

Pancoi Biscuit from *Buah Merah (Pandanus conoideus)*: A Local Food-Based Intervention for Stunting Prevention in West Papua

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Abstract. Stunting remains a major public health problem in Indonesia, especially in West Papua, where chronic malnutrition impairs growth of children. Maternal nutrition during pregnancy is crucial for fetal development, and inadequate intake increases the risk of stunting. Utilization of local food resources offers a sustainable preventive approach. This study investigated the potential of *buah merah (Pandanus conoideus)* through the development of Pancoi Biscuit as a local nutritional supplement for pregnant women. A true experimental design was used to analyze nutritional content and consumer acceptance. Each 30 g serving of Pancoi Biscuit provides 110 kcal energy, 3 g protein, 1 g fat, 0.63 g vitamin D, and 0.75 g zinc, fulfilling at least 10% of the Indonesian Recommended Dietary Allowance (RDA) for pregnant women. A hedonic test with 30 untrained panelists indicated an 83.20% acceptance rate for color, aroma, taste, texture, and overall appeal. These findings show that Pancoi Biscuit is both nutritionally beneficial and well-accepted by consumers. This innovation supports the SDGs, particularly Goals 2 and 3 (Zero Hunger, Good Health, and Well-being), and aligns with Indonesia's Asta Cita to strengthen food security, enhance human resources, and reduce stunting. Thus, Pancoi Biscuit demonstrated strong potential as a locally driven stunting prevention strategy.

1 Introduction

Stunting (short stature) is a major global nutritional problem, particularly in poor and developing countries [1]. Stunting is a condition of impaired growth in children under five due to chronic malnutrition, causing children to be too short for their age.

Currently, stunting remains one of the main focuses of the Indonesian government in addressing child nutrition issues. According to the 2021 Indonesian Toddler Nutritional Status Survey (SSGBI), the prevalence of stunting in Indonesia is still 24.4%, equivalent to 5.33 million children under five [2]. The prevalence decreased in 2022 to 21.6%. Nevertheless, this figure is still higher than the maximum tolerance for stunting set by the World Health Organization (WHO), which is below 20% [3].

In general, stunting is caused by inadequate nutritional intake over an extended period owing to improper feeding that does not meet nutritional needs. One of the key factors contributing to stunting is maternal intake, particularly during pregnancy. Pregnant women with nutritional deficiencies or inadequate food intake may experience fetal growth disorders. During pregnancy, mothers require additional energy, proteins, vitamins, and minerals to support fetal development and metabolism [4]. Therefore, the health

status of pregnant women plays a vital role in the prevention of stunting.

Based on the 2022 Food Security and Vulnerability Atlas (FSVA), West Papua is categorized as a red zone, indicating that it is a top-priority area. Indirectly, the stunting rate in West Papua is considered high. The prevalence of stunting in this region has shown a fluctuating trend, increasing from 24.7% in 2020 to 26.2% in 2021 and reaching 30% in 2022 [5].

One of the main causes of the persistently high stunting rate in Papua is the lack of information regarding proper nutritional intake and healthy lifestyle practices in pregnant women and infants. Therefore, stunting needs to receive more attention, as it can affect a child's life well into adulthood, particularly in terms of physical and cognitive development disorders, if not addressed promptly and properly. One of the steps that can be taken to reduce stunting rates is to improve nutritional status. Stunting prevention can be achieved by utilizing available local resources [6].

Red fruit (*Pandanus conoideus*) is an endemic plant that grows in the easternmost part of Indonesia, Papua. Over time, red fruit has gained popularity in the Papuan community due to its high nutritional value and well-known benefits as a remedy for various serious diseases such as cancer, tumors, and HIV/AIDS. The nutritional content of red fruits includes energy, protein, fat,

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carbohydrates, fiber, calcium, phosphorus, zinc, carotene, vitamin B1, vitamin C, niacin, and water [7].

To help achieve the goals of sustainable development (SDGs), specifically points 2 and 3, a local food-based product was developed using red fruit, sago, purple sweet potato, and dragon fruit as the main ingredients. This product is called Pancoi Biscuit.

Pancoi is inspired by the Latin name of the red fruit plant *Pandanus conoideus*, which originates from Papua. Biscuits are widely known and favored by people of all ages and backgrounds. Biscuit is a type of food made from wheat flour with the addition of other food ingredients [8].

