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Organoleptic Test and Hedonic Test on Biscuits Made from Sweet Potato Leaves and Tilapia Fish

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Abstract: Biscuits can be a beneficial snack for who are experiencing nutritional deficiencies. Based on previous research, there has been no research on herbal biscuits, namely biscuits made from a mixture of sweet potato leaves and tilapia fish called JAMU herbal biscuits. This study aims to determine the level of consumer acceptance of JAMU herbal biscuits. The research employed a quantitative experiment, focusing on pregnant women from North Tapanuli Regency, North Sumatra, Indonesia, who served as the study's population. The sample (panelists) comprised 35 pregnant women selected through purposive sampling. We conducted the test on 35 panelists who served as organoleptic and hedonic tester examiners. The statistical analysis method we used was an analysis of variance with a difference test (post hoc test). According to the study's findings, formula A3 had the highest level of acceptance for the organoleptic test of herbal biscuits based on taste parameters, with an average of 4.69. The results of the hedonic test showed that overall panelists preferred Formula A3 JAMU herbal biscuits. According to consumers' organoleptic and hedonic tests, Formula A3 JAMU herbal biscuits had the highest level of acceptance for herbal biscuits. We hope that consumers will accept this product as a healthy option.

Keywords: Herbal biscuits; Organoleptic test; Sweet potato leaves; Tilapia fish

Introduction

Anemia is a significant global health concern, with a prevalence of up to 75% in developing countries and only 15% in industrialized nations (Mehra & Rani, 2020; Choudhary et al., 2020). The condition is predominantly associated with nutritional deficiencies, specifically iron, folic acid, and vitamin B12, and is further exacerbated by a lack of awareness and insufficient dietary intake (Hamid et al., 2022; Lakshmi & Rani, 2023). According to a study, the prevalence of anemia among pregnant women was 74.6%, with the maximum rate (80.3%) occurring in the third trimester. Maternal morbidity, preterm delivery, and low birth weight are all significant hazards associated with anemia during pregnancy (Ashfya et al., 2023). To mitigate these risks and enhance both maternal and fetal outcomes, it is essential to implement effective management strategies, including early screening and iron supplementation (Kanu et al., 2022). In general, a multifaceted approach, which includes public health education and nutritional interventions, is necessary to address anemia in pregnancy.

Nutritional interventions during pregnancy significantly influence fetal development through various mechanisms, including maternal health, placental function, and long-term health outcomes for the offspring. Research suggests that maternal nutritional status has a direct impact on the placental phenotype, which in turn affects nutrient transport and metabolism. Ultimately, this benefits fetal growth and reduces the risk of complications such as low birth

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weight and stillbirths (Bonnell et al., 2024; Lassi et al., 2022). Research has reduced the incidence of macrosomia in gestational diabetes cases and demonstrated the enhancement of maternal and neonatal outcomes through specific interventions, such as micronutrient supplementation (Tan et al., 2023). Also, the fact that a mother's nutrition can cause epigenetic changes that make her children more likely to get chronic diseases later in life shows how important it is to get the right nutrition during important developmental windows (Arslan & Yıldıran, 2021; Campoy et al., 2021). However, the long-term effects and the need for a personalized approach still require further research, although many studies have shown the benefits of nutritional interventions (Curioni et al., 2022; Cetin et al., 2022). In general, pregnant women should implement nutritional strategies designed to improve fetal health and prevent future health problems. Pregnant women should consume foods rich in iron, folic acid, vitamin B, nuts, vegetables, and biscuits as healthy snacks.

Biscuits can be a beneficial snack for expectant women, particularly those who are experiencing nutritional deficiencies. Research suggests that biscuit supplementary feeding can substantially improve the nutritional status of pregnant women with chronic energy deficiency, enhancing their knowledge and attitudes toward healthy eating behaviors (Riandha Feliza et al., 2023). More specifically, research has shown that modified biscuits with peanuts, moringa leaves, and pumpkin increase hemoglobin levels and mid-upper arm circumference (MUAC), which lowers the risk of anemia in pregnant women (Sudaryati et al., 2023; Nur et al., 2022). Additionally, pumpkin seed biscuits have been associated with enhanced nutritional status, such as elevated serum zinc levels and weight gain, both of which are essential for embryonic development (Syakur et al., 2022). Nevertheless, certain studies have identified obstacles, including a lack of social support and an insufficient comprehension of consumption guidelines, which may impede the efficacy of these interventions (Rahmiati, 2023). Overall, if pregnant women strengthen their education and support systems, strategic integration of nutrient-rich biscuits into their diets can improve maternal and fetal health.

Previous researchers who have studied nutrient-rich biscuits as healthy snacks to improve maternal and fetal health include Musaidah et al. (2022) who found that when fortified with nutrient-rich ingredients, cookies can provide substantial nutritional advantages for expectant women. Consuming biscuits made with pumpkin, moringa leaves, and peanuts can reduce the prevalence of anemia among expectant women by 60%, while also increasing hemoglobin levels and maternal upper arm circumference. Furthermore, studies have demonstrated that pumpkin seed biscuits enhance the nutritional status and serum zinc levels, essential for maternal health and embryonic development (Syakur et al., 2022). Additionally, supplementary feeding biscuits have been associated with an elevated body mass index (BMI) and enhanced interpretation of fetal weight in women with chronic energy deficiency (Sri. et al., 2022). Specifically designed for early pregnancy, all-purpose nutrient biscuits are advantageous due to their abundance of essential fatty acids like DHA, vitamins, and proteins. These nutrients are essential for the development of the fetal brain and the enhancement of expectant women's overall nutritional status (Ayensu et al., 2019). These results collectively emphasize the potential of specially formulated biscuits to address common nutritional deficiencies during pregnancy, thereby promoting improved health outcomes for both mothers and their infants.

