Sensory Evaluation of Finger Food Based On Sunflower Seed And Dragon Fruit As A Supplementary Food For Toddlers

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Abstract.
Stunting among children under five remains a major public health problem in Indonesia, with a national prevalence of 19.8% according to the 2024 Indonesian Nutritional Status Survey released in 2025. Supplementary foods made from local ingredients must therefore be both nutrient-dense and acceptable so that children actually eat them. Sunflower seed (Helianthus annuus) is rich in plant protein and unsaturated fat, and dragon fruit (Hylocereus sp.) provides fiber, vitamin C and natural betacyanin pigments, yet the sensory acceptability of their combination in finger food for toddlers has rarely been studied. This study aimed to evaluate the sensory properties of finger food biscuits in which wheat flour was partially replaced by an equal mixture of sunflower seed flour and dragon fruit flour, and to determine the most acceptable substitution level. Four formulations were prepared, namely P0 (100% wheat flour, control), P1 (20% substitution), P2 (40%) and P3 (60%). The samples were labeled with three-digit random codes and evaluated by 49 panelists through a hedonic test (color, aroma, taste and crispness) and a hedonic quality test (the same attributes plus aftertaste) on a five-point scale. Overall liking was analyzed using the Friedman test followed by pairwise Wilcoxon signed-rank tests with Holm correction ($\alpha = 0.05$). Overall liking differed significantly among formulations ($p < 0.001$). It rose from P0 (3.76) to a peak at P2 (4.16) and fell at P3 (3.49). P1 (4.00) and P2 were the most preferred and did not differ significantly, whereas P3 was significantly lower than all other formulations. Color and taste were the attributes that most clearly separated the formulations, while crispness was consistently liked at every substitution level. Moderate substitution (20 to 40%) gave the highest acceptability, and P2 is recommended as the selected formulation for further development as a nutrient-dense supplementary food for toddlers, pending confirmation of acceptance among children.
Keywords: *dragon fruit, finger food, hedonic test, sensory evaluation and sunflower seed.*

I. INTRODUCTION

Stunting remains a major nutritional problem among toddlers in Indonesia. The 2024 Indonesian Nutritional Status Survey (SSGI), published in 2025, recorded a national stunting prevalence of 19.8% [1], down from 21.5% in 2023 [2]. Although this is the first time the prevalence has fallen below 20%, it remains well above the national target of 14% by 2029 [3]. Stunting is a failure of linear growth caused by chronic undernutrition, with long-term consequences for cognitive development, immunity and productivity. Improving the dietary intake of toddlers through nutrient-dense and easily accessible foods is therefore an important strategy.

One approach to improving toddler nutrition is supplementary feeding (*Pemberian Makanan Tambahan, PMT*), which in Indonesia is commonly provided as biscuits or snacks. International guidelines emphasize the importance of nutrient-dense and diverse complementary foods in early childhood [4], and adequate high-quality protein plays a crucial role in the catch-up growth of stunted Indonesian children [5]. However, these benefits are achieved only when the product is actually eaten, which makes sensory acceptability a decisive factor in the success of a supplementary food. A product that is nutrient-dense but disliked is unlikely to be consumed and will fail to deliver its intended benefits.

Sensory attributes such as color, aroma, taste and texture are key determinants of consumer acceptance and food choice [6]. For toddlers, visual appeal and an appropriate texture strongly influence willingness to eat. Sensory evaluation, comprising a hedonic test to measure the degree of liking and a hedonic quality test to describe the perceived quality of each attribute, is therefore an essential step in developing supplementary foods. The hedonic scale method has long been used to measure food preferences and remains a standard approach in sensory evaluation [7, 8].

Sunflower seed (Helianthus annuus) is a rich source of plant protein, approximately 20.8 g per 100 g, as well as unsaturated fatty acids, vitamin E and minerals [9, 10]. In baked products, partial substitution of wheat flour with sunflower seed flour increases protein, ash and antioxidant capacity but tends to produce darker and harder products [11, 12]. Dragon fruit (Hylocereus sp.) is rich in dietary fiber, minerals, vitamin C and betacyanin pigments, which act as antioxidants and natural colorants that can enhance visual appeal [13, 14]. Combining the two ingredients could improve both the nutritional value and the appearance of finger food biscuits for toddlers, but the substitution may also change their sensory characteristics, so their acceptability needs to be evaluated.

