

Contribution of Golden Apple Snail Flour to Enhance Omega-3 and Omega-6 Fatty Acids Contents in Weaning Food

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Abstract. The case of undernourished children in Grobogan District (15.3%) is caused by children nutrients intake less than the Recommendation Dietary Allowance (RDA). To enhance children nutrients intake, be required formulation of weaning food using high-nutrient local food such as golden apple snail (*Pomacea canaliculata*). Golden apple snail flour contains high contents of zinc, iron, omega-3 and omega-6 fatty acids. This study aims to analyze the effect of golden apple snail flour substitution on nutrients content and organoleptic properties of weaning food (baby porridge). This is an experimental research by substitution of golden apple snail flour in the making of weaning food with four treatments of substitution (0%, 5%, 10%, 15%). Substitution of golden apple snails flour could affect the nutrient content levels of fat, zinc, iron ($p=0.0001$), carbohydrate ($p=0.011$), water ($p=0.003$), ash ($p=0.001$), omega-3 and omega-6 fatty acids. Whereas, it could not affect the content of energy ($p=0.678$), protein ($p=0.129$) and fiber ($p=0.482$). Furthermore, the substitution could affect the organoleptic properties include color, texture and taste ($p=0.0001$) while not for the aroma ($p=0.798$). Based on nutrient content analysis, substitution of golden apple snail flour could enhance the zinc, iron, omega-3 and omega-6 fatty acids contents of weaning food.

Keywords: Weaning food, golden apple snail flour, zinc, iron, omega-3, omega-6.

1. Introduction

Malnutrition, especially undernourished, is one of the biggest nutritional problems which is not resolved in some developing countries such as Indonesia[1]. Based on Riset Kesehatan Dasar (Riset Kesehatan Dasar) 2013[2], the prevalence of under nutrition in Indonesia continues to increase in every year. The prevalence of undernourished toddler (based on the value of Z-Score weight-for age $\leq -2SD$) is 19.6% in 2013 which increased compared in 2010 amounted to 17.9%.

Grobogan District is one of the Districts in Central Java which had undernourished prevalence in medium category by 15.3%[3]. Undernourished classification based on WHO in high category if the prevalence more than 20%[4]. The highest incidence of undernourished is in children under five years[2]. Based on some previous researches, it can be concluded that undernourished in Central Java, especially in Grobogan, caused by children nutrients intake less than the Recommendation Dietary Allowance (RDA).



The government has conducted several programs of interventions against malnutrition problems. Nutritional improvement movement in Indonesia focused on the group of 1000 first day of life (1000 HPK) which is Scaling Up Nutrition (SUN Movement) at the global level. Undernourished intervention carried out since born until the age of two years[5]. Beside the improvement of nutritional status pregnant women, exclusive breastfeeding and weaning food after birth are also very important.

The making of weaning food is prominent local food with ingredients that are inexpensive and easily obtained in the local area[6]. Then weaning food should be high energy and nutrients both macronutrients and micronutrients. One of the foodstuffs in Grobogan with high nutrients but its utility is still lacking is the golden apple snails (*Pomacea canaliculata*). Golden apple snail protein and minerals content such as zinc and iron are quite high so it can improve the children nutritional status and prevent nutrients deficiency in the metabolism process[7]. In addition, golden apple snail also contains omega-3 and omega-6 which is good for the immune system and brain development in children growth[8].

Prevention of undernourished children should be done early with the consumption of weaning food for > 6 months children are vital. One type of weaning food that is appropriate for children aged 6-12 months is baby porridge. Therefore, this research aim to analyze the effect of golden apple snails flour substitution on nutrients content include protein, fat and fatty acids (omega 3 and omega 6), carbohydrates, fiber, water, ash, zinc, iron and also the organoleptic properties.

2. Methods

This is an experimental research with complete randomized design by substitution of golden apple snail with skimmed milk in the making of weaning food (baby porridge). This research divided into two stages, the initial stage of processing golden apple snail flour to be analyzed and as the basic for formulation determination. The second stage is making the weaning food by substitution of golden apple snail based on the formulation determination in the early stage then done to processing of nutrient analysis and organoleptic properties test by panelist acceptance test of the weaning food. This research was carried out in the Integrated Laboratory of Diponegoro University, Food Technology Laboratory of Soegijapranata Catholic University, Integrated Testing and Research Laboratory of Gadjah Mada University, and Central Laboratory of Pollution Prevention Industry (BBTPPI).