This study aimed to examine the nutritional content and level of consumer satisfaction with Pancoi Biscuit, with the hope that it can meet the nutritional needs of pregnant women, serve as an alternative method for preventing stunting, and enhance the potential of local food in West Papua.

2 Materials and Methods

This type of research is a pure experimental study.

2.1 Research Location and Time

The development and formulation of Pancoi biscuit was carried out at the researcher's residence. Nutritional content analysis of Pancoi Biscuit was conducted at the Food Quality and Safety Laboratory of PT. Maxzer Solusi Steril. The research was conducted over approximately one month, from January 2024 to February 2024.

2.2 Materials and Tools

The ingredients used in the production of Pancoi Biscuit include red fruit paste made from Papua red fruit extract (*Pandanus conoideus*), "Engka" brand sago flour, purple sweet potato, dragon fruit, raisins, "Edna" brand palm sugar, "Blue Band" brand margarine, "Dancow" brand powdered milk, and salt. The tools used included a digital scale, large-and medium-sized bowls, molds, baking trays, tablespoons, knives, spatulas, a mixer, and an oven. The formulations of Pancoi Biscuit are presented in **Table 1**.

2.3 Production Process

The production of *Pancoi Biscuit* followed the stages outlined in the flow diagram shown in **Fig. 1**. Generally, the process begins with the preparation of a cream mixture. This cream mixture was prepared by combining palm sugar, margarine, and Papua red fruit paste.

Next, the cream mixture was blended with sago flour, powdered milk, and salt. The process then continued by flattening the dough, shaping it using molds, and baking it at a temperature of 180 °C for 25 min.

Table 1. Pancoi Biscuit Formulation.

Ingredient	Amount (g)
Red Fruit Paste	60
Sago Flour	250
Purple Sweet Potato	50
Dragon Fruit	50
Raisins	30
Palm Sugar	40
Margarine	50
Milk Powder	26
Salt	2

2.4 Nutritional Content Analysis

The nutritional contents to be tested in the *Pancoi Biscuit* product were energy, protein, fat, vitamin D, and zinc. These nutrients are essential to meet the nutritional needs of pregnant women. Fulfilling the nutritional requirements of pregnant women is important. By obtaining balanced and adequate nutrition, pregnant women can reduce health risks to both the fetus and themselves.

The sources of these nutrients in the production of *Pancoi Biscuit* come from various local foods used as the base ingredients, namely red fruit paste, sago flour, and purple sweet potato, along with the addition of other food ingredients such as dragon fruit and raisins. The nutritional content of each base ingredient is shown in **Table 2**.

Table 2. Nutritional Content of Basic Ingredients for Pancoi Biscuits

Nutritional Content Base Ingredient	Energy	Protein	Fat	Vit. D	Zink
Red Fruit Paste	✓	✓	✓		✓
Sago Flour	✓	✓			✓
Purple Sweet Potato	✓	✓			✓
Dragon Fruit	✓	✓	✓	✓	✓
Raisins	✓	✓	✓	✓	✓

