaca*) are high in sugar and serve as a good source of prebiotics due to their 0.3% fructooligosaccharide content. Additionally, the plantain variety of banana is rich in resistant starch and fiber. One type of soluble fiber in bananas is inulin, which is found at a rate of about $\pm 1\text{g}/100\text{g}$. Generally, banana flour is a local food

source with advantages over fresh bananas, including longer shelf life and easier supplementation (Hardisari & Amaliawati, 2016).

One food that contains calcium is chicken feet. Chicken feet have a higher protein content compared to fat and carbohydrates. The protein content in chicken feet is 19.8 grams per 100 grams. Protein is an excellent nutrient for children undergoing growth and development. About 30% of total human protein is collagen. Chicken feet are also rich in omega-3 and omega-6 fatty acids, with 187 mg and 2,571 mg per 100 grams, respectively. Omega-3 and omega-6 are essential unsaturated fatty acids that are crucial for health (Rasbawati, & Rauf, 2018). Garlic plays a significant role in health, such as inhibiting and killing bacteria. Garlic can also enhance the immune system to fight potential diseases and maintain health. It is considered an effective antioxidant for protecting cells from free radical damage and as a natural antibacterial agent. Garlic functions as an immunostimulant by facilitating phagocytic cell function and enhancing bactericidal activity (Agnesa et al., 2017).

In addition to the ingredients used in the food formula, another important factor to consider is the acceptability of the food formula. Food acceptability refers to the extent to which consumers are willing to accept the food served, which is a key measure of the success of food preparation (Sunarya & Puspita, 2018). This study aimed to evaluate the acceptability of the calcium-prebiotic food formula made from chicken feet, garlic, and bananas for children with stunting.

2. METHOD

This study used an experimental design consisting of three treatments: F1 (75%:25%), F2 (50%:50%), and F3 (25%:75%). The method employed in this research was an organoleptic test conducted by panelists to assess their acceptability of the food formula in terms of color, aroma, texture, and taste. The research was carried out at the Food Science and Technology Laboratory, Department of Nutrition, Politeknik Kesehatan Pontianak. The study was conducted in July 2020. The data obtained were tabulated and analyzed statistically using the Friedman test to determine significant differences in the panelists' responses to the formulations.