The first step is to process the golden apple snail meat into flour by purging the meat and boiled for approximately 30 minutes, then cut the flesh to thin shapes and dried using a dry oven for 24 hours with a temperature of $\pm 50^{\circ}\text{C}$, the dried flesh will be milled using a grinder and filtered using 1000 μm sieve then conducted nutrient content analysis of energy, carbohydrates, fat, protein, fiber, iron, zinc, omega-3 fatty acids and omega-6 fatty acids. In addition to heavy metal analysis that is lead (Pb).

The formulation were determined by the result of golden apple snail flour nutrient analysis, then calculates with the other nutrient contents of the other ingredients (rice flour, skimmed milk, powdered sugar, vegetable oil) which is obtained from the list of foodstuffs compositions book (DKBM) and adjusted to the terms of government regulations (based on Indonesian Ministry of Health Decision in 2007 about instant powder of weaning food for children aged 6-12 months). There were four treatments of golden apple snail flour substitution by 0%, 5%, 10%, and 15%.

The second stage was making the weaning food with golden apple snail flour substitution by 5%, 10%, and 15% and mixed with the other ingredients. The rice flour will be gelatinized first, by boiled glutinous rice flour using water with a ratio of 1:4 then pat dried in dry oven and milled using grinder. After that process done, continued to mixing all the ingredients of weaning food (baby porridge) based

on formulation determination using blender and filtered on the 1000 μm sieve or 18 mesh sieve. That powdered baby porridge will be cooked using water with a ratio of 1:8 for approximately 10-15 minutes.

Furthermore, the powdered baby porridge will be analyzed the nutrient contents with minimal two times repetitions. Analysis of the energy content method using Bomb Calorimeter, carbohydrate content analysis using calculations Carbohydrate-by-difference method, protein content analysis using Bradford method, fat content analysis using Soxhlet method, fiber and ash content analysis using Gravimetric method, water content analysis using Oven method, iron and zinc content analysis using AAS (*Atomic Absorption Spectrophotometry*) method, omega-3 fatty acids and omega-6 fatty acids using GCMS (*Gas Chromatography Mass Spectrometry*). Assessment of 25 panelist acceptance test using organoleptic test on color, aroma, texture, and flavor with four scales of assessments namely 1 (very dislike), 2 (dislike), 3 (like), and 4 (really like). 25 rather-well trained young adult panelists are nutrition science's students of Diponegoro University in Semarang.

The data that has been collected will be analyzed using statistical software. The effects of variation of golden apple snail substitution on nutrient content was tested using one way ANOVA test with 95% confidence degree, and followed by Tukey Posthoc Test to know the real difference between the treatments group, while the acceptance level test using Friedman test and followed by Wilcoxon Test.

3. Results

3.1 Formulation Determination

Nutrients content analysis of golden apple snail flour is required to determine the weaning food formulation then those analysis results could be calculated with the other ingredients of weaning food making process based on the specification requirement of Indonesian Ministry of Health Decision (Keputusan Kementerian Kesehatan RI) in 2007 about instant powder of weaning food for children aged 6-12 months. This formulation determination is aim to determine the best formulation and eligible weaning food (based on the organoleptic test) which can fulfill the children nutrition requirements at age 6-12 months to prevent malnutrition specifically undernourished. In this research, the nutrients content that could be seeded is the fatty acids (omega-3 and omega-6) and also mineral content (zinc and iron). The result of nutrients content analysis of golden apple snail flour is presented in Table 1.

Table 1. Nutrient content of golden apple snail flour (100 grams)

Test parameters	Content	Unit
Energy	363.98	Kkal
Protein	12.73	Gram
Fat	13.67	gram
Carbohydrate	49.68	gram
- Fiber	0.87	gram
Ash	18.78	gram
Water	4.26	gram
Zinc	76.77	mg
Iron	66	mg
Omega 3	1.50	gram
Omega 6	3.07	gram
Lead	<0.00004*	ppm

*Terms of lead level ≤ 1.14 ppm

The determination of formulation aim to increase the nutritional value of weaning food, especially in fatty acids content (omega-3 and omega-6 fatty acids) and mineral content (zinc and iron). Based on calculations of the nutrients content analysis of golden apple snail flour and the nutrient content of other ingredients which is obtained from the list of foodstuffs compositions book (DKBM), the formulation determined is substitution of golden apple snail as much as 5%, 10% and 15%. Experimental formulation in this research is presented in Table 2.