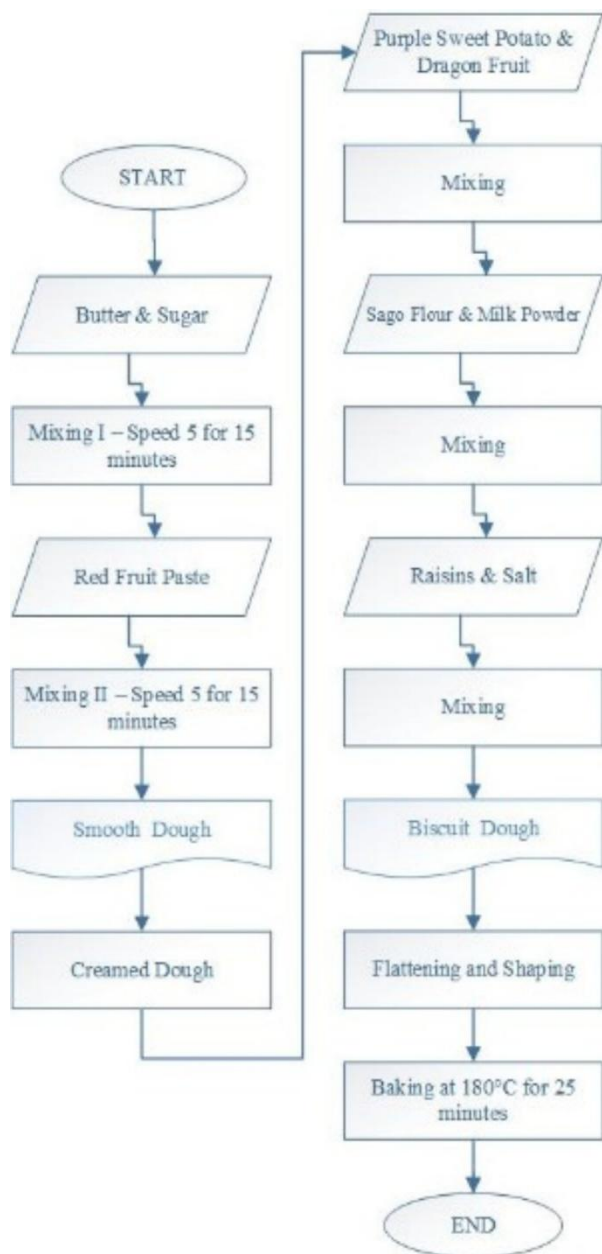


Fig. 1. Flowchart of Pancoi Biscuit Production

2.4.1 Energy

Humans require energy to support their growth, perform physical activities, and maintain lives. During pregnancy, pregnant women require energy for tissue formation and adequate breast milk production.

2.4.2 Protein

Proteins are essential components in all organisms. Proteins function as primary energy sources, building materials, and regulatory agents in the body. During pregnancy, proteins are not only necessary for the health, development, and growth of the fetus but also influence the growth of tissue cells in the body, such as the breasts, uterus, blood, heart, and supporting tissues of the fetus in the womb, including the embryo and placenta. Therefore, protein intake during pregnancy is very important to pay attention to, as it has a positive impact when adequately fulfilled [9].

2.4.3 Fat

Fat is the largest energy source in the body, and serves as an energy reserve. Similarly, during pregnancy, fat functions as an energy reserve for childbirth and as a solvent for vitamins A, D, E, and K as well as fatty acids. Moreover, fat intake in pregnant women affects the health, growth, and development of their children [10].

2.4.4 Vitamin D

In pregnant women, vitamin D plays an important role, especially during embryogenesis, including fetal bone development and calcium homeostasis. Vitamin D deficiency in the body can increase the risk of low birth weight, premature birth, and preeclampsia in pregnant women [11].

2.4.5 Zinc

During pregnancy, the mother's body requires iron to produce hemoglobin, which is a protein in the red blood cells responsible for carrying oxygen to the tissues. Zinc is also essential for child development; a deficiency that begins during pregnancy increases the risk of the child being born with stunted growth [12].

The daily nutritional requirements of pregnant women and children based on the 2019 Recommended Dietary Allowance (RDA) are shown in **Table 3**.

Table 3. Recommended Daily Allowance of Nutrients

Nutritional Content Pregnancy Trimester	Energy (kcal)	Protein (g)	Fat (g)	Vit. D (mcg)	Zinc (mg)
1 st	+180	+1	+2.3	+0	+0
2 nd	+300	+10	+2.3	+0	+9
3 rd	+300	+30	+2.3	+0	+9

2.5 Organoleptic Test

Organoleptic testing, also known as sensory evaluation, is a method that uses human senses as the primary tool to measure product acceptance. An organoleptic test was conducted to determine consumer preferences regarding the following attributes: *Color, Taste, Aroma, Texture and Appearance*. Thirty panelists participated in this study. Each panelist was provided with a product sample. The panelists were asked to complete a form and rate the sample on a 5-point scale. The criteria and rating scales for organoleptic tests are presented in **Table 4**. It should be mentioned here that *Appearance* shares a numerical scale similar to that of *Aroma*.