Several related studies have been reported. Grasso et al. [11] found that replacing wheat flour with sunflower seed flour in biscuits improved nutritional value but made the product darker and harder, while Man et al. [12] showed that crackers containing up to 35% sunflower seed flour remained acceptable for all sensory attributes. Rista et al. [15] reported that adding red dragon fruit peel extract to biscuits significantly affected color, aroma and texture but not taste, and Rochmawati [16] used red dragon fruit peel flour to make cookies. However, these studies examined sunflower seed or dragon fruit separately, and few have evaluated the sensory acceptability of their combination in products intended for toddlers.

This study therefore aimed to evaluate the sensory properties of finger food biscuits substituted with sunflower seed flour and dragon fruit flour using hedonic and hedonic quality tests on color, aroma, taste, crispness and aftertaste, and to determine the most acceptable substitution level for developing a local food-based supplementary food for toddlers.

II. RESEARCH METHOD

2.1 Tools and Materials

The test materials were finger food biscuits prepared in four formulations in which wheat flour was partially replaced by an equal mixture of sunflower seed flour and dragon fruit flour. The other ingredients were butter, a limited amount of powdered sugar and egg white. Drinking water was provided as a palate cleanser, and a structured questionnaire was used to record the assessments. The equipment consisted of coded sample containers, stationery and documentation tools.

2.2 Sample Formulation and Presentation

The four formulations followed the substitution levels in Table 1. Total substitution of wheat flour increased from 0% (P0) to 60% (P3), with sunflower seed flour and dragon fruit flour contributing equal proportions at each level. Each formulation was labeled with a three-digit random code to minimize panelist bias, namely 293 (P0), 116 (P1), 687 (P2) and 432 (P3).

Table 1. Flour substitution formulation and sample code for each treatment

Treatment	Sample code	Flour (%)	Sunflower seed flour (%)	Dragon fruit flour (%)
P0	293	100	0	0
P1	116	80	10	10
P2	687	60	20	20
P3	432	40	30	30

2.3 Sensory Test

Sensory evaluation was carried out by 49 semi-trained panelists who were familiar with sensory evaluation procedures. Two tests were used, a hedonic test to measure the degree of liking and a hedonic quality test to describe the perceived quality of each attribute. The hedonic test covered color, aroma, taste and crispness, and the hedonic quality test covered the same attributes plus aftertaste. Both tests used a five-point scale [7, 8]. In the hedonic test, the scale points were defined as 1 = dislike very much, 2 = dislike, 3 = neither like nor dislike, 4 = like and 5 = like very much. Each panelist received the four coded samples at the same time, rinsed the mouth with water between samples and recorded the scores on the questionnaire. This procedure kept the assessment of each sample independent.

2.4 Data Analysis

Scores for each attribute were summarized as mean ± standard deviation for each formulation. Overall liking was calculated for each panelist as the mean of the four hedonic attribute scores. Differences in overall liking among formulations were tested with the Friedman test, followed by pairwise Wilcoxon signed-rank tests with Holm correction at a 5% significance level. Hedonic quality scores were analyzed descriptively.

III. RESULTS AND DISCUSSION

The results of the hedonic and hedonic quality tests are presented in Tables 2 and 3. In general, panelist liking increased at low to moderate substitution levels, peaked at P2 and then decreased at the highest level (P3), forming a non-linear dose-response pattern.

Table 2. Hedonic test scores (liking) for each formulation (mean and SD, scale 1 to 5, n = 49)

Attribute	P0 (293)	P1 (116)	P2 (687)	P3 (432)
Color	3.53 ± 0.93	4.00 ± 0.81	4.22 ± 0.81	3.00 ± 0.88
Aroma	3.69 ± 0.91	4.00 ± 0.83	3.98 ± 0.82	3.53 ± 0.88
Taste	3.76 ± 0.80	4.16 ± 0.77	4.33 ± 0.74	3.61 ± 0.90
Crispness	4.04 ± 0.88	3.82 ± 0.82	4.10 ± 0.89	3.82 ± 0.75
Overall liking	3.76^{b}	4.00^{ab}	4.16^{a}	3.49^{c}

Values in the overall liking row followed by different superscript letters differ significantly (Friedman test followed by pairwise Wilcoxon signed-rank tests with Holm correction, $p < 0.05$).