Specific types of biscuits, particularly those fortified with nutritious ingredients, may benefit expectant women, according to research. For example, the positive effects of biscuits made from pumpkin, moringa leaves, and peanuts on maternal nutritional status and hemoglobin levels have substantially reduced the prevalence of anemia among pregnant women (Sudaryati et al., 2023). Furthermore, researchers have created biscuits composed of purple sweet potato, skim milk powder, and nutmeg to alleviate tension, supply essential nutrients, and satisfy a portion of pregnant women's energy requirements (Sudaryati et al., 2023). Pregnant women can also improve their nutrition and help their baby's development by adding milk powder to all-purpose nutrient biscuits, which contain essential fatty acids. DHFortified biscuits with palm weevil larvae and orange-fleshed sweet potatoes also show high acceptability and nutritional benefits, especially in terms of protein and micronutrient content (Ayensu et al., 2019). Finally, studies have shown that pumpkin seed biscuits enhance the mid-upper arm circumference and zinc levels in pregnant women, potentially leading to weight gain (Syakur et al., 2022). These results suggest that customized biscuits with specific ingredients can provide expectant women with the necessary nutrients. Based on previous research, it seems that there has been no research examining herbal biscuits made from a combination of sweet potato leaves and tilapia fish or what we call JAMU (Jalar-Mujair) herbal biscuits. The community, particularly in North Tapanuli Regency, North Sumatra, Indonesia, does not widely use sweet potato leaves. Despite the presence of antioxidants, riboflavin, niacin, vitamins A, B, C, E, K, thiamine, calcium, iron, beta-carotene, folic acid, and protein in sweet potato leaves, livestock typically consume them as

food. In addition, tilapia fish is cheap, simple to get, and contains high nutrition. 100 grams of tilapia fish consists of 84 grams of calories, 18.2 grams of protein, 0.7 grams of fat, 44 mg of cholesterol, and 0.4 mg of iron. This study aims to determine the results of organoleptic tests and consumer acceptance of the herbal biscuits produced.

Method

Type of Research

This study employs a quantitative research method, using a scientific approach to conduct experiments with intervention groups.

Place and Time of Research

We conducted the research in the Hutabaginda Health Center area, Siatas Barita, Sarulla Health Center, Sitada-Tada Health Center, Paniaran Health Center, Siborong-borong Health Center, North Tapanuli Regency, North Sumatra, Indonesia, in March 2024.

Population and Sample

This study focused on the population and sample of pregnant women in North Tapanuli Regency, North Sumatra, Indonesia. The study's sample, or panelists, consisted of 35 pregnant women who attended the pregnancy class and met the inclusion criteria: (a) Pregnancy in the third trimester; (b) Do not use drugs at the moment; (c) Willing to be respondents (panelists).

Ingredients for Making Herbal Biscuits

Table 1. Composition of Ingredients for Making JAMU Herbal Biscuit Formula for Each Treatment

Ingredients	Herbal biscuit formula		
	A1	A2	A3
Sweet potato leaves	50 gr	60 gr	80 gr
Tilapia fish	50 gr	80 gr	130 gr
Wheat flour	150 gr	150 gr	150 gr
Milk	25 gr	25 gr	25 gr
Butter	150 gr	150 gr	150 gr
Eggs	2	2	2
Sugar	200 gr	200 gr	

Herbal biscuits are a healthy snack for pregnant women because they contain various nutrients needed by the body during pregnancy, such as protein, calcium, iron, folic acid, and various types of vitamins that are important for pregnant women. To make JAMU herbal biscuits, combine sweet potato leaves and tilapia fish. The composition of the ingredients for making herbal biscuit formulas consists of sweet potato leaves, tilapia fish, wheat flour, milk, butter, eggs, and sugar (Table 1).

Procedure for Making JAMU Herbal Biscuits

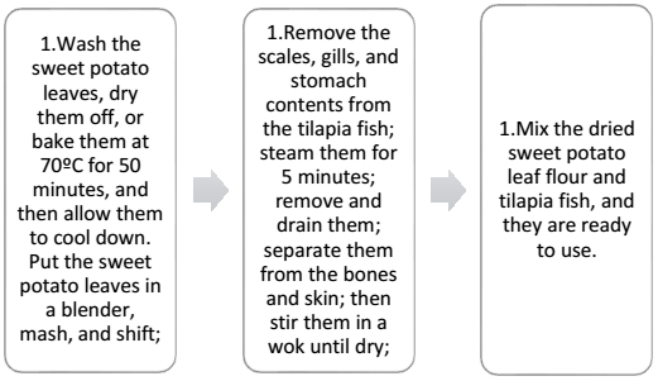

Figure 1. Scheme for making JAMU herbal biscuit flour dough

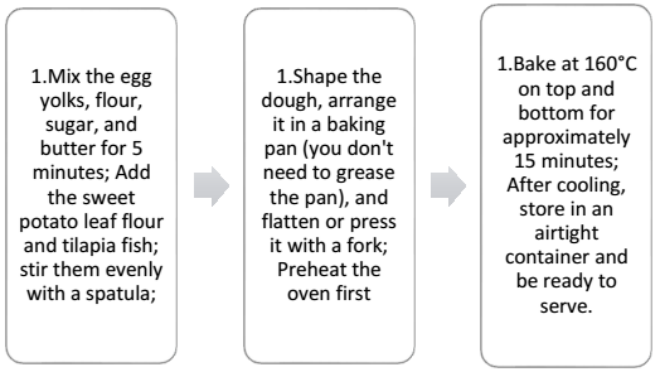

Figure 2. Scheme for making JAMU herbal biscuits

Data Collection

Panelists filled out the organoleptic test instrument, covering aroma, color, taste, and texture. We asked respondents to rate their preferences for the aroma, color, taste, and texture of herbal biscuit products. The organoleptic instrument used a 5-level Likert scale. We assessed the panelists' answers based on the interpretation interval (Table 2).

Table 2. Organoleptic Test Assessment Interval Scale for JAMU Herbal Biscuits

Aroma	Color	Flavor	Texture	Interpretation Interval
Very unpleasant	Very unappetizing	Not very tasty	Not very crispy	0.0–1.0
Not pleasant	Not appetizing	Not tasty	Not crispy	1.1–2.0
Somewhat unpleasant	Somewhat appetizing	Slightly tasty	Slightly crispy	2.1–3.0
Good	Appetizing	Savory	Crispy	3.1–4.0
Very good	Very appetizing	Very tasty	Very crispy	4.1–5.0

The hedonic test instrument uses a Likert scale with 5 levels, namely from very like to very dislike. To calculate the average (mean) assessment for the hedonic test, we provide the following interpretation intervals: (a) 0.0-11.0 indicates very dislike; (b) 1.1-22.0 is classified as dislike; (c) 2.1–3.0 is classified as neutral; (d) 3.1-44.0 is classified as like; and (e) 4.1-55.0 is classified as very like.

Data Analysis and Processing

We conducted organoleptic and hedonic tests in this study. Organoleptic tests can be defined as tests conducted based on sensory assessments or sensory assessments. Organoleptic tests include the aroma, color, taste, and texture of herbal biscuits. Hedonic tests measure a product's level of liking, facilitating acceptance. We refer to this liking level as a hedonic scale, which comprises five categories: like, really like, neutral, dislike, and very dislike. The higher the average value of a parameter, the better it is; the lowest value indicates the worst value, while the highest value indicates the best value, and vice versa. We used Analysis of Variance (ANOVA) to analyze the obtained data; if the test results indicate a significant difference between the samples, we proceeded with the Least Significant Difference (LSD) test.