3. RESULTS AD DISCUSSION

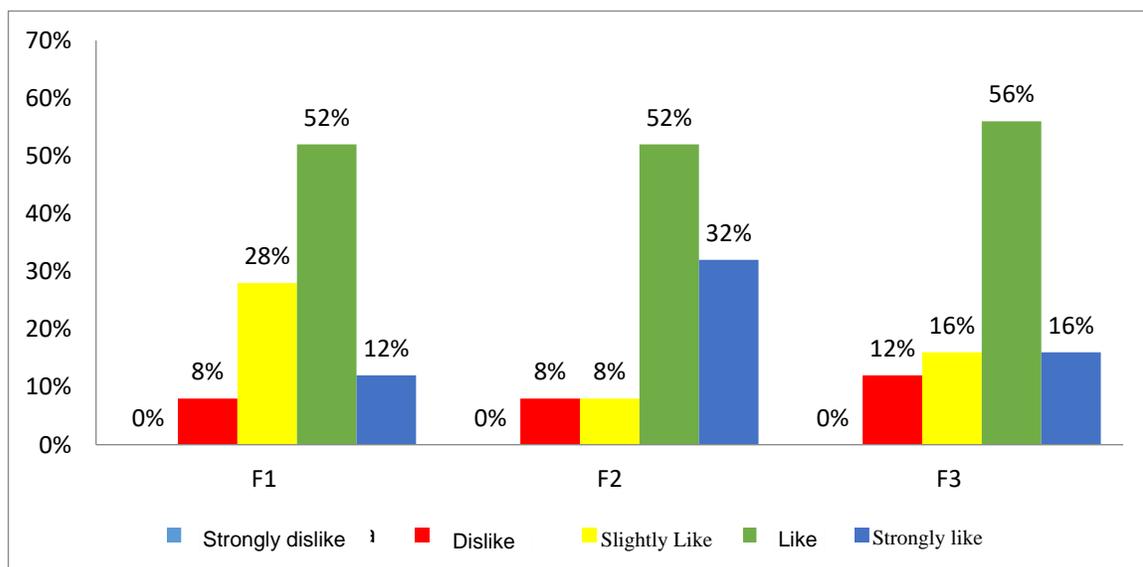


Figure 1. Graph of Panelists' Evaluation on Color

Figure 1 shows that the selected formula for color is F2, with 32% of panelists indicating they "strongly liked" it and 52% indicating they "liked" it.

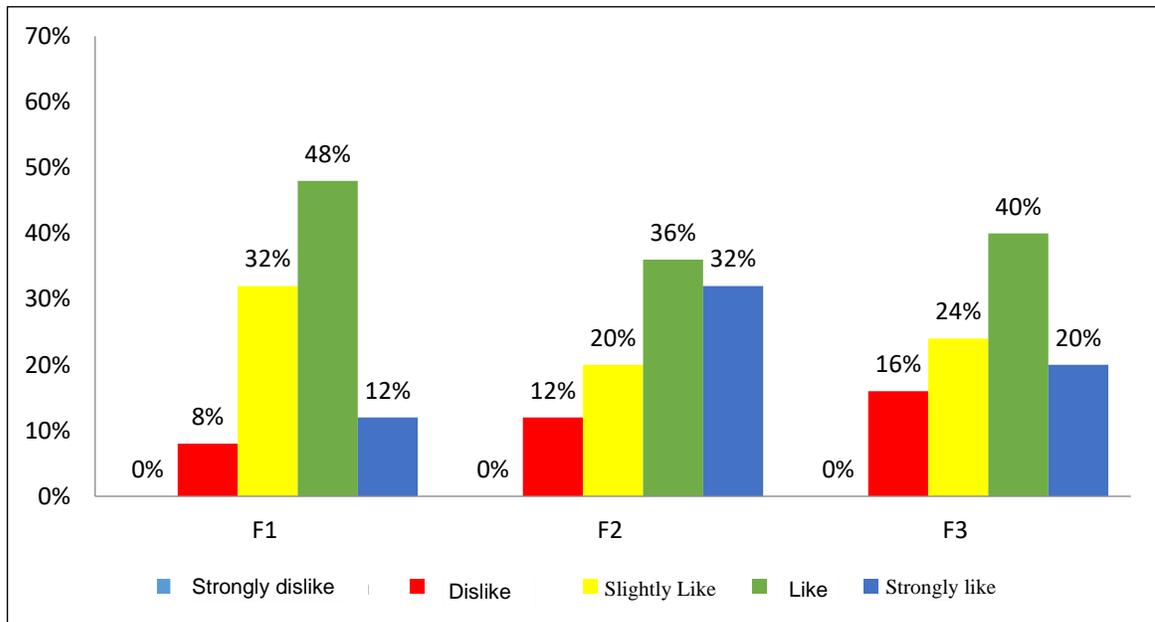


Figure 2. Graph of Panelists' Evaluation on Aroma

Figure 2 shows that the selected formula for aroma is F2, with 32% of panelists indicating they "strongly liked" it and 36% indicating they "liked" it.