Table 3. Hedonic quality test scores for each formulation (mean and SD, scale 1 to 5, n = 49)

Attribute	P0 (293)	P1 (116)	P2 (687)	P3 (432)
Color	2.76 ± 1.08	2.10 ± 0.93	1.53 ± 0.93	3.27 ± 1.40
Aroma	3.04 ± 0.99	3.69 ± 0.91	3.43 ± 1.09	3.00 ± 1.01
Flavor	3.35 ± 0.89	3.88 ± 0.63	3.80 ± 0.81	3.10 ± 1.07
Crispness	4.00 ± 0.76	3.92 ± 0.83	4.12 ± 0.85	4.08 ± 0.72
Aftertaste	3.59 ± 0.88	3.29 ± 0.99	3.16 ± 1.17	3.31 ± 1.01

P0 = 100% wheat flour; P1 = 20% substitution; P2 = 40% substitution; P3 = 60% substitution.

3.1 Color

Color liking increased from P0 (3.53) to P1 (4.00), peaked at P2 (4.22) and then dropped sharply at P3 (3.00), the lowest score. The difference of 1.22 points between P2 and P3 made color one of the attributes with the widest range of acceptance. Substitution at low to moderate levels therefore improved the appeal of the biscuit color, whereas the highest level made it less liked.

This pattern can be explained by pigment chemistry and browning reactions. Betacyanins from dragon fruit give an attractive purplish-red color at low to moderate proportions [13, 14]. At P3, however, the high proportion of both flours made the color too dark or intense because of the darkening effect of sunflower seed flour [11], the strong color of dragon fruit and browning during baking. These results agree with Rista et al. [15], who found that red dragon fruit peel extract significantly affected biscuit color. Because color is the first attribute perceived and strongly drives children's interest, the advantage of a moderate substitution level is important for a toddler-friendly supplementary food.

The hedonic quality test showed the opposite pattern for color, with P3 receiving the highest score (3.27) and P2 the lowest (1.53). Since the meaning of a hedonic quality score depends on the scale anchors, and P3 was the least liked despite its highest color quality score, this result must be interpreted according to the scale definitions used. The contrast shows that a more intense color is not necessarily a more liked color, so color optimization should target a moderate substitution level.

3.2 Aroma

Aroma liking increased from P0 (3.69) to practically equal peaks at P1 (4.00) and P2 (3.98) and then decreased at P3 (3.53). The hedonic quality test showed a similar trend, with P1 the highest (3.69) and P3 the

lowest (3.00). All scores remained in the neutral to liked range, indicating that aroma was not a major limiting factor for acceptability.

Sunflower seed contributes a savory, slightly nutty aroma, mainly because its high fat content generates aroma compounds during baking [10], while dragon fruit adds a light fruity note. The lower score at P3 suggests that the aroma became too strong or unfamiliar at the highest proportion, whereas low to moderate levels achieved the best scores. This trend is consistent with Rista et al. [15], who reported a significant effect of dragon fruit on biscuit aroma.

3.3 Taste

Taste most clearly differentiated acceptance among the formulations and followed the same pattern as color and aroma. Taste liking increased from P0 (3.76) to P1 (4.16), peaked at P2 (4.33) and declined at P3 (3.61). In the hedonic quality test, P1 (3.88) and P2 (3.80) were again the highest and P3 (3.10) the lowest. The agreement between liking and quality scores confirms that taste was a major determinant of panelist preference.

The taste of the product results from the savory flavor of sunflower seed, the sweet and slightly sour taste of dragon fruit and the limited amount of sugar used. At P1 and P2, these components appeared to be well balanced, whereas at P3 the taste became too strong or unbalanced, lowering the score. Unlike Rista et al. [15], who found no significant effect of dragon fruit peel extract on biscuit taste, the present results suggest that taste was influenced more by the oily, savory sunflower seed than by dragon fruit. Because taste strongly determines how much children eat, the superior taste at moderate levels makes these formulations strong candidates for development.