Result and Discussion

We conducted organoleptic and hedonic tests on the herbal biscuit products. The following results illustrate the outcomes of both tests:

Organoleptic Test Results

We conducted the organoleptic test of herbal biscuits by tasting and consuming a small sample, ensuring the panelists were neither full nor hungry. After tasting the product, they neutralized their five taste buds by consuming a small amount of mineral water, and so on.

a) Aroma

Assess the aroma of a food product by smelling the odor it produces and the smell of food determines its aroma. Table 3 displays the organoleptic test results for the aroma of JAMU herbal biscuits. Based on the Aroma of JAMU Herbal Biscuits (Table 3), the panelists' assessment revealed that 12 people, or 34.3%, rated the A3 JAMU herbal biscuit formula as very tasty. In the tasty category, there were 15 panelists with a percentage of 42.8% on the A1 herbal biscuit formula. The panelists gave the highest score of 34.3% in the very tasty category on the A3 JAMU herbal biscuit formula because the addition of sweet potato leaves and tilapia fish as the basic ingredients was not too pungent. However, the average value obtained was not significantly different ($p<0.05$).

Table 3. Panelist Assessment based on the Aroma of JAMU Herbal Biscuits

Criteria	A1		A2		A3		p
	n	%	n	%	n	%	
Very unpleasant	0.0	0.0	1.0	2.8	1.0	2.8	0.132
Not pleasant	5.0	14.3	4.0	11.5	3.0	8.6	
Somewhat unpleasant	10	28.6	8.0	22.8	6.0	17.2	
Good	15	42.8	12	34.3	13	37.1	
Very good	5.0	14.3	10	28.6	12	34.3	
Average	4.03		3.97		4.23		

b) Color

Panelists looked directly at the color of the A3 JAMU herbal biscuit formula. Panelists judged the quality of food ingredients based on the color of the food, which shaped their perception. The green color of the A3 JAMU herbal biscuit formula originated from the green color of sweet potato leaves. Based on the results of the questionnaire, the following table displays the panelists' acceptance level of the herbal biscuits' color (Table 4).

Table 4. Panelist Assessment Based on the Color of JAMU Herbal Biscuits

Criteria	A1		A2		A3		p
	n	%	n	%	n	%	
Very unappetizing	1.0	2.80	0.0	0.0	1.0	2.80	
Not appetizing	8.0	22.8	5.0	14.2	0.0	0.0	0.219
Somewhat appetizing	14	40.0	17.0	48.6	9.0	25.7	
Appetizing	10	28.5	7.0	20.0	18.0	51.4	
Very appetizing	2.0	5.71	6.0	17.1	7.0	20.0	
Average	4.03		3.97		4.23		

The organoleptic tests on the color of JAMU herbal biscuits (Table 3) show that formula A3, with 18 participants or 51.4%, has the highest level of acceptance, while formula A1, with 8 participants or 22.8%, has the lowest level of acceptance. This is because A3's color criteria are more concentrated than those of other treatments. However, the average value obtained for the color element is not significantly different ($p>0.05$). This is likely because it comes from one product with basic ingredients that are not too different.

c) Flavor

The flavor organoleptic test is a sensory evaluation technique that evaluates the acceptability and quality of

food products. Panelist assessment based on the taste of herbal biscuits herbal biscuits are shown in the Table 5. According to the questionnaire results from 35 panelists, Formula A3, the JAMU herbal biscuit treatment, received the highest level of acceptance based on taste, with 21 respondents or 60.0%. The lowest acceptance (non-savory category) was in Formula A1, with 6 people, or 17.2%. Formula A3 achieved the highest average value (4.68) in the organoleptic test, which measured the taste elements in herbal biscuits. The substitution treatment of herbal biscuits affects the resulting taste. This is because the taste produced from herbal biscuits A1, A2, and A3 with the addition of sweet potato leaf flour and tilapia fish has a significantly different taste ($\rho>0.05$). The taste produced in A3 is perceived as more savory.

Table 5. Panelist Assessment based on the Taste of JAMU Herbal Biscuits

Criteria	A1		A2		A3		p
	n	%	n	%	n	%	
Not very tasty	1	2.80	0	0	1.0	2.80	0.002
Not tasty	6	17.2	4.0	11.4	0.0	0.0	
Slightly tasty	11	31.4	10.0	28.6	5.0	14.3	
Savory	14	40.0	14.0	40.0	21.0	60.0	
Very tasty	3	8.60	7.0	20.0	8	22.8	
Average		3.48	3.54		4.68		

d) Texture

The organoleptic texture test is a sensory evaluation procedure that assesses the texture of food products based on human perception. This approach typically entails the evaluation of a variety of attributes, including texture, flavor, aroma, and overall acceptability, by trained or semi-trained panelists. Five criteria categorize the crispiness of herbal biscuits observed through touch. The following Table 6 displays the results of the panelists' organoleptic texture test on JAMU herbal biscuits.

Table 6. Panelist Assessment based on the Texture of JAMU Herbal Biscuits

Criteria	A1		A2		A3		p
	n	%	n	%	n	%	
Not very crispy	1.0	2.8	0.0	0.0	0.0	0.0	
Not crispy	11.0	31.5	5.0	14.3	2.0	5.7	0.301
Slightly crispy	12.0	34.2	11.0	31,4	7.0	20.0	
Crispy	11.0	31.5	16.0	45.7	17.0	48.6	
Very crispy	0.0	0.0	3.0	8.6	9.0	25.7	
Average	4.22		3.88		4.42		

According to the results of the questionnaire from 35 panelists, as many as 17 people, or 48.6 percent, chose the crunchy texture of the Formula A3 product, whereas, for the very non-crunchy category, 1 person (2.8%) chose the A1 formula. The results of the organoleptic test on the texture of herbal biscuits showed that the panelists preferred the texture of formula A3, with an average of 4.42. You can feel the sensory value of the product texture as a testing parameter during the eating process. However, there was no significant difference in the texture elements of herbal biscuits with formulas A1, A2, and A4 ($p > 0.05$) because they used the same raw materials.

Hedonic Test Result

The hedonic test is generally used to evaluate the sensory attributes and overall acceptance of biscuits formulated with sweet potato leaves and tilapia fish. According to the results of the analysis of variance (ANOVA), the consumer acceptance of 35 panelists revealed that the aroma, color, flavor, and texture of formula A3 had the highest average compared to formulas A1 and A2 (Table 7).

