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Nutritional composition and preference of hanjeli arem-arem with tilapia balado filling

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ABSTRAK

Latar Belakang: *Tingginya prevalensi anemia defisiensi zat besi pada remaja di Indonesia membutuhkan intervensi berbasis pangan. Hanjeli (Coix lacryma-jobi L.) merupakan serealia lokal yang memiliki zat besi tinggi (11 mg/100 g), namun pemanfaatannya dalam produk kudapan tradisional masih terbatas, termasuk pada arem-arem.*
Tujuan: *Penelitian ini bertujuan untuk menemukan formula, menguji komposisi gizi, dan mengetahui tingkat kesukaan pada arem-arem dengan substitusi hanjeli dan isian balado ikan nila (Anjeli).*
Metode: *Penelitian menggunakan Research and Development (R&D) dengan model 4D meliputi: (1) Define, menentukan produk acuan, (2) Design, menentukan persentase biji hanjeli pada produk pengembangan, (3) Develop, dilakukan uji validasi, uji proksimat dan zat besi, (4) Disseminate, dilakukan uji kesukaan oleh 80 mahasiswa.*
Hasil: *Formula produk Anjeli terbaik menggunakan 50% biji hanjeli dan memiliki komposisi air 54,73%, abu 1,06%, protein 4,30%, lemak 2,55%, karbohidrat 37,38%, dan zat besi 5,95 mg. Informasi gizi produk Anjeli per takaran saji (60 gram) mengandung 118 kkal energi total, 18 kkal energi dari lemak, 2 g lemak, 3 g protein (AKG 4,6%), 22 g karbohidrat (AKG 7,0%), dan 4 mg zat besi (AKG 26,7%). Tingkat kesukaan remaja secara keseluruhan pada produk Anjeli (4,48) berbeda nyata dan lebih disukai dibandingkan dengan produk acuan (4,18) ($p<0,05$).*
Kesimpulan: *Produk Anjeli mengandung zat besi 5,95 mg per 100 g dan lebih tinggi daripada produk acuan sehingga dapat digunakan sebagai kudapan sumber zat besi bagi remaja.*

KATA KUNCI*: arem-arem, biji hanjeli, ikan nila, remaja, zat besi*

ABSTRACT

Background: *A high prevalence of iron-deficiency anemia in Indonesian adolescents requires food-based interventions. Hanjeli (Coix lacryma-jobi L.) is an iron-rich local cereal (11 mg/100 g); however, it is rarely used in traditional snacks, including arem-arem.*

Objectives*: This study aims to determine a formula, the nutritional composition, and the level of preference of arem-arem with hanjeli substitution and balado tilapia filling (Anjeli).*

Methods: *The research method used Research and Development (R&D) with a 4D development model, which includes: (1) Define, determining the reference product, (2) Design, determining the percentage of hanjeli seeds in the development product, (3) Develop, conducting validation tests and limited sensory tests, (4) Disseminate, conducting preference tests by 80 undergraduate students.*

Results: *Anjeli's product formula uses 50% hanjeli seeds and has a composition of 54.73% moisture, 1.06% ash, 4.30% protein, 2.55% fat, 37.38% carbohydrates, and 5.95 mg iron. The nutritional information of Anjeli per serving (60 grams) contains 118 kcal of total energy, 18 kcal of energy from fat, 2 g of fat, 3 g of protein (4.6% RDA), 22 g of carbohydrates (7.0% RDA), and 4 mg of iron (26.7% RDA). The overall level of preference among adolescents for the Anjeli product (4.48) was significantly higher than that for the reference product (4.18) ($p < 0.05$).*

Conclusions: *Anjeli products contain 5.95 mg of iron per 100 g, exceeding the reference product, therefore it can be used as a source of iron for adolescents.*

KEYWORDS*:* *adolescents, arem-arem, hanjeli seeds, iron, tilapia*

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INTRODUCTION

Adolescence is a transitional period from childhood to adulthood, characterized by physical, psychological, and social changes. According to the Indonesian Ministry of Health, adolescents are defined as individuals between the ages of 10 and 18 (1). According to the World Health Organization (WHO), adolescence is defined as the age range of 10 to 19 years (2). In addition, National Population and Family Planning Agency (BKKBN) defines the adolescents as the age range of 10 to 24 years and not married (3). Nutrient deficiencies in adolescents can have a negative impact on growth, development, and overall health (4). Nutrient deficiencies in adolescents can include energy and micronutrient deficiencies such as iron, vitamin A, and zinc (5). This can lead to anemia, fatigue, and decreased immunity (6).