Table 2. Experimental formulation (%)

Ingredients	KM 0 (Control)	KM I	KM II	KM III
Golden apple snail flour	-	5	10	15
Rice flour	35	35	35	35
Skimmed milk	50	45	40	35
Powdered sugar	5	5	5	5
Vegetable oil	10	10	10	10
Total	100	100	100	100

Description: KM is an acronym of Keong Mas

3.2 Nutrient Contents

The results of statistical tests indicate that substitution of golden apple snail flour could affect the fat content and mineral content (zinc and iron) ($p=0.0001$), carbohydrate content ($p=0.011$), water content ($p=0.001$), while there is no effect on the energy content ($p=0.682$), protein content ($p=0.129$), and fiber content ($p=0.482$). Based on Indonesian Ministry of Health Decision about instant powder of weaning food for children aged 6-12 months, the nearest experimental formulation is formulation KM I (5% of golden apple snail flour substitution), all the nutrient content (energy, fat, carbohydrate, fiber, ash, and iron) have been qualified except protein, zinc and water content. Protein and zinc content is below the predetermined standards whereas, water content is over the predetermined standards. The nutrients content analysis of weaning food (four treatments) is presented in Table 3 and Figure 1.

Table 3. Average Result of Energy and Nutrients Content Weaning Food with Substitution of Golden Apple Snail Flour

Average Results	Formulation				<i>p value</i>
	KM 0	KM I	KM II	KM III	
Energy	423.47±59.11	418.05±15.20	421.04±131.57	413.13±90.52	0.682*
Protein	10.77±0.17	13.84±2.30	11.43±1.41	11.49±1.12	0.129*
Fat	11.04±0.78 ^a	11.88±0.84 ^{ab}	13.16±0.74 ^b	20.31±0.98 ^c	0.0001*
Carbohydrate	69.22±1.76 ^a	62.61±2.78 ^{ab}	63.69±2.09 ^a	55.66±0.80 ^b	0.011*
Crude Fiber	1.08±0.69	1.55±0.91	1.21±0.20	1.81±0.59	0.482*
Water	5.01±0.64 ^a	5.48±0.25 ^a	6.53±0.10 ^b	6.22±0.35 ^b	0.003**
Ash	2.84±0.01 ^a	3.25±0.16 ^b	3.58±0.08 ^a	4.16±0.04 ^c	0.001*
Zinc	1.64±0.00 ^a	1.88±0.00 ^b	1.98±0.00 ^c	2.39±0.10 ^d	0.0001*
Iron	1.04±0.00 ^a	6.85±0.91 ^b	12.18±0.10 ^c	17.76±0.02 ^d	0.0001*

Note: numbers are followed by different superscript letters (a, b, c, d) show real differences

*Analysis Test using *One-way ANOVA* ; ** Analysis Test using *Kruskal-Wallis*

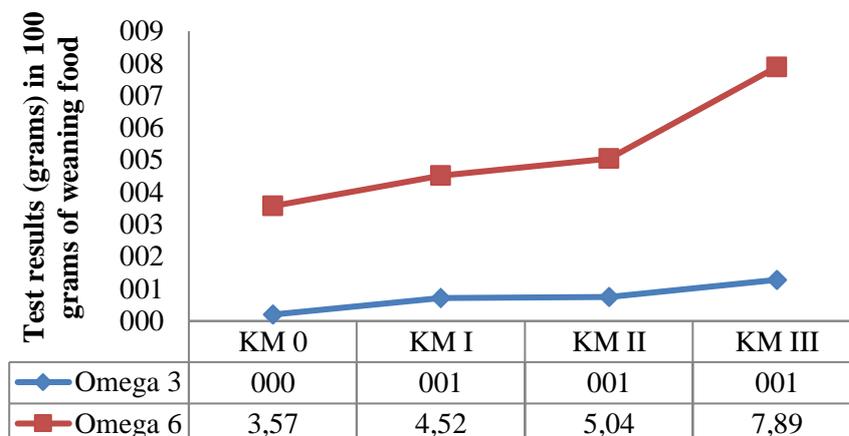


Figure 1. Graphic of Increased omega-3 and omega-6 fatty acids content of weaning food

Since there is no repetitions data for omega-3 and omega-6 fatty acids, the data is presented in descriptively by graphic. Based on the results of omega-3 and omega-6 fatty acids content analysis, there is an increase of omega 3 and omega 6 content of weaning food with substitution of golden apple snail flour by 5%, 10% and 15%. Substitution of golden apple snail flour with skimmed milk can increase the content of omega-3 fatty acids by ± 0.5 gram in each formulation, while the omega 6 contents increases by $\pm 0.5-2$ grams.