Table 4. Organoleptic Test Rating Scale

Hedonic Scale Numeric Scale	Color	Taste	Aroma	Texture
5	Very Red	Like Very Much	Like Very Much	Very Crispy
4	Quite Red	Like	Like	Quite Crispy
3	Less Red	Dislike slightly	Moderately Like	Moderately Crispy
2	Not Red	Dislike	Dislike	Not Crispy
1	Very Not Red	Dislike Very Much	Dislike Very Much	Very Not Crispy

3 Results and Discussion

Pancoi is an abbreviation derived from the Latin name of a plant endemic to Papua, *Pandanus conoideus*, also known as the Red Fruit. Pancoi Biscuit is made by utilizing various local foods found in Papua, including red fruit. Pancoi has a reddish color, namely red fruit, which is obtained from natural coloring. The process of making Pancoi is relatively simple, aiming to make it easier for the community to produce Pancoi Biscuit. Moreover, Pancoi is made without preservatives and has a shelf life of approximately 14 days, or in other words, 2 weeks.

3.1 Results of Nutritional Content Analysis

A 30 g serving of Pancoi Biscuit (see **Table 5**) contributes to the additional daily nutritional requirements of pregnant women, as referenced to the recommended dietary allowances across pregnancy trimesters (**Table 3**).

Table 5. Nutritional Content of Pancoi Biscuit.

Nutrient	Nutritional Content of Pancoi Biscuit Per Serving (30g)
Energy	110 kcal
Protein	3 gram
Fat	1 gram
Vitamin D	0.63 mcg
Zinc	0.75 mg

Table 6. Contribution of Pancoi Biscuit (30 g) to Recommended Daily Nutrient Intake by Pregnancy Trimester.

Nutritional Content Pregnancy Trimester	Energy (%)	Protein (%)	Fat (%)	Vit. D (%)	Zinc (%)
1 st	61.1	100	43.48	63	25
2 nd	36.66	30	43.48	63	8.33
3 rd	36.66	10	43.48	63	8.33

Table 6 presents the percentage contribution of a 30 g serving of Pancoi Biscuit to the recommended daily nutrient intake across pregnancy trimesters. In the first trimester, the product contributes 61.1% of energy, 100% of protein, 43.48% of fat, 63% of vitamin D, and 25% of zinc. In the second and third trimesters, the contribution to energy decreased to 36.66%, whereas the protein contribution declined to 30% and 10%, respectively. Fat and vitamin D contributions remained constant across the trimesters, whereas zinc contribution decreased to 8.33% in the second and third trimesters.

The results indicate that Pancoi Biscuit partially contributes to the recommended daily intake of several nutrients during pregnancy, with the magnitude of contribution varying by nutrient type and trimester. Higher contributions were observed for protein in the first trimester as well as for fat and vitamin D across all trimesters. In contrast, the contribution to zinc intake is relatively limited, particularly in the second and third trimesters, suggesting that additional dietary sources are required to meet the zinc requirements during the later stages of pregnancy.

3.2 Organoleptic Test Results

3.2.1 Color

Color is an important attribute because it affects the appearance of a food product and influences the preference level of panelists. An appealing color attracts the panelists to taste the product. The results of the organoleptic tests related to color are shown in **Fig. 2**. Most panelists rated the color of Pancoi Biscuit between 'Less Red' and 'Quite Red,' with 11 and 14 respondents selecting these categories, respectively. These findings indicate a moderate acceptance of the product's color and suggest the potential for further refinement of this attribute.

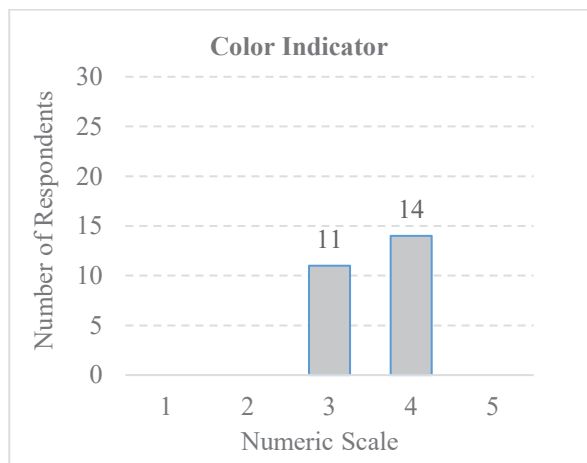


Fig. 2. Result of *Color* Test.