Iron is very important for adolescents because it is needed for rapid growth, blood formation, brain function, and immunity; iron deficiency can reduce concentration, school performance, and cause anemia (5). Based on the Indonesian Health Survey (7), the prevalence of anemia in all ages in Indonesia reached 16.2% with the highest proportion occurring in pregnant women and adolescent girls. Hanjeli (Coix lacryma-jobi L.), also known as jali-jali, is a local cereal crop with great potential as an alternative iron source in Indonesia (8). Hanjeli contains 23 g of water, 1 g of ash, 11 g of protein, 4 g of fat, 61 g of carbohydrates, 3.1 g of fiber, and 11 mg of iron per 100 g (9). The high iron content of hanjeli can help in the formation of red blood cells, thereby preventing anemia in adolescents (10). Hanjeli can be used as an iron-rich snack, such as in Arem-arem products. Hanjeli has long been used by the community to make hanjeli flour, porridge, rice, hanjeli popcorn, cakes, bread, snack bars, cereal drinks, and kolak mixes (11). Hanjeli seeds can also be used to make innovative food products that are popular with all groups as an effort to diversify local foods, one of which is the production of snacks. Snacks are side dishes that can be consumed between main meals and during leisure time (12). Snack consumption has become a necessity for the community and is often used as a side dish and ready-to-eat food at home.

Arem-arem is a traditional snack that popular in Indonesia, particularly in Central Java and Special Region of Yogyakarta. The main ingredient of arem-arem is rice with various fillings. This food is similar to lemper, but is larger in size than lemper and uses regular rice instead of sticky rice (13). The rice is then filled with various side

dishes, wrapped in banana leaves, and steamed. The most common filling of arem-arem is seasoned stir-fried carrots and potatoes, sometimes with shredded chicken, shredded beef, oncom, or tempeh (14). The fillings for arem-arem can be varied, such as tilapia balado. Tilapia contains 20.1 g of protein per 100 g, thus being an excellent source of protein (15). Protein is very important for growth, tissue repair, and maintaining hormonal balance. Tilapia is also rich in various minerals such as iron, calcium, phosphorus, potassium, and selenium (16). Arem-arem is a popular snack among the community but does not contain balanced nutrition, especially iron and protein. Therefore, arem-arem needs to be innovated by using local cereal ingredients that are a source of iron, such as hanjeli.

In previous studies, the use of hanjeli seeds as a substitute in food innovations has been reported, such as in snack bars (17), rangginang (18), kembang goyang and eggroll (19), éclairs (20), and cakes (21). The use of tilapia has also been widely studied in previous research, such as tilapia floss (22), tilapia nuggets (23), tilapia serundeng snack bars (24), and tilapia meatballs (25). However, to date, the use of hanjeli as a substitute ingredient in the production of arem-arem with tilapia balado filling has not been reported. Therefore, the objectives of this study are to determine a formula, the level of preference among adolescents, and the nutritional composition of arem-arem products with hanjeli substitution and tilapia balado filling (Anjeli). The results of this study are expected to provide traditional snacks as a source of iron for adolescents.

MATERIALS AND METHODS

The ingredients used in this study included hanjeli, white rice (C4 Raja brand), bay leaves, pandan leaves, salt (Refina brand), instant coconut milk (Kara brand), agar-agar powder (Nutrijel brand), tilapia fillets, shallots, garlic, red chilies, cayenne peppers, galangal, lemongrass, sweet soy sauce, pepper, palm sugar, and oil. The tools used in this research include a cutting board, chopper, spatula, knife, frying pan, and steamer. This research was conducted from March to June 2025 in the culinary laboratory and chemistry laboratory, Wates campus, D4 Culinary Arts study program, Vocational Faculty, Yogyakarta State University. The proximate and iron test were carried out at the PSPG Laboratory, Gadjah Mada University.

Determination of the arem-arem formula with hanjeli as a substitute and tilapia balado filling

The define stage is the first stage in identifying and determining one selected reference formula from three different reference formulas to determine the best reference formula. The selected arem-arem formula is then used as a reference to be substituted with hanjeli and tilapia balado filling. The design stage is the stage of testing the selected reference formula, R1, on a panel of culinary arts lecturers and culinary arts students. At this stage, the reference formula is substituted with 50%, 75%, and 100% hanjeli. The selected substitution result is by adding 50% hanjeli. The next step is to replace the shredded chicken balado filling with tilapia balado.