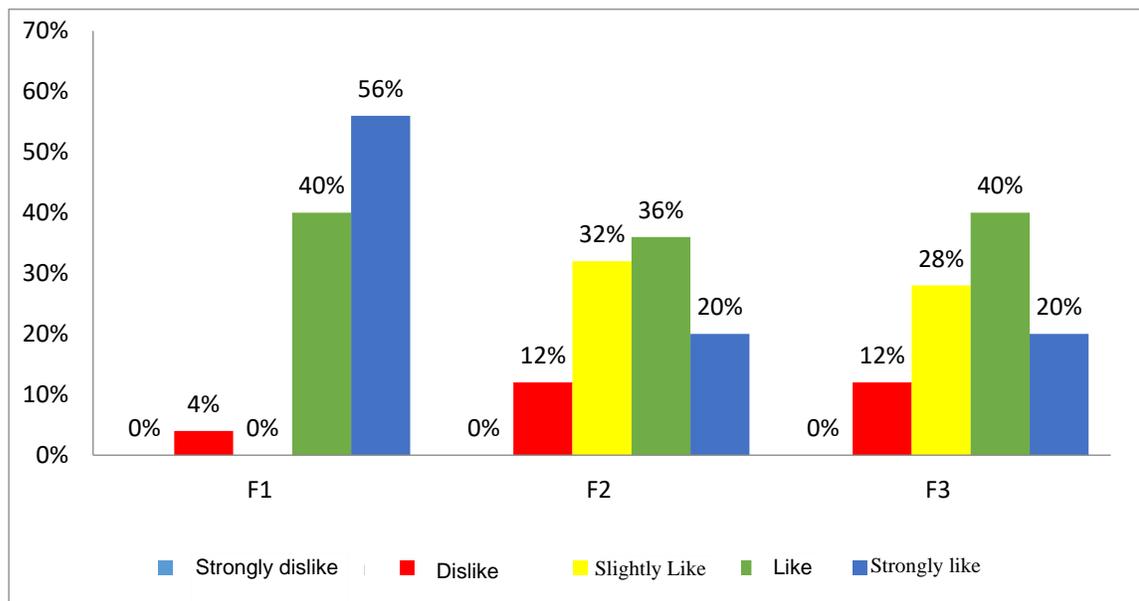


Figure 3. Graph of Panelists' Evaluation on Texture

Figure 3 shows that the selected formula for texture is F1, with 56% of panelists indicating they "strongly liked" it and 40% indicating they "liked" it.

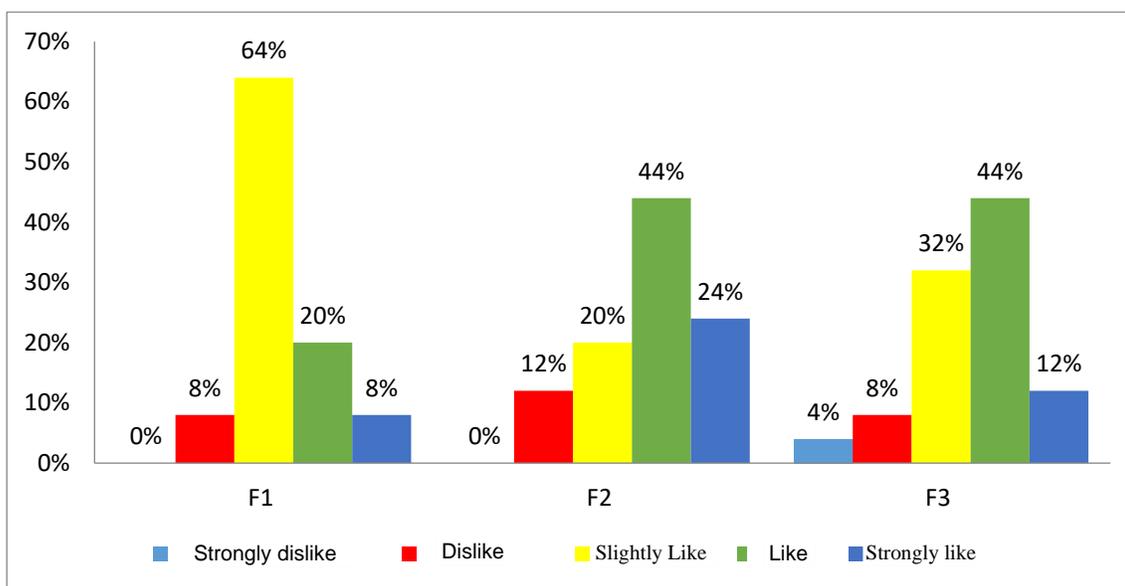


Figure 4. Graph of Panelists' Evaluation on Taste

Figure 4 shows that the selected formula for taste is F2, with 24% of panelists indicating they "strongly liked" it and 44% indicating they "liked" it.