3.3 Acceptance Level

Based on organoleptic properties test indicate that substitution of golden apple snail flour could affect the organoleptic properties include color, texture and taste ($p=0.0001$) while not for the aroma ($p=0.798$). Rather-well trained panelists who are young adults tend to choose control formulation (KM 0 with 0% golden apple snail flour substitution) while weaning food with substitution of golden apple snail flour which is acceptable is formulation KM I (5% of golden apple snail flour substitution). The average rate of acceptance level results of weaning food (four treatments) is presented in Table 4.

Table 4. The average rate of acceptance level results of weaning food (four treatments)

Formulation	Color		Aroma		Texture		Flavor	
	Average	Info	Average	Info	Average	Info	Average	Info
KM 0	3.24 \pm 0.66 a	Like	2.72 \pm 0.6 7	Lik e	2.96 \pm 0.73 ^a c	Like	3.08 \pm 0.57 ^{ab} c	Like
KM I	2.08 \pm 0.75 b	Dislik e	2.56 \pm 0.5 8	Lik e	2.16 \pm 0.68 ^a b	Dislik e	2.20 \pm 0.64 ^{ab} e	Dislik e
KM II	2.12 \pm 0.66 c	Dislik e	2.52 \pm 0.7 1	Lik e	2.44 \pm 0.65 ^b e	Dislik e	2.04 \pm 0.67 ^b e	Dislik e
KM III	1.60 \pm 0.65 d	Very Dislik e	2.56 \pm 0.7 6	Lik e	2.16 \pm 0.68 ^c e	Dislik e	1.96 \pm 0.73 ^c e	Very Dislik e
<i>p value</i>	$p = 0.0001^*$		$p = 0.798^*$		$p = 0.0001^*$		$p = 0.0001^*$	

Note: KM is an acronym of Keong Mas, numbers are followed by different superscript letters (a, b, c, d) show real differences

4. Discussions

4.1 Formulation Determination

Based on the nutrient content analysis of golden apple snail flour, omega-3 and omega-6 fatty acids also zinc and iron content could be seeded. In addition the heavy metals content such as lead has qualified based on government regulation which is safe to be an ingredient of making weaning food. Formulation determination is done based on the estimation of nutrient content calculations from the main ingredients of weaning food (rice flour, skimmed milk, powdered sugar, vegetable oil) and substitution ingredient (golden apple snail flour) that has been qualified. However, there are some nutrients which are not appropriate with the initial formulation determination. It occurs due to processing such as heating or interaction between the presence nutrients which can cause the existence of increase or decrease in the content of certain nutrients.

4.2 Nutrient Contents

4.2.1. Energy

Energy content of the 4th formula of weaning food ranges between 413.13-423.47 kcal/100 grams are qualified the specification requirement (400-440 kcal/100 grams)[9]. The energy content can fulfill 11% from the Recommendation Dietary Allowance (RDA) of children aged 7-11 months in one serving of 20 grams and in one day child can consume weaning food in four times so it could be fulfill 44% of RDA in one day. Children energy needs which amounted to 725 kcal/day[10] also fulfill by breastfeeding.

4.2.2. Protein

In this research, the protein content is not stable caused by the use of blender is not constant during the mixing process. Previous research shows that the milling process with blender could lower quality of protein[11]. Dissolve protein content of weaning food with the golden apple snail flour substitution ranged from 11.43-13.84 gram/100 grams that reach approximately 80% of the specification requirement of Indonesian Ministry of Health Decision is 15-22 grams/100 grams. The protein content can fulfill 12-15% RDA of children aged 7-11 months in one serving of weaning food (20 grams)[10].