The development stage is the stage of improving the product development according to the design obtained from the design stage. The selected arem-arem hanjeli product formula in the design stage is determined in terms of presentation and packaging in the development validation stage. After conducting validation tests, the improvements that need to be made to the arem-arem development product are to reduce the size to 60 grams from the previous 80 grams and to add plain agar-agar when cooking rice and hanjeli so that the arem-arem becomes more solid. The dissemination stage was carried out by testing the sensory characteristics, namely color, aroma, taste, texture, and overall characteristics of Anjeli products by 80 panelists at Gunung Kidul campus, Universitas Negeri Yogyakarta.

The process of making arem-arem begins with preparing the rice and hanjeli. First, soak the hanjeli in water for at least 8 hours until soft, then wash the rice and hanjeli until clean. Put the rice, hanjeli, coconut milk, salt, pandan leaves, powdered agar-agar, and water in a pot, then cook while stirring occasionally for 30 minutes until cooked, then set aside. The second step in making hanjeli arem-arem is to prepare the tilapia balado filling. First, clean the tilapia fillets, then squeeze lime juice over them and let them sit in the refrigerator for 15 minutes. Then clean the fish that

has been left to stand and steam for 15 minutes, then set aside. The final step is to make the balado tilapia-filled arem-arem hanjeli. Weigh 50 grams of the rice and hanjeli mixture, then fill with 10 grams of balado tilapia. Wrap in banana leaves to form arem-arem and steam for 45 minutes until cooked. The proximate composition was analyzed for their moisture (Method No. 925.09), crude protein (Nx6.25) (Method No. 920.87), total lipid (Method No. 920.39) with petroleum ether as a solvent, and ash content (Method No. 923.03) following the standard methods of AOAC (26). Iron content was analysed using dry destruction with Atomic Absorption Spectrophotometer (27).

The preference test was conducted with 80 untrained panelists from university students who tested the reference product and the developed product on the parameters of color, aroma, taste, texture, and overall characteristics, with scores ranging from 1 = strongly dislike, 2 = dislike, 3 = somewhat like, 4 = like, and 5 = strongly like. Descriptive statistical and paired t-tests were used to analyze the data of formula, nutritional composition, and level of preference of Anjeli products.

RESULTS AND DISCUSSIONS

Formula of arem-arem with hanjeli substitution and tilapia balado filling

The define stage is the first stage in identifying and determining one selected reference formula from three different reference formulas to determine the best reference formula.

Table 1 show the reference formula for the rice used to make arem-arem and also the filling for arem-arem, which is shredded chicken balado. This is in accordance with research conducted by Tarissa & Ani (31) who used shredded chicken balado as the filling for mocaf pancakes. The three reference formulas that have been tested have different characteristics due to differences in the ingredients and measurements used. Sensory characteristics were assessed by five panelists, and the averages were calculated to obtain one selected reference formula

Table 1. Reference formula for rice products in the define stage

Materials Name	R1	R2	R3
Rice (g)	300	300	350
Coconut milk (ml)	750	750	700
Salt (sdt)	1	1	1
Pandan Leaf (lbr)	2	-	-
Bay leaf (lbr)	-	2	-
Sesame oil (sdm)	-	-	1
Filling:			
Chili pepper (pcs)	-	-	5
Red onion (pcs)	3	5	10
Garlic (pcs)	2	3	6
Lemongrass (stalk	1	1	-
Bay leaf (leaf)	1	3	-
Galangal (cm)	1	2	2
Red chilli peppers (pcs)	3	2	10
Cayenne chili peppers (pcs)	3	3	20
Sugar	1	-	1
Salt (sdt)	1	1	1
Lime leaves (pcs)	-	3	5
Sweet soy sauce (tbsm)	-	5	-
Peppers (tsp)	-	0.5	-
Palm sugar (g)	-	30	-

Source:
Formula 1: Soewitomo (28)
Formula 2: Ekawatiningsih and Munif (29)
Formula 3: Christianto (30)