3.4 Crispness

In contrast to color and taste, crispness was relatively uniform across all formulations in both the hedonic test (3.82 to 4.10) and the hedonic quality test (3.92 to 4.12), with the highest score at P2. This narrow range indicates that crispness, a defining characteristic of biscuits, was maintained at every substitution level and did not differentiate acceptability.

Consistent crispness reflects the low moisture content of biscuits, which supports both texture and shelf life by limiting water activity. Although sunflower seed flour has been reported to increase hardness because its protein and fiber interfere with gluten network formation [11, 12], the panelists still liked the texture of all formulations, and texture quality even increased slightly at higher substitution levels. For toddlers, however, the texture should dissolve easily in the mouth to prevent choking, so the crispness preferred by adult panelists must be balanced against texture safety for young children.

3.5 Aftertaste and Summary of Hedonic Quality

Aftertaste scores were moderate, with P0 the highest (3.59), P2 the lowest (3.16) and P1 and P3 in between, indicating that aftertaste was reasonably acceptable in all formulations. The aftertaste may be influenced by phenolic compounds in sunflower seed, which can give a slightly astringent finish at certain proportions [10].

Overall, the hedonic quality test showed that taste and aroma reached their best quality at moderate substitution and declined at P3, crispness was uniformly high and color varied the most among formulations. This pattern matches the hedonic test and confirms that color and taste were the attributes that most determined differences in acceptance, while texture was a consistent strength of the product.

3.6 Overall Liking and Selected Formulation

Based on the mean of the hedonic attributes, the order of liking was P2 (4.16), P1 (4.00), P0 (3.76) and P3 (3.49). The Friedman test showed significant differences among formulations ($p < 0.001$). Post hoc tests indicated that P1 and P2 were the most liked and did not differ significantly from each other, P0 was intermediate and did not differ from P1, and P3 had the lowest score and differed significantly from all other formulations. Liking therefore increased at low to moderate substitution, reached its optimum at P2 (40%) and fell significantly at P3 (60%).

This dose-response pattern is consistent with reports that sunflower seed flour is acceptable in baked products up to a certain level [12] and that sensory attributes are key determinants of food acceptance [6]. The reddish color and flavor of dragon fruit increased appeal at low to moderate levels, but at the highest

level the color became too intense and the taste too strong. A trade-off should be noted. The highest substitution level, which contains the largest proportion of sunflower seed and dragon fruit and therefore potentially the highest nutritional value [10, 13], was the least liked. The moderate level, particularly P2, balances improved nutritional potential with good acceptability and is recommended as the selected formulation.

3.7 Implications for Supplementary Food for Toddlers

Finger food biscuits substituted with sunflower seed flour and dragon fruit flour showed adequate acceptability at low to moderate substitution levels, with P2 as the most liked formulation and P1 as an equivalent alternative. These results support the potential of the product as a local food-based supplementary food for toddlers.

Several aspects need attention in its application. The natural color of dragon fruit can be used to attract children, but it should not be excessive. Sugar should be limited because the target group is toddlers, and the texture should dissolve easily to prevent choking. Because the assessment was performed by adult panelists, acceptance by toddlers should be confirmed through appropriate methods, such as consumption observation or caregiver assessment, before the product is introduced into a supplementary feeding program.

3.8 Research Limitations

This study has several limitations. First, the interpretation of the hedonic quality scores depends on the anchor definitions, particularly for color, whose quality pattern was opposite to its liking pattern. Second, significance testing was performed only for overall liking, while individual attributes were described without inferential testing. Third, the panelists were adults, so the results do not fully reflect acceptance by toddlers, the primary target group. Fourth, the study focused on sensory properties, and the nutritional, textural safety and microbiological quality of the product still need to be evaluated before it can be widely recommended. Nevertheless, the consistent pattern across attributes and the clear dose-response relationship provide a sound basis for prioritizing moderate substitution levels in further development.

IV. CONCLUSION

Partial substitution of wheat flour with sunflower seed flour and dragon fruit flour produced finger food biscuits with good sensory acceptability at low to moderate levels. Overall liking peaked at P2 (40% substitution), did not differ significantly from P1 (20%) and declined significantly at P3 (60%). Color and taste were the main attributes distinguishing the formulations, whereas crispness was liked at all levels. P2 is recommended as the selected formulation for a local food-based supplementary food for toddlers, although its acceptance among toddlers should be confirmed before use in feeding programs.

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