Table 7. Univariate Analysis of Variance

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	24.217a	15	1.614	3.138	.000
Intercept	21.093	1	21.093	41.003	.000
Aroma	3.741	4	.935	1.818	.132
Color	3.017	4	.754	1.466	.219
Flavor	9.575	4	2.394	4.653	.002
Texture	1.908	3	.636	1.237	.301
Error	45.783	89	.514		
Total	490.000	105			
Corrected Total	70.000	104			
a. R Squared = .346 (Adjusted R Squared = .236)					

Based on the univariate Anova test, it was found that the taste of herbal biscuits in formulas A1, A2, and A3 had a significant difference ($p<0.005$), so a difference test (post hoc tests) was carried out. The post hoc test using Duncan on the taste of the A3 formula herbal biscuit sample revealed a highly significant difference in the taste parameters between the three tested samples (Table 8).

The post hoc test results revealed that the panelists preferred the taste of herbal biscuits with formula A3, scoring 4.69 (very like category) compared to formulas A1 and A2. In terms of overall acceptance, the panelists preferred herbal biscuits with formula A3, and statistically, the panelists' assessments differed significantly in the taste of herbal biscuits (Figure 3). Figure 3 reveals that the A3 herbal biscuit formula significantly influences the average taste. The A1 herbal biscuit formula has the least influence on taste. Taste and aroma are closely related; both are components of taste. If one enjoys the aroma, they are likely to enjoy the taste as well.

Table 8. Test of Differences in Preference Levels of Formula A1, A2, and A3 JAMU Herbal Biscuits based on Taste

Duncan[b]			
			Subset
Formula		1	2
A1	35	3.49[a]	
A2	35	3.54[a]	
A3	35		4.69[b]
Sig.		.793	1.000

Description: Results based on Duncan's test using SPSS

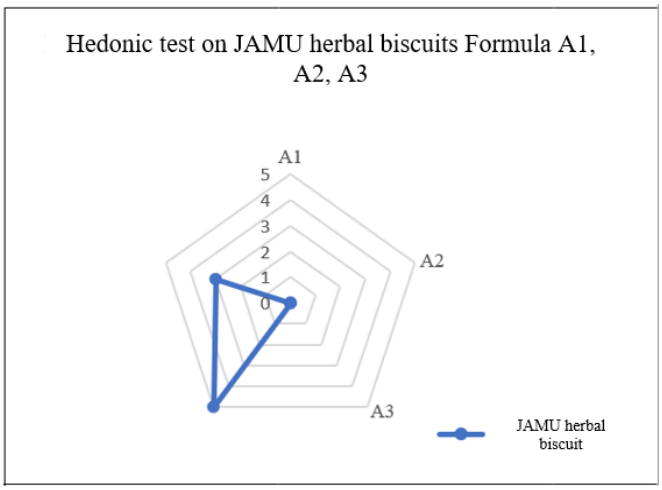

Figure 3. Panelist hedonic level on herbal biscuits

Discussion

Formulate healthy snack biscuits for pregnant women using various nutrient-rich ingredients to overcome common nutritional deficiencies. We can formulate healthy snack biscuits for pregnant women that not only meet their nutritional needs but also taste delicious. Research shows that biscuits enriched with certain ingredients can provide significant benefits for pregnant women. For instance, you can make herbal biscuits using a combination of sweet potato leaves and tilapia fish. We have successfully conducted organoleptic and hedonic tests on herbal biscuits.

Organoleptic Test

Organoleptic tests assess the sensory quality of herbal biscuit products, such as aroma, color, taste, and texture, to ensure panelist preferences.

a) Aroma

The organoleptic aroma test results indicate that the A3 JAMU herbal biscuit formula, with a value of 34.3%, falls into the category of very good aroma (Table 3). Assess the aroma of the A3 JAMU herbal biscuit formula by smelling the produced odor. Various studies have investigated the organoleptic aroma test of herbal biscuits, emphasizing the influence of various herbal constituents on sensory attributes. For instance, biscuits fortified with Moringa leaf powder demonstrated favorable organoleptic profiles. The formulations that contained 2.5 g of Moringa exhibited the highest aroma scores, suggesting a strong level of acceptability among the panelists (Lestari et al., 2024). In the same vein, biscuits that included Tulshi and Moringa leaves exhibited enhanced sensory characteristics, with the 1% addition of these botanicals being particularly well-received (Alam et al., 2014). Another study positively evaluated the aroma of biscuits enriched with organic apple and basil granules, suggesting that the incorporation of herbal ingredients can enhance consumer acceptance (Dragomir et al., 2020). Research on Moringa flower and leaf powder biscuits revealed that specific formulations significantly influenced sensory attributes like aroma. Taste testers favored particular ratios (Kc et al., 2022).

Adding butter and milk to the A3 biscuit formula can enhance the aroma. Recent research findings indicate that we can implement several methods to improve the organoleptic aroma of herbal biscuits. One effective method is to incorporate specific flavor compositions that include aliphatic amino acids, organic acids, sugars, and minerals. This can substantially enhance the overall sensory properties of the biscuits (Starowicz et al., 2020). Furthermore, the use of ghee in place of white butter has been shown to improve biscuits' sensory acceptance and flavor, as ghee biscuits received higher scores in sensory evaluations than those made with white butter (Nagib et al., 2023). An additional approach involves applying edible oils and flavoring compounds to the surface of herbs, which can further improve their aromatic properties (Starowicz et al., 2020). Furthermore, the use of extracts from herbal ingredients, such as Moringa or Ashwagandha, can contribute to the improvement of the final product's flavor and aroma profiles (Král et al., 2021a). Collectively, these strategies suggest that the meticulous selection and integration of ingredients can substantially improve the organoleptic properties of herbal wafers.

b) Color

The organoleptic tests on the color of herbal biscuits (Table 3) show that the A3 JAMU herbal biscuit formula, with 18 participants or 51.4%, has the highest level of acceptance. Color plays a crucial role in the acceptability of herbal biscuits, with variations in formulation impacting consumer perception and preference. The panelists directly perceive color as the first sensory element. The panelists generally assess the quality of food ingredients based on the color of the food. The herbal biscuit's green color is a result of the sweet potato leaves' inherent green hue. Organoleptic experiments on the color of herbal biscuits revealed significant insights into panelist preferences and product quality. Sweet potato leaves contribute to the green color of herbal biscuits. The high content of chlorophyll, anthocyanins, carotenoids (lutein and β-carotene), and dietary fiber in sweet potatoes has high stability compared to anthocyanins from other sources, making this plant a healthier food choice (Chirwa-Moonga et al., 2020). The organoleptic evaluation of ginger cookies revealed a crispy texture, a typical ginger aroma, and a brownish color, even though the overall acceptability did not satisfy the desired standards (Murwati, 2022). Another investigation concentrated on fiber-enriched herbal biscuits that consisted of Tulshi and Moringa leaves. The biscuits achieved an overall acceptability score of 4.46 out of 5, which suggests that consumers responded favorably to their color and appearance (Alam et al., 2014). Furthermore, research on shortbread cookies containing herbal extracts revealed that the concentration of the herbal extracts impacted color parameters. Specifically, there was a decrease in brightness and an increase in yellow tints, which had a positive impact on sensory properties (Kozlowska et al., 2019).