Table 2. Average results of the define stage sensory test

Sensory characteristics	R1	R2	R3
Shape	4.0±0.8	4.0±0.5	4.0±0.5
Size	4.2±0.5	3.6±0.6	4.0±0.0
Color	3.8±0.6	3.6±0.6	3.4±0.5
Aroma	4.2±0.5	4.2±0.5	4.0±0.8
Taste	4.0±0.5	4.0±0.2	3.4±0.6
Texture	4.2±0.0	3.8±0.5	4.2±0.5
Overall	4.2±0.0	3.6±0.6	3.6±0.6

Table 2 shows the average results of the three reference formulas, indicating reference formula one (R1), sourced from Sisca Soewitomo's book, has a higher score than the other two formulas. In terms of shape, aroma, color, size, and texture, it has a higher score than the other reference products, while for taste, it is not too spicy so that it is acceptable to many people. The selected reference formula is used as a reference formula for product development at the design stage.

The ratio of material usage in the three reference formulas affects the reference products characteristics. R1 and R2 have the same coconut milk to rice ratio, while R3 is different. The higher the coconut milk to rice ratio, the softer the texture. R1 and R2 have a higher ratio than R3, so R1 and R2 have a soft texture and are not hard. In addition, differences in other ingredients also affect the taste and aroma. R1 uses pandan leaves, R2 uses bay leaves, while R3 uses sesame oil. Of the three other ingredients, the panelists preferred R1, which uses pandan leaves as an aromatic (28), so it can be concluded that R1 is superior in terms of texture and aroma.The design stage is the stage of testing the selected reference formula, R1, on a panel of culinary arts lecturers and culinary arts students. At this stage, the reference formula is substituted with 50% (F1), 75% (F2), and 100% (F3) hanjeli. The results of the formula development at the design stage can be seen in **Table 3**.

Table 3. Design stage development formula

Ingredients name	References	Development		
	R1	F1 (50%)	F2 (75%)	F3 (100%)
White rice (g)	300	150	100	-
Hanjeli (g)	-	150	200	300
Coconut milk (ml)	750	750	750	750
Pandan leaf (pcs)	2	2	2	2
Salt (tsp)	1	1	1	1

The sensory test results at the design stage conducted by five expert panelists show that F1 is superior to F2 and F3, so the selected formula at the design stage is F1, which is a 50% substitution of hanjeli applied at the development stage. This is in line with the research conducted by Aminah et al. (17), which shows that the use of 50% hanjeli seeds in the production of hanjeli seed snack bars is the most acceptable formula in terms of color, aroma, and taste. Nurjanah and Ratnaningsih (32) reported the development of jali jali chicken arancini with 100% jali jali or hanjeli substitution was well accepted by the panelists, as well as the Rice Bowl hanjeli seeds with a 100% hanjeli substitution by Salsabilla (33). These results show that product development with hanjeli substitution has been well accepted by the community.

The development stage is the stage of improving the product development according to the design obtained from the design stage. The selected arem-arem hanjeli product formula in the design stage is determined in terms of presentation and packaging in the development validation stage. After conducting validation tests,

the improvements that need to be made to the arem-arem development product are to reduce the size to 60 grams from the previous 80 grams and to add plain agar-agar when cooking rice and hanjeli so that the arem-arem becomes more solid. The arem-arem product requires improvement by adding jelly powder to make the arem-arem product more solid with a ratio of 2 grams and 3 grams, suggesting the selected arem-arem uses 2 grams of jelly powder. The function of jelly powder is to improve texture and act as a binder that helps bind ingredients to form the desired texture (34). The average results of the sensory test at the development stage by two expert panelists show a higher average than the reference product, so it can proceed to nutritional composition and preference level testing.

Composition and Nutritional Information

Arem-arem hanjeli products with tilapia balado filling are rich in iron, which is found in hanjeli. Anjeli products were then tested in a laboratory to determine their nutritional value. The results of the paired t-test for nutritional value can be seen in **Table 4**. Based on **Table 4**, the reference product has a water content of 72.07%, while the developed product has a water content of 54.73%.