Table 1. Percentage of Liking for Each Treatment Based on Color, Aroma, Texture, and Taste.

	level of preference (%)				Result
	Color	Aroma	Texture	Taste	
F1	46	48	48.00	43	185
F2	56.50	52	56.50	58	223
F3	47.50	50	46	49	192

Table 1 shows that the percentage of liking for each treatment based on color, aroma, texture, and taste of the calcium-prebiotic food formula was highest in treatment 2, with a total of 223.00%, indicating that this treatment was the most preferred by the panelists.

Table 2. Results of Organoleptic Test on Color Preference Evaluation

P1			P2			P3		
Results	R	R ²	Results	R	R ²	Results	R	R ²
2	1.5	2.25	3	3	9	2	1.5	2.25
4	1.5	2.25	5	3	9	4	1.5	2.25
4	2	4	4	2	4	4	2	4
4	3	9	3	2	4	2	1	1
4	2	4	4	2	4	4	2	4
4	2	4	4	2	4	4	2	4
3	1	1	5	3	9	4	2	4
5	3	9	4	2	4	3	1	1
4	1	1	5	2.5	6.25	5	2.5	6.25

4	2	4	4	2	4	4	2	4
3	1	1	5	3	9	4	2	4
4	2.5	6.25	4	2.5	6.25	3	1	1
3	1	1	5	3	9	4	2	4
4	1	1	5	2.5	6.25	5	2.5	6.25
4	2	4	4	2	4	4	2	4
3	1	1	4	2	4	5	3	9
3	1	1	5	3	9	4	2	4
4	2	4	4	2	4	4	2	4
3	2	4	5	3	9	2	1	1
5	3	9	4	2	4	3	1	1
2	1.5	2.25	2	1.5	2.25	4	3	9
4	3	9	2	1	1	3	2	4
5	3	9	4	1.5	2.25	4	1.5	2.25
4	2	4	4	2	4	4	2	4
3	1	1	4	2	4	5	3	9
Sum of Powers	46	98		56.5	135.25		47.5	99.25
Sum of Squares		2116			3192.25			2256.25

Calculated T < F table (2 < 3.19)

Table 2 shows that the calculated T (T hitung) is less than the F table (2 < 3.19), indicating that there is no effect of the different calcium-prebiotic food formulas on the color of the calcium-prebiotic food formula made from chicken feet, garlic, and banana.

Table 3. Results of Organoleptic Test on Aroma Preference Evaluation of the Formula

P1			P2			P3		
Results	R	R ²	Results	R	R ²	Results	R	R ²
3	2	4	2	1	1	4	3	9
4	2	4	4	2	4	4	2	4
4	2	4	4	2	4	4	2	4
4	3	9	2	1.5	2.25	2	1.5	2.25
4	2.5	6.25	4	2.5	6.25	3	1	1
2	1	1	3	2	4	4	3	9
3	1	1	5	3	9	4	2	4
4	3	9	3	2	4	2	1	1
4	1.5	2.25	4	1.5	2.25	5	3	9
4	2.5	6.25	4	2.5	6.25	3	1	1
3	1	1	5	3	9	4	2	4
4	1	1	5	2.5	6.25	5	2.5	6.25
3	1	1	5	3	9	4	2	4
	2.5	6.25	4	1	1	5	2.5	6.25
5	3	9	4	2	4	3	1	1
4	1	1	5	2.5	6.25	5	2.5	6.25
3	1	1	5	3	9	4	2	4
4	2	4	5	3	9	3	1	1
4	2.5	6.25	3	1	1	4	2.5	6.25
3	2	4	3	2	4	3	2	4
2	1.5	2.25	2	1.5	2.25	4	3	9