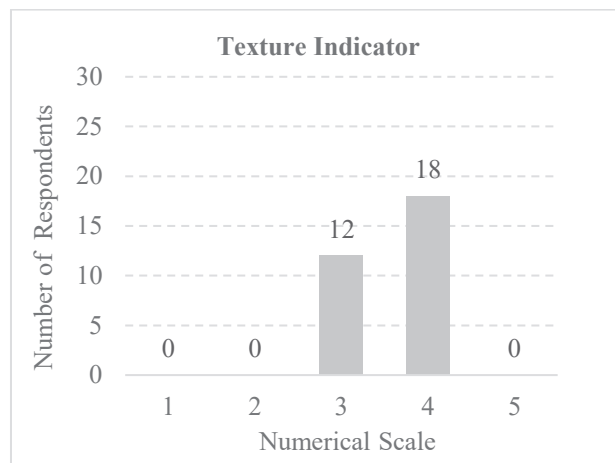


Fig. 4. Result of *Texture* Test.

3.2.2 Aroma

Aroma is a sensory attribute that influences panelists' acceptance of food products. *Aroma* may indicate whether a food product is appealing. The results of the organoleptic tests related to the aroma are shown in **Fig. 3**. The majority of panelists rated the aroma as 'Like Very Much,' with 25 of 30 respondents selecting this category. Only a small proportion of the panelists assigned lower ratings, indicating a high level of consumer acceptance of the product's aroma.

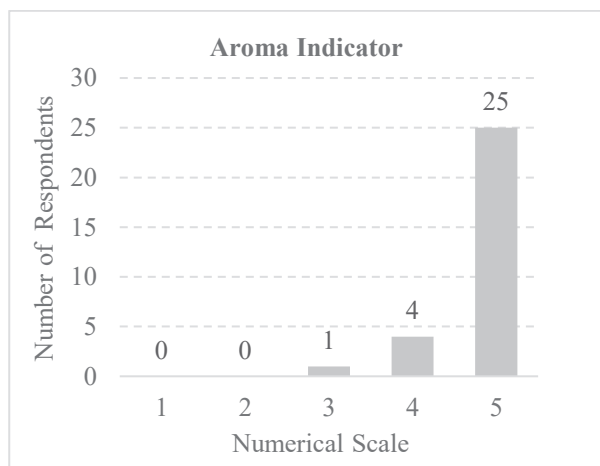


Fig. 3. Result of *Aroma* Test.

3.2.4 Taste

Taste is the result of a combination of food ingredients perceived by a sense of taste. This is the most important factor for determining the final decision regarding product acceptance. The results of the organoleptic tests related to taste are shown in **Fig. 5**. Based on the responses of 30 panelists, the taste of Pancoi Biscuit was highly accepted, with 23 respondents rating it as 'Like Very Much' and the remaining 7 respondents rating it as 'Like.'

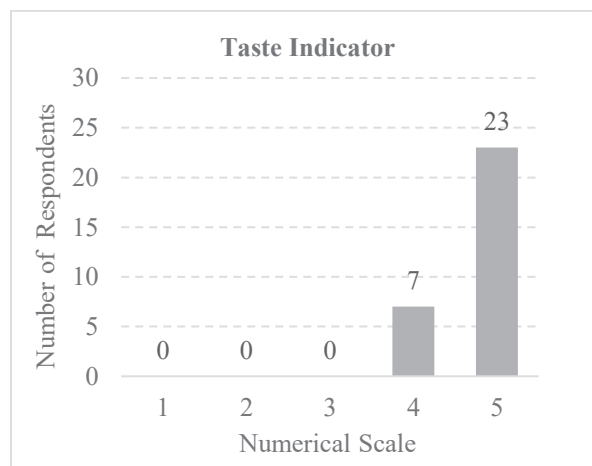


Fig. 5. Result of *Taste* Test.

3.2.3 Texture

Texture is the result of a combination of food ingredients that can be perceived by a sense of touch and taste. The results of the organoleptic tests related to texture are shown in **Fig. 4**. Based on the responses of 30 panelists, the texture of Pancoi Biscuit was predominantly crispy. A total of 18 panelists rated the texture as 'Crispy,' while 12 panelists assessed it as 'Moderately Crispy,' indicating a generally favorable texture acceptance.

3.2.5 Appearance

Appearance refers to the visible physical characteristics of a product that influence consumer perceptions and acceptance. The results of the appearance evaluation are shown in **Fig. 6**. Most panelists rated the appearance of Pancoi Biscuit positively, with 22 respondents selecting 'Like,' while smaller proportions rated it as 'Moderately Like' and 'Like Very Much' (four panelists each). These results indicate a generally favorable visual acceptance of the product.