Various studies have demonstrated that the color of herbal biscuits has a substantial impact on panelist perception. Panelists found the A3 JAMU herbal biscuit formula to have the highest level of acceptance due to its more concentrated color compared to the A1 and A2 herbal biscuit formulas. Research indicates that the addition of herbs alters the color profile of biscuits, thereby influencing consumer attractiveness and sensory properties. For example, the addition of spices such as cloves led to significant color changes, which helped to differentiate fortified samples from control ones and improved the overall acceptability of the product at specific concentrations (Král et al., 2021). In the same vein, the incorporation of herbal extracts into cookies resulted in a decrease in brightness and modifications to color coordinates, which were associated with sensory attributes such as fragrance and taste (Kozlowska et al., 2019). In addition, the psychology of visual-taste synesthesia posits that the color of packaging can influence consumer expectations and flavor judgments, underscoring the significance of visual elements in product design (Liu & Zhou, 2021). In conclusion, these findings emphasize that color is not only a significant factor in the establishment of consumer preferences and perceptions but also impacts the aesthetic allure of herbal biscuits (Kumar et al., 2024; Wirawan & Yan, 2021).

c) Flavor

Panelist assessment based on the flavor of JAMU herbal biscuits found that the A3 formula had the highest level of acceptance based on taste, with 21 respondents, or 60.0% (Table 5). Panelists felt the A3 JAMU herbal biscuit formula was sweet; the sweet taste comes from the sugar and milk added to the herbal biscuit formula. The incorporation of a variety of herbal constituents influences a wide variety of sensory attributes in the flavor of herbal biscuits, as evidenced by organoleptic tests. For example, biscuits prepared with Ashwagandha and Ragi exhibited a favorable taste and overall acceptability, particularly when ghee was substituted for white butter, thereby enhancing the flavor and nutritional benefits (Baghel et al., 2020). Similarly, biscuits fortified with Moringa leaf powder received exceptional ratings for taste, aroma, and texture. The optimal formulation, which contained 2.5 g of Moringa, demonstrated the highest overall acceptability (Lestari et al., 2024). An additional study Alam et al. (2014) significantly enhanced the sensory characteristics by including Tulshi and Moringa leaves at 1%. Additionally, researchers conducted a sensory evaluation of Moringa flower and leaf granules in biscuits, resulting in high ratings for certain formulations' overall attributes (Kc et al., 2022). Collectively, these results suggest that the meticulous selection and proportionate use of herbal ingredients can substantially improve the flavor profile and consumer acceptability of herbal biscuits (Dragomir et al., 2020).

The ingredients in making the A3 JAMU herbal biscuit formula can improve the taste because it consists of balanced components, namely sweet potato leaves, tilapia fish, wheat flour, milk, butter, eggs, and sugar. Numerous studies have demonstrated the substantial influence of various herbal constituents on biscuit flavor. Not only does the inclusion of botanicals like mint, cinnamon, and cloves increase the antioxidant capacity of biscuits, but it also modifies their sensory properties, including texture and flavor. For instance, consumers found biscuits fortified with 10% cloves to have a marked increase in antioxidant capacity and a unique flavor profile, making them more appealing (Král et al., 2021). In the same vein, the addition of lemon balm and

nettle extracts to shortbread cookies resulted in enhanced aroma and flavor, with higher concentrations resulting in superior sensory scores (Kozlowska et al., 2019). Additionally, the use of Ashwagandha and Ragi flour in herbal biscuits demonstrated that specific ingredient combinations can enhance flavor and overall acceptability, especially when ghee replaces butter (Baghel et al., 2020). Additionally, baking conditions can influence the volatile nature of plant-derived flavors, highlighting the need for meticulous ingredient selection to maximize flavor retention (Manley, 2011). In general, the addition of herbal ingredients can considerably improve the flavor of biscuits, thereby rendering them more appealing and nutritious (Filipcev et al., 2017).

d) Texture

The results of organoleptic tests on the texture of the A3 JAMU herbal biscuits formula revealed that as many as 17 people, or 48.6% of panelists, preferred the texture of herbal biscuit formula A3 (Table 6) because it has a crunchy texture. To make the A3 biscuit formula, add butter, stir with a mixer, and then add the egg yolks in stages. The texture of herbal biscuits is subject to organoleptic tests, which yield inconsistent results depending on the specific constituents employed. The formulation with 2.5 g of Moringa (F2) obtained the highest texture score of 4.06 in a study on biscuits incorporating Moringa leaf powder, indicating a favorable texture among panelists (Lestari et al., 2024). Similarly, panelists praised ginger cookies for their crispy texture, despite their overall lower hedonic scores, suggesting potential for improvement in other sensory attributes (Murwati, 2022). Researchers found that using ghee instead of white butter improved the texture and overall sensory acceptability of biscuits made with Ashwagandha and Ragi (Baghel et al., 2020). Also, herbal biscuits with Tulshi and Moringa leaves added to them to make them higher in fiber had better quality, with a clear preference for the texture at a 1% inclusion level (Dias & Bandara, 2019). In general, the composition of ingredients and their preparation significantly influences the texture of herbal biscuits, highlighting the importance of optimizing these factors to enhance sensory acceptance (Sharma, 2017).

Numerous investigations demonstrate that the texture of herbal biscuits significantly determines consumer preferences. Research suggests that food texture is a critical factor in influencing consumer decisions, with sensory experiences and cultural norms influencing preferences in various populations (Baingana, 2024). Comparing the textures of herbal biscuits showed that differences in texture, like those caused by using different fat sources (ghee vs. white butter), had a big effect on the overall acceptability and sensory scores (Baghel et al., 2020). Furthermore, cookies infused with medicinal herbs significantly influenced the consumer preference mapping process through texture attributes like firmness and chewiness (Pestorić et al., 2017). Additionally, sensory analysis of cookies containing Ayurvedic ingredients showed positive responses from consumers, showing how important texture is for improving the overall eating experience (Singh et al., 2024). In conclusion, these results emphasize the importance of texture in the development of culinary products to ensure that they meet consumer expectations and preferences (Haque et al., 2016).