4	3	9	3	2	4	2	1	1	
5	2.5	6.25	5	2.5	6.25	2	1	1	
3	2.5	6.25	4	1	1	3	2.5	6.25	
3	1		4	2	4	5	3	9	
Sum of Powers	48	105		52	119		50	113.5	
Sum of Squares	2304			2704			2500		

Calculated $T < F$ table ($0.20 < 3,19$)

Table 3 shows that the calculated T (T hitung) is less than the F table ($0.20 < 3.19$), indicating that there is no effect of the different calcium-prebiotic food formulas on the aroma of the calcium-prebiotic food formula made from chicken feet, garlic, and banana.

Table 4. Results of Organoleptic Test on Texture Preference Evaluation of the Formula

	P1			P2			P3		
Results	R	R ²	Results	R	R ²	Results	R	R ²	
4	3	9	3	2	4	2	1	1	
4	1.5	2.25	5	3	9	4	1.5	2.25	
4	2	4	4	2	4	4	2	4	
4	3	9	3	2	4	2	1	1	
4	2.5	6.25	4	2.5	6.25	3	1	1	
3	1.5	2.25	4	3	9	3	1.5	2.25	
3	1	1	4	2	4	5	3	9	
5	3	9	3	2	4	2	1	1	
4	2.5	6.25	4	2.5	6.25	3	1	1	
4	2.5	6.25	3	1	1	4	2.5	6.25	
3	1	1	5	3	9	4	2	4	
4	2.5	6.25	4	2.5	6.25	3	1	1	
3	1	1	5	3	9	4	2	4	
4	1.5	2.25	5	3	9	4	1.5	2.25	
5	3	9	4	2	4	3	1	1	
3	1	1	4	2	4	5	3	9	
3	1	1	4	2	4	5	3	9	
3	1	1	5	3	9	4	2	4	
2	1.5	2.25	2	1.5	2.25	5	3	9	
5	3	9	4	2	4	3	1	1	
2	1	1	3	2	4	4	3	9	
2	1	1	5	3	9	4	2	4	
5	3	9	4	2	4	3	1	1	
5	3	9	4	1.5	2.25	4	1.5	2.25	
3	1	1	4	2	4	5	3	9	
Sum of Powers	48	110		56.5	135.25		45.5	98.25	
Sum of Squares	2304			3192.25			2070.25		

Calculated $T < F$ table ($1.56 < 3,19$)

Table 4 shows that the calculated T (T hitung) is less than the F table ($1.56 < 3.19$), indicating that there is no effect of the different calcium-prebiotic food formulas on the texture of the calcium-prebiotic food formula made from chicken feet, garlic, and banana.

Table 5. Results of Organoleptic Test on Taste Preference Evaluation of the Formula

Results	P1		P2			P3		
	R	R ²	Results	R	R ²	Results	R	R ²
3	3	9	2	2	4	1	1	1
4	1.5	2.25	5	3	9	4	1.5	2.25
3	1	1	4	2.5	6.25	4	2.5	6.25
3	2	4	2	1	1	4	3	9
3	2.5	6.25	3	2.5	6.25	2	1	1
2	1.5	2.25	2	1.5	2.25	3	3	9
3	1	1	5	3	9	4	2	4
4	2	4	5	3	9	3	1	1
3	1	1	4	2.5	6.25	4	2.5	6.25
3	1.5	2.25	4	3	9	3	1.5	2.25
3	1	1	5	3	9	4	2	4
3	1	1	4	2.5	6.25	4	2.5	6.25
3	1	1	4	2	4	5	3	9
5	2.5	6.25	4	1	1	5	2.5	6.25
4	2.5	6.25	4	2.5	6.25	3	1	1
5	3	9	4	2	4	3	1	1
3	1	1	5	3	9	4	2	4
3	1	1	5	3	9	4	2	4
3	1.5	2.25	4	3	9	3	1.5	2.25
4	3	9	3	1.5	2.25	3	1.5	2.25
2	1	1	3	2	4	4	3	9
3	2	4	3	2	4	3	2	4
4	2	4	4	2	4	4	2	4
3	2.5	6.25	3	2.5	6.25	2	1	1
3	1	1	4	2	4	5	3	9
Sum of Powers	43	87		58	144		49	109
Sum of Squares	1849		3364			2401		