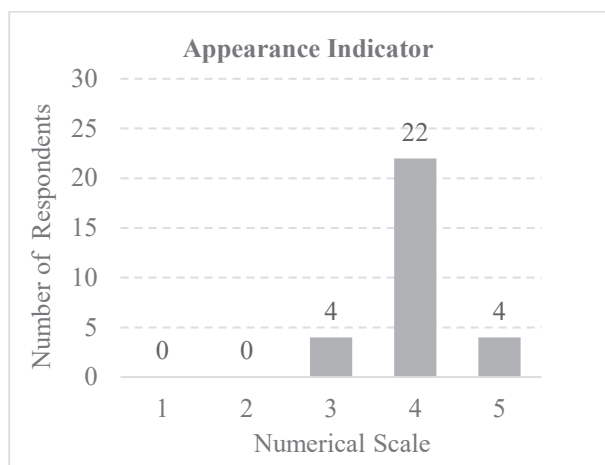


Fig. 6. Result of Appearance Test.

3.3 Level of Satisfaction

Based on the consumer satisfaction questionnaire for Pancoi Biscuit distributed, the percentage of satisfaction in choosing each attribute was calculated to obtain their Index Value. The calculation provides the sensory satisfaction results for the product. A summary is presented in **Table 7**.

Table 7. Consumer Satisfaction Result of Pancoi Biscuit

Criteria	% Satisfaction in Choosing					Index Value
	1	2	3	4	5	
<i>Color</i>	0	0	36.67	63.33	0	72.67
<i>Aroma</i>	0	0	3.33	13.33	83.33	96.00
<i>Texture</i>	0	0	40.00	60.00	0	72.00
<i>Taste</i>	0	0	0.00	23.33	76.67	95.33
<i>Appearance</i>	0	0	13.33	73.33	13.33	80.00
Average Index Value						83.20

Based on the sensory evaluation results displayed in **Table 7**, *Aroma* and *Taste* were the preferred attributes of Pancoi Biscuit, with satisfaction indices of 96.00% and 95.33%, respectively. *Appearance* also demonstrated a high level of acceptance (80.00%), indicating a favorable visual perception of the product. In contrast, *Color* and *Texture* exhibited comparatively lower but similar satisfaction levels (72.67% and 72.00%, respectively), suggesting that these attributes contributed less strongly to overall consumer acceptance.

Table 8. Criteria Scale of CSI (Customer Satisfaction Index)

No	CSI Score	CSI Criteria
1	>0.81	Very Satisfied
2	0.66 – 0.80	Satisfied
3	0.51 – 0.65	Satisfied Enough
4	0.35 – 0.50	Less Satisfied
5	0.00 – 0.34	Not Satisfied

With an average customer satisfaction index (CSI) value of 83.20%, Pancoi biscuit falls within the ‘Very Satisfied’ category based on the criteria reported in [14] (see **Table 8**). These findings indicate favorable consumer acceptance, suggesting that Pancoi biscuit has the potential for community-level production and further development as a complementary food product. Furthermore, Pancoi biscuit may be explored as a complementary food option in nutrition-related intervention programs, including those aimed at preventing stunting.

4 Conclusion

This study indicates that a 30 g serving of Pancoi biscuit partially contributes to the recommended daily intake of several nutrients for pregnant women, with variations observed across pregnancy trimesters and nutrient types. Sensory evaluation results further demonstrated favorable consumer acceptance of the product, with an overall customer satisfaction index (CSI) value of 83.20%, classifying Pancoi biscuit within the ‘Very Satisfied’ category. These findings suggest that Pancoi biscuit has the potential for further development and community-level production as a complementary food product in nutrition-related intervention programs, including those targeting stunting prevention.

Future studies should consider applying fuzzy-based methods to improve the interpretation of organoleptic data involving subjective assessments. Our previous work using fuzzy time series to forecast annual tourist arrivals [15] indicated that fuzzy approaches are effective for handling uncertainty, which may also benefit sensory evaluation research.

We would like to acknowledge the financial support provided by the Universitas Papua (Himmasta, Himbio, Dept. of Math and Stats, and the university). This funding has enabled the realization of this project and has alleviated the financial constraints associated with conducting research.