Hedonic Test

A sensory evaluation method known as a hedonic test evaluates consumer preferences for food products by evaluating a variety of attributes, including appearance, aroma, color, flavor, and texture. Panelists preferred the A3 JAMU herbal biscuits formula in terms of overall acceptance, and statistically, their assessments were significantly different in terms of taste (Table 8). The A3 JAMU herbal biscuits formula treatment has the greatest impact on the average taste of herbal biscuits, while the A1 formula treatment has the least influence. Aroma and taste have a close relationship; both are components of taste. If one enjoys the aroma, they are likely to enjoy the taste as well (Burseg et al., 2009). The percentage of products that the panelists like most aligns with both aroma and taste. Flavor compounds in products have the potential to stimulate the receptor's senses. Several factors influence taste, including chemical compounds, temperature, concentration, and interactions with other taste components (Anita et al., 2017). Panelists can assess a product's acceptance based on its taste. Human taste sensing identifies four main tastes: sweet, bitter, sour, and salty, with additional responses arising from modifications. The panelists' preference for each treatment with the addition of different leaves determines the difference in taste likes or dislikes, as the processing process can influence the relative preference for a product (Aryadi et al., 2017).

Several studies have utilized hedonic tests to assess various formulations in the context of culinary product development. In hedonic taste testing, a variety of factors, including emotional and sensory responses, can influence the pleasantness or preference associated with different tastes. Researchers have used hedonic testing to assess panelists' preferences for food products like herbal biscuits, where variations in ingredients significantly influenced taste preferences (Rahmayani et al., 2022; Mareta, 2019). Sweetness has a significant impact on hedonic flavor perception, influencing both preference and consumption behaviors. Research

indicates a positive correlation between sweetness and liking in various food and beverage contexts (Kim et al., 2016). Furthermore, by improving the perception of sweetness through olfactory modulation, the interplay between taste and scent can enhance the enjoyment of eating while simultaneously reducing sugar intake (Wei & Wang, 2023). Nevertheless, the correlation between palatability and saccharine intensity is intricate. Perceived sweetness and palatability frequently co-occur, but they can also dissociate, suggesting that changes in one do not inherently influence the other (Fonseca et al., 2020). This implies that, although sweetness improves hedonic perception, individual differences and contextual factors also have a significant impact on flavor preference and consumption patterns (Cheung et al., 2022). Consequently, a variety of individual and sensory factors mitigate the impact of sweetness, a critical factor in the perception of hedonistic flavors.

Conclusion

The organoleptic test results revealed that the panelists preferred the A3 JAMU herbal biscuit formula due to its aroma, color, taste, and texture. The aroma of the A3 JAMU herbal biscuit formula was not too pungent; the color was green, the taste was more savory, and the texture was crispy. The results of the hedonic test revealed that the panelists generally preferred the taste of the A3 herbal biscuit formula. After conducting organoleptic and hedonic tests, researchers recommend performing an effectiveness test on the A3 herbal biscuit formula.

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Author Contributions
Author 1, 2: Sulastry Pakpahan, Ganda Agustina Simbolon; Conceived and designed the analysis, Colected the data, Contributed data or analysis tools, Performed the analysis, Wrote the paper. Author 3: Tienne Artha Ulina Nadeak; Ensuring the process of making herbal biscuits meets nutritional standards and is safe for consumption, collected the data, performed the analysis.

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All authors declare no conflict of interest.

References

Alam, A., Alam, J., Hakim, A., Huq, A. K. O., & Moktadir, S. M. G. (2014). Development of fiber-enriched herbal biscuits: A preliminary study on sensory evaluation and chemical composition. *International Journal of Nutrition and Food Sciences, 3*(4), 246-250. https://doi.org/10.11648/j.ijnfs.20140304.13.

Anita, S., Monisha, D., Sundararajan, P., Narasimman, S., & Bharath, G. (2017). Formulation of Withania somnifera based herbal cookies using response surface methodology. *International Research Journal of Pharmacy, 8*(6), 100–108. https://doi.org/10.7897/2230-8407.086105.

Arslan, S., & Yıldıran, H. (2021). Maternal Beslenmenin Yavrular Üzerine Etkileri: Fetal Programlama ve Epigenetik Mekanizmalar. *Journal of Nutrition and Dietetics*, 1–8. https://doi.org/10.33076/2021.BDD.1437.

Aryadi, F., Wahyuni, S., & Rejeki, S. (2017). Analisis Organoleptik Produk Teh Celup Tawaloho (Spondias pinnata.). *J. Sains Dan Teknologi Pangan*, *2*(5), 792–799. http://dx.doi.org/10.33772/jstp.v2i5.3739

Ashfya, A., & Doppa, G. (2023). Prospective Study on Prevalence of Anemia in Pregnant Women and Its Association with Maternal and Fetal Outcome. *Global Journal For Research Analysis*, 63–65. https://doi.org/10.36106/gjra/8102351.

Ayensu, J., Lutterodt, H., Annan, R. A., Edusei, A., & Loh, S. P. (2019). Nutritional composition and acceptability of biscuits fortified with palm weevil larvae (*Rhynchophorus phoenicis Fabricius)* and orange-fleshed sweet potato among pregnant women. *Food Science & Nutrition*, *7*(5), 1807–1815. https://doi.org/10.1002/fsn3.1024.

Baghel, S., Saraugi, S. S., Kumar, A., Rathore, A., & Soni, D. K. (2020). Sensory and physical evaluation of herbal biscuits incorporated with Ashwagandha (Withania somnifera) and Ragi (Eleusine coracana). *International Journal of Chemical Studies*, *8*(5), 136–142. https://doi.org/10.22271/chemi.2020.v8.i5b.1029.

Baingana, M. (2024). Food Texture Perception and Its Influence on Consumer Preferences. *Journal of Food Sciences*, *5*(2), 43–55. https://doi.org/10.47941/jfs.1847.

Bonnell, V., White, M., & Connor, K. (2024). Do nutritional interventions before or during pregnancy affect placental phenotype? Findings from a systematic review of human clinical trials.

Journal of Global Health, 14, 04240. https://doi.org/10.1101/2024.05.15.24307442.

Burseg, K., Linforth, R. S. T., Hort, J., & Taylor, A. J. (2009). Flavor Perception in Biscuits; Correlating Sensory Properties with Composition, Aroma Release, and Texture. *Chemosensory Perception*, *2*(2), 70–78. https://doi.org/10.1007/s12078-009-9042-8.