Calculated T < F table (3.08 < 3.19)

Table 5 shows that the calculated T (T hitung) is less than the F table (3.08 < 3.19), indicating that there is no effect of the different calcium-prebiotic food formulas on the taste of the calcium-prebiotic food formula made from chicken feet, garlic, and banana.

DISCUSSION

This study examines the formulation of calcium-rich food based on chicken feet flour, banana flour, and garlic flour. The combination of these ingredients not only aims to diversify food but also to increase nutritional content and improve the sensory properties of the product. Sensory tests were conducted using the hedonic method with 25 panelists as respondents. The parameters observed include color, aroma, texture, and taste, with rating scores ranging from 1 to 5.

Color

Color is the first impression observed by panelists, as stated by Lamusu (2007), that color is a key organoleptic parameter in food presentation. Attractive colors can increase consumer interest in trying the product (Lamusu, 2007). Evaluation of color is important as it serves as an initial attraction before consumers are familiar with other food attributes.

The results of the organoleptic test showed that formula F2 (50%:50%) received the highest percentage in the "strongly like" category at 32%, followed by F3 (25%:75%) at 16%, and F1 (75%:25%) at 12%. However, the Friedman statistical test showed no significant difference in color acceptance between the three formulas. The brownish color produced is suspected to come from the blend of the base ingredients such as chicken feet flour, banana flour, and garlic flour. Therefore, all formulations F1, F2, and F3 were accepted by the panelists based on the color parameter.

Aroma

Aroma is one of the sensory attributes that is most difficult to classify due to its variety (Setyaningsih et al., 2010). Aroma is also an important factor in determining consumer acceptance. A product with an attractive appearance but an unremarkable aroma will reduce consumer interest. The results of the organoleptic aroma test showed that F2 (50%:50%) again received the highest percentage in the "strongly like" category at 32%, followed by F3 at 20%, and F1 at 12%. The Friedman statistical test also showed no significant differences between the formulations. The high acceptance of F2 is likely due to the balanced aroma between chicken feet flour and banana flour. Overall, all formulas F1, F2, and F3 were accepted by the panelists in terms of aroma.

Texture

Texture is an important physical property that affects food quality. The characteristics of texture are influenced by raw materials and processing. Texture also includes mechanical elements (hardness, chewiness), geometric elements (gritty, crumbly), and mouthfeel sensations (oily, watery) (Setyaningsih et al., 2010). Based on the organoleptic test, F1 (75%:25%) showed the highest acceptance rate at 56% in the "strongly like" category, while F2 and F3 each received 20%. The Friedman test showed no significant differences in texture between the three formulations. This indicates that all formulas were accepted texturally by the panelists.

Taste

Taste is the main parameter that determines the deliciousness of food. There are five basic tastes: sweet, bitter, salty, sour, and umami. Additionally, trigeminal sensations such as spiciness, astringency, or soda-like sensations also affect taste perception (Setyaningsih et al., 2010). The results of the organoleptic taste test showed that F2 (50%:50%) received the highest percentage of 24% in the "strongly like" category, followed by F3 at 12% and F1 at 8%. The Friedman test showed no significant differences between the formulations. This suggests that the taste of the food formula is influenced by the base ingredients and the processing, including the addition of supplementary ingredients (Ladamay & Yuwono, 2014). Thus, all three formulations, F1, F2, and F3, were accepted in terms of taste.

4. CONCLUSION

Based on the results of the study on the acceptance of the calcium-rich prebiotic food formula, it can be concluded that there are no differences in color, aroma, texture, and taste of the high calcium prebiotic food formula in Formulas F1, F2, and F3.

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