The data supporting the findings of this study are currently stored by the authors and will be made available upon reasonable request.

Conceptualization: MKD, JS; Methodology: NN; Data Collection: MKD, DR; Formal Analysis: MKD, NN; Writing—Original Draft Preparation: MKD; Writing—Review and Editing: All Authors; Supervision: NN. All authors have read and agreed to the published version of the manuscript.

References

1. A. Asri, Y. Sorachmmad, R. Reski, & M. S. Ashari, Analisis determinan kejadian stunting pada balita di wilayah kerja puskesmas Kecamatan Campalagian Kabupaten Polewali Mandar. *J. Kesehat. Masy.*, **8**, 170 (2023). <https://journal.lppm-unasman.ac.id/index.php/jikm/article/view/3213>.
2. Y. A. Manita, P. N. Akbar, M. F. Rahman, P. I. Rosanti, & C. D. Rahayu, Optimalisasi Kader Dashat (Dapur Sehat Stunting) untuk Pengendalian Stunting. *J. Peduli Masy.*, **3**, 419 (2022).
3. S. N. Tarmizi, Prevalensi Stunting di Indonesia Turun ke 21,6% dari 24,4%. Kemenkes, (2023). <https://kemkes.go.id/id/prevalensi-stunting-di-indonesia-turun-ke-216-dari-244>.
4. S. Notoatmodjo, Kesehatan Masyarakat Ilmu & Seni (Rineka Cipta, Jakarta, 2007).
5. Jess, Hasil Intervensi Berjenjang 13,51 Persen, Papua Barat Role Model Penanganan Stunting (Manokwari, 2023).
6. R. A. Putri, S. Sulastri, & N. C. Apsari, Pemanfaatan Potensi Lokal dalam Upaya Pencegahan Stunting. *J. Demos*, **5**, (2023). <https://doi.org/2721-0642>.
7. BSN (Badan Standarisasi Nasional), SNI 01-2973-1992 Mutu dan Cara Uji Biskuit (Jakarta, 1992).
8. N. Isnaini, A. Mariza, & M. A. Putri, Pentingnya Gizi Pada Ibu Hamil Sebagai Upaya Pencegahan Stuning Diperiode 1000 HPK. *J. Perak Malahayati*, **4**, 87 (2012).
9. R. Stephenson, H. You, D. P. McManus, & I. Toth, Schistosome Vaccine Adjuvants in Preclinical and Clinical Research. *Vaccines*, **2**, 654 (2014). <https://doi.org/10.3390/vaccines2030654>.
10. S. Sausenthaler, S. Koletzko, B. Schaaf, I. Lehmann, M. Borte, O. Herbarth, H.-E. Wichmann, A. von Berg, & J. Heinrich, Maternal Diet during Pregnancy in Relation to Eczema and Allergic Sensitization in the Offspring at 2 y of Age. *Am. J. Clin. Nutr.*, **85**, 530 (2007). <https://doi.org/10.1093/ajcn/85.2.530>.
11. Kemenkes RI, Gizi Seimbang Ibu Hamil (Kementerian Kesehatan RI, 2022).
12. R. A. Damayanti, L. Muniroh, & Farapti., Perbedaan Tingkat Kecukupan Zat Gizi dan Riwayat Pemberian ASI Eksklusif pada Balita Stunting dan Non Stunting. *Media Gizi Indones.*, **11**, 61 (2016). <https://doi.org/10.20473/mgi.v11i1.61-69>.
13. Y. Amir, S. Sirajuddin, & A. Syam, Daya Terima Susu Bekatul Sebagai Pangan Fungsional. *Hasanuddin J. Public Health*, **1**, 16 (2018). <https://journal-old.unhas.ac.id/index.php/hjph/article/view/9509>.
14. G. A. S. Rustamaji, & R. Ismawati, Daya Terima Kandungan Gizi Daun Kelor Sebagai Alternatif Makanan Selingan Balita Stunting. *J. Gizi Unesa*, **01**, 31 (2021). <https://ejournal.unesa.ac.id/index.php/GIZIUNESA/article/view/41287>.
15. Nurhaida, Subanar, Abdurakhman, & A. M. Abadi, Fuzzy Estimations for Detecting Abrupt Changes : Cases on Tourism Series. *Math. Stat.*, **8**, 747 (2020). <https://doi.org/10.13189/ms.2020.080616>.