Table 4. Results of the paired t-test for nutritional value composition

Nutritional composition (%)	Reference product	Developed product	p value
Water	72.07 ± 0.02	54.73 ± 0.21	0.005
Ash	0.67 ± 0.04	1.06 ± 0.06	0.113
Protein	4.42 ± 0.56	4.30 ± 0.02	0.805
Fat	1.29 ± 0.03	2.55 ± 0.04	0.005
Carbohydrates	21.57 ± 0.64	37.38 ± 0.21	0.012
Iron	4.81 ± 0.04	5.95 ± 0.05	0.035

This is because hanjeli starch has greater water absorption and binding properties than regular rice, so that after steaming, more water is trapped in the hanjeli starch matrix (35). The protein content of the reference product is 4.42% and the developed product is 4.30%, showing no significant difference, despite skinless chicken breast (the reference filling) having a protein content of 27-32 g and tilapia fillet having a protein content of 20-26 g per 100 g (36). The carbohydrate and iron content in the developed product is significantly higher than that of the reference product because the raw material of hanjeli has a higher carbohydrate and iron content than white rice (8). The results of the paired t-test of the average nutritional value composition of the reference product show that the iron (Fe) content of Anjeli is higher than that of the reference product, making it suitable as a snack to meet daily iron requirements. Although Anjeli has a higher calorie content than the reference product, it is still low in fat. The disadvantage of Anjeli is that it has a relatively short shelf life, so it needs to be stored in the freezer if not consumed immediately and can be steamed again if desired. The calculation of the Nutritional Adequacy Level (AKG) refers to Minister of Health Regulation No. 28 of 2019 (37) based on nutritional adequacy of girl adolescents (16-18 years old), including 2100 kcal of energy, 65 g of protein, 70 g of fat, 300 g of carbohydrate, and 15 mg of iron. The nutritional value calculation for Anjeli products with a serving size of 60 grams with 3 pieces per package, contains 118 kcal of total energy, 18 kcal of energy from fat, 2 grams (AKG 2.9%) of fat, 3 grams (AKG 4.6%) of protein, 22 grams (AKG 7%) of carbohydrates, and 4 mg (AKG 26.7%) of iron.

Based on BPOM Regulation No. 1 of 2022 (38), iron content can be claimed as a source of iron if it is not less than 15% ALG per 100 g in solid form. Thus, Anjeli products can be claimed as a source of iron because they can contribute 24% of the daily iron requirement for girl adolescents (16-18 years old). This is in line with research conducted by Tarissa & Ani (31), which highlights the iron content in mocaf pancake products as a means of preventing anemia in adolescents. In addition, Salsabilla (33) reported that Hanjeli rice

bowl contains 8 mg of iron per serving (150 g) which can contribute 53% of AKG for girl adolescents (13-15 years old).

Preferences of Anjeli

The level of preference for Anjeli products was obtained at the dissemination stage. The results of sensory tests on reference products and development on a large scale can be seen in **Table 5.** Table 5 shows the results of the paired t-test for preference level of the reference and Anjeli products. The sensory properties of color, aroma, taste, texture, packaging, and overall appearance are significantly different from the reference arem-arem.

The preference test results show that some people like the Anjeli product because of its distinctive taste and texture, while others dislike it because they are trying a new flavor for the first time. The developed product had a higher average score than the reference product due to the different texture and taste from the arem-arem products on the market and had a nutritional advantage in terms of iron content.

Table 5. Results of the paired t-test for preference level

Sensory characteristic	References Product	Developed Product	p-value
Color	4.18 ± 0.63	4.5 ± 0.55	0.00
Aroma	4.21 ± 0.54	4.5 ± 0.53	0.00
Taste	4.06 ± 0.64	4.34 ± 0.57	0.00
Texture	4.01 ± 0.68	4.36 ± 0.60	0.00
Packaging	4.04 ± 0.58	4.46 ± 0.52	0.00
Overall	4.18 ± 0.55	4.48 ± 0.53	0.00

Note: p-value < 0.05 means that the reference and development are significantly different; p-value > 0.05 means that the reference and development are not significantly different.

CONCLUSION AND RECOMMENDATION

The Anjeli formula is obtained by substituting 50% hanjeli and tilapia balado filling. Nutritional information for a 60-gram serving of Anjeli contains 118 kcal of total energy, 18 kcal of energy from fat, 2 g of fat (2.9% of AKG), 3 g of protein (4.6% of AKG), 22 g of carbohydrates (7.0% of AKG), and 4 mg of iron (26.7% of AKG) based on nutritional adequacy level for girl adolescent (16-18 years old). The level of preference for Anjeli was significantly different and more preferred by adolescents compared to the reference arem-arem product ($p<0.05$). The result suggests that Anjeli has the potential as an iron-source snack for the prevention of anemia in adolescents.

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