Campoy, C., Escudero-Marín, M., Diéguez, E., & Cerdó, T. (2021). Perinatal nutritional intervention. In *Molecular Nutrition: Mother and Infant* (pp. 179–203). Elsevier. https://doi.org/10.1016/B978-0-12-813862-5.00008-6.

Cetin, I., Passoni, D., & Laoreti, A. (2022). Nutritional challenges during pregnancy. *Italian Journal of Gynaecology and Obstetrics*, *34*(03), 202. https://doi.org/10.36129/jog.2021.08

Cheung, M. M., Kramer, M., Beauchamp, G. K., Puputti, S., & Wise, P. M. (2022). Characterizing Individual Differences in Sweet Taste Hedonics: Test Methods, Locations, and Stimuli. *Nutrients*, *14*(2), 370. https://doi.org/10.3390/nu14020370.

Chirwa-Moonga, T., Muzungaile, T., Siyumbano, N., Moonga, H. B., & Nyau, V. (2020). Nutrient Composition of Raw and Steamed, Green and Purple Sweet Potato Leaf Varieties (Ipomoea batatas). *Journal of Medicinally Active Plants*, *9*(4), 253. https://doi.org/10.7275/9ns0-1640

Choudhary, R., Koshti, A., & Malik, R. (2020). Study of Morphological Pattern of Anaemia at a Tertiary Care Centre. *Journal of Evolution of Medical and Dental Sciences*, *9*(8), 468–472. https://doi.org/10.14260/jemds/2020/106.

Curioni, C. C., Mocellin, M. C., Tavares, M. D. S., Da Silva, A. C. F., De Velasco, P. C., Ribas, S. A., Lamarca, F., & André, C. (2022). Effectiveness of nutritional interventions to prevent nonprogressive congenital and perinatal brain injuries: A systematic review and meta-analysis of randomized trials. *Nutrition Reviews*, *80*(11), 2136–2153. https://doi.org/10.1093/nutrit/nuac028.

Damayanti., Ningsih, S. J., Karo Karo, T. M., & Bintang, S. S. (2022). Effectiveness of Giving Biscuits to Increase Body Mass Index (BMI) and Interpretation of Fetal Weight In Pregnant Women Chronic Energy Deficiency. *Jurnal Kebidanan Kestra (JKK)*, *4*(2), 65–71. https://doi.org/10.35451/jkk.v4i2.987.

Dias, N. A. I. S., & Bandara, G. M. W. R. (2019). Nutritive Assessment of Composite Flour Biscuit Incorporated with Herbal Plant Powder. *Journal of Food and Agriculture*, *12*(1), 17. https://doi.org/10.4038/jfa.v12i1.5217.

Dragomir, N., Nicolae, C. G., Stan, A., Ion, V. A., & Badulescu, L. (2020). Sensorial evaluation of new developed biscuits enriched with organic apple and basil powders: preliminary study. *Scientific Papers. Series D. Animal Science*, *63*(1), 428-434. Retrieved from https://orgprints.org/id/eprint/40270/

Filipcev, B., Nedeljkovic, N., Simurina, O., Sakac, M., Pestoric, M., Jambrec, D., Saric, B., & Jovanov, P. (2017). Partial replacement of fat with wheat bran in the formulation of biscuits enriched with herbal blend. *Hemijska Industrija*, *71*(1), 61–67. https://doi.org/10.2298/HEMIND150922018F.

Fonseca, E., Sandoval-Herrera, V., Simon, S. A., & Gutierrez, R. (2020). Behavioral Disassociation of Perceived Sweet Taste Intensity and Hedonically Positive Palatability. *Eneuro*, *7*(5). https://doi.org/10.1523/ENEURO.0268-20.2020.

Hamid, K., Ajaz, M., Akhter, M., Khan, S. A., Sadiq, M. S., & Aitazaz, F. (2022). Prevalence Of Anemia In Pregnant Women. *Pakistan Journal of Physiology*, *18*(1), 16–19. https://doi.org/10.69656/pjp.v18i1.1426.

Haque, M., Mandal, R., Akter, N., Akter, S., & Sultana, M. (2016). A Study on Development and Evaluation of Functional Herbal Wafer Biscuits. *Journal of Environmental Science and Natural Resources*, *9*(1), 17–21. https://doi.org/10.3329/jesnr.v9i1.30285.

Kanu, F. A., Hamner, H. C., Scanlon, K. S., & Sharma, A. J. (2022). Anemia Among Pregnant Women Participating in the Special Supplemental Nutrition Program for Women, Infants, and Children—United States, 2008–2018. *Morbidity and Mortality Weekly Report*, *71*(25), 813–819. https://doi.org/10.15585/mmwr.mm7125a1.

Kc, Y., Bhattarai, S., Shiwakoti, L. D., Paudel, S., Subedi, M., Pant, B. R., Paudel, M., Dhugana, S., Bhattarai, S., Tiwari, T., Koirala, N., Aljarba, N. H., Alkahtani, S., Batiha, G. E.-S., Shiwakoti, R., & Upadhyaya, J. (2022). Sensorial and chemical analysis of biscuits prepared by incorporating Moringa flower powder and leaf powder. *International Journal Of Food Properties*, *5*(1), 894–9066. https://doi.org/10.1080/10942912.2022.2069807.

Kim, H., Lim, J., Buehler, S. S., Brinkman, M. C., Johnson, N. M., Wilson, L., Cross, K. S., & Clark, P. I. (2016). Role of sweet and other flavors in liking and disliking of electronic cigarettes. *Tobacco Control*, *25*(Suppl 2), ii55–ii61. https://doi.org/10.1136/tobaccocontrol-2016-053221.

Kozlowska, M., Zbikowska, A., Marciniak-Lukasiak, K., & Kowalska, M. (2019). Herbal Extracts Incorporated into Shortbread Cookies: Impact on

Color and Fat Quality of the Cookies. *Biomolecules*, *9*(12), 858. https://doi.org/10.3390/biom9120858.

Král, O., Javůrková, Z., Dordevic, D., Pospiech, M., Jančíková, S., Fursova, K., & Tremlová, B. (2021b). Biscuits Polyphenol Content Fortification through Herbs and Grape Seed Flour Addition. *Processes*, *9*(8), 1455. https://doi.org/10.3390/pr9081455.

Kumar, A., Yadav, S., Tomar, D., Pramanik, J., & Batta, K. (2024). Consumer Food Perception: In *Advances in Environmental Engineering and Green Technologies* (pp. 224–248). IGI Global. https://doi.org/10.4018/979-8-3693-2121-8.ch011.

Lassi, Z. S., Padhani, Z. A., Salam, R. A., & Bhutta, Z. A. (2022). Prenatal nutrition and nutrition in pregnancy: Effects on long-term growth and development. In *Early Nutrition and Long-Term Health* (pp. 397–417). Elsevier. https://doi.org/10.1016/B978-0-12-824389-3.00013-1.

Lestari, L. A., Rachmawati, A. I., Rachmadanty, A. S. S., & Sholikhati, A. S. (2024). Organoleptic profile of high protein and dietary fiber biscuits based on soybean flour, tempeh flour, and Moringa leaf powder. *Slovak Journal of Food Science*, 18, 654-665. https://doi.org/10.5219/1955.

Liu, J., & Zhou, M. (2021). The Correlation of Biscuit Packaging Image Based on Visual-Taste Synesthesia Psychology. In *Human Interaction, Emerging Technologies and Future Applications IV* (Vol. 1378, pp. 299–306). Springer International Publishing. https://doi.org/10.1007/978-3-030-74009-2_38.

Mareta, D. T. (2019). Hedonic Test Method for Measuring Instant Pindang Seasoning Powder Preferences. *Journal of Science and Applicative Technology*, *3*(1), 34. https://doi.org/10.35472/jsat.v3i1.195.

Mehra, R., & Rani, J. (2020). Anemia in Pregnancy. In *Labour Room Emergencies* (pp. 85–94). Springer Singapore. https://doi.org/10.1007/978-981-10-4953-8_9

Murwati, M. (2022). Physical Test and Hedonic Test Ginger Cookies (*Zingiber officinale*). *Jurnal Jamu Kusuma*, *1*(2), 76–83. https://doi.org/10.37341/jurnaljamukusuma.v1i2.20.

Musaidah, M., Syam, A., Wahyu, A., Hadju, V., Sudargo, T., Abdullah, A. Z., Syafar, M., Zainal, Z., Hafid, R., & Syukur, R. (2022). The Influence of Giving Biscuits of Yellow Pumpkin Seed and Capsule of Moringa Leaves on the Level of C-Reactive Protein on Pregnant Women. *International Journal of Design & Nature and Ecodynamics*, *17*(4), 627–632. https://doi.org/10.18280/ijdne.170419.

Nur, N., Sakung, J., & Bima. (2022). Haemoglobin Levels and Mid-Upper Arm Circumference in Pregnant Women Through The Giving of Moringa Biscuits. *Journal of Health Science and Prevention*, *6*(1). https://doi.org/10.29080/jhsp.v6i1.632.

Pestorić, M., Škrobot, D., Žigon, U., Šimurina, O., Filipčev, B., Belović, M., & Mišan, A. (2017). Sensory profile and preference mapping of cookies enriched with medicinal herbs. *International Journal of Food Properties*, *20*(2), 350–361. https://doi.org/10.1080/10942912.2016.1160922.

Rahmayani, S., Iryani, I., Iswendi, I., & Amelia, F. (2022). Hedonic Test Method for Beef Rendang with Variations in The Addition of Cinnamomum Verum. *Jurnal Periodic Jurusan Kimia UNP*, *11*(3), 53. https://doi.org/10.24036/p.v11i3.114883.

Rahmiati, L. (2023). Consumption Compliance Supplementary Food Biscuits for Pregnant Women in Banda Aceh, Indonesia. *Journal of Complementary and Alternative Medical Research*, *22*(1), 28–39. https://doi.org/10.9734/jocamr/2023/v22i1450.

Riandha Feliza, V., Desmawati, D., & Anggraini Nursal, D. G. (2023). Analysis of Factors Associated with the Behavior of Chronic Energy Deficiency Pregnant Women in Consuming Biscuit Supplementary Feeding in Pesisir Selatan District in 2023. *International Journal of Research and Review*, *10*(10), 413–421. https://doi.org/10.52403/ijrr.20231051.

Singh, V., Anjana, C. S., & Galib, R. (2024). Pharmaceutical study and evaluation of herbal cookies infused with Rasayana Churna: A comprehensive study on sensory acceptance and nutrient profile. *Journal of Drug Research in Ayurvedic Sciences*, *9*(1), 40–47. https://doi.org/10.4103/jdras.jdras_54_23.

Starowicz, M., Lelujka, E., Ciska, E., Lamparski, G., Sawicki, T., & Wronkowska, M. (2020). The Application of Lamiaceae Lindl. Promotes Aroma Compounds Formation, Sensory Properties, and Antioxidant Activity of Oat and Buckwheat-Based Cookies. *Molecules, 25*(23), 5626. https://doi.org/10.3390/molecules25235626

Sudaryati, E., Panjaitan, A. M., Nadeak, T. A. U., Tobing, A. M. L., Masthalina, H., & Keloko, A. B. (2023). *The Effect of Pumpkin Biscuits (Cucurbita moschata), Peanut (Arachis hypogaea) andMoringa Leaves (Moringa oleifera) on Hemoglobin Levels and Maternal Upper Arm Circumference (MUAC) of Pregnant Women*. https://doi.org/10.21203/rs.3.rs-2761631/v1.

Swarajya Lakshmi, A. V., & Sandhya Rani, M. (2023). A Study of Prevalence of Anaemia in Pregnant Women Attending Antenatal Op in A Tertiary Care Hospital. *Paripex Indian Journal of Research*, 60–

61. https://doi.org/10.36106/paripex/3702240.

Syakur, R., Syam, A., Hadju, V., Palutturi, S., Hadi, A. J., Hafid, R., & Musaidah, M. (2022). The Effect of Pumpkin Seed Biscuits on Nutritional and Zinc Status: A Randomized Controlled Trial in Pregnant Women. *Open Access Macedonian Journal of Medical Sciences*, *10*(E), 1161–1168. https://doi.org/10.3889/oamjms.2022.9937.

Tan, J., Huo, L., Qian, X., & Wang, X. (2023). Effect of individualized nutritional intervention on the postpartum nutritional status of patients with gestational diabetes mellitus and the growth and development of their offspring: A quasi-experimental study. *Journal of Obstetrics and Gynaecology*, *43*(1), 2171280. https://doi.org/10.1080/01443615.2023.2171280.

Wei, J., & Wang, Y. (2023). The Scented Sip: Enhancing Beverage Sweetness Perception through Olfactory Modulation. *Proceedings of the Eleventh International Symposium of Chinese CHI*, 589–595. https://doi.org/10.1145/3629606.3629674.

Wirawan, E. U., & Yan, S. W. (2021). Consumers' perception and physicochemical properties of novel functional cookies enriched with medicinal plant *Strobilanthes crispus*. *British Food Journal*, *123*(3), 1121–1132. https://doi.org/10.1108/BFJ-07-2020-0630.