Protein content decreased along with the increasing of golden apple snail flour substitution is caused by protein content of golden apple snail flour (12.73 grams/100 grams) which is lower than the protein content of skimmed milk (22.5 grams/100 grams), it does not comply with previous research (62%/100 grams).[12] In addition, the heating at temperatures $\geq 60^{\circ}\text{C}$ proved to be able to reduce the protein content in food by as much as ± 1 gram/100 grams[13]. Golden apple snail is known to contain essential amino acids such as histidine, leusin, isoleucine, threonine, methionine, lysine, phenylalanine, and valin, which were involved in the process of children linear growth[14][15].

4.2.3. Fat

The fat content of golden apple snail flour amounted to 13.67 grams/100 grams which higher compared to the fat content of skimmed milk that only amounted to 1 gram/100 grams. Golden apple snail flour substitution could increase the fat content of weaning food. However, formulation KM III (20.31 grams/100 grams) exceeded the specification requirement of 10-15 grams/100 grams, whereas other formulations are qualified[9].

In the making of weaning food, there is animal fat content from golden apple snail apple flour and vegetable fat content from vegetable oil. Vegetable fat such as phospholipids contain lecithin (phosphatidylcholines) that can increase the absorption of nutrients into the cell through its function as cell membrane[15] protector while the animal fat accounted to the most of the essential fatty acids such as omega-3 and omega-6 fatty acids.

4.2.4. *Omega-3 and omega-6 fatty acids*

Omega-3 fatty acids content of golden apple snail flour amounted to 1.50 grams/100 grams and omega-6 fatty acids amounted to 3.07 grams/100 grams or 10.96% omega-3 and 22.45% omega-6 of the fat content that high compared to with other foodstuffs such as poultry, meat and some types of freshwater fish[7][16]. The omega-3 content of weaning food can fulfill 38-51% RDA while the omega-6 can fulfill 20-35% RDA of children aged 7-11 months in one serving (20 grams)[10]. Omega-3 fatty acids have an importance role in the brain intelligence and bone growth[17][18] while the omega-6 fatty acids can prevent the energy loss during metabolic process as to prevent energy deficiency[19] and the role of both fatty acids in increasing the concentrations of Growth Hormone (GH)[19][20].

4.2.5. *Carbohydrate*

Carbohydrate content of weaning food range between 55-69 grams/100 grams, it contributes about 1.08-1.81 grams/100 grams of crude fiber. There is no specific specification of carbohydrate content in weaning food, but there is only specification requirement for the fiber content that should not exceed 5 gram/100 grams. Carbohydrate content of four treatments of weaning food can fulfill 13-16% RDA of children aged 7-11 months[10]. Carbohydrate content of weaning food is decreased along with the increasing of golden apple snail flour substitution caused by carbohydrate content of skimmed milk is higher than golden apple snail flour[21].

4.2.6. *Fiber*

Fiber content on animal food tends to be lower than on vegetable food. Fiber content of golden apple snail flour amounted to 0.87 grams/100 grams is equivalent to freshwater fish which is only about 0-1%[22]. The varieties of fiber golden apple snails among others are cellulose, hemicellulose and lignin. The fiber content of golden apple snail is influenced by their living environment. Rice field environment contain organic material such as lignin and cellulose[23]. The fiber content in 100 grams weaning food has qualified the specification requirement because it's not exceeding 5 grams/100 grams[9].

Children should be introduced by weaning food at aged > 6 months. At that age, children have digestive systems adaptation especially in the absorption phase in the intestine. The fiber cannot fully ferment. Therefore, there are two types of fiber digestion results in small intestine. Firstly, the fermented part which has the prebiotic function as oligosaccharides in breast milk, then the non-fermented part which has a role in the feces softening[21]. Fiber content of weaning food should be qualified the specification requirement of Indonesian Ministry of Health Decision because it can cause digestive system disorder and mal-absorption of certain nutrients in the intestine[24].

4.2.7. *Water*

Golden apple snail flour has high water content that is $\pm 4\%$ or 4 grams/100 gram. Golden apple snail flour substitution can increase the water content of weaning food. The content of weaning food water ranges 5.48-6.53 grams/100 grams which tend to exceed the specification requirement

limit of Kepmenkes (4 grams/100 grams). Besides the substitution of golden apple snail flour that contain high water content, the high water content of weaning food is caused by inadequate drying process which uses dry oven or hot air drying (HAD). The evaporation process of water in the dry oven is very minimal and slow which caused the moisture of the material tends to still high[13][25]. The high water content is related to the food shelf life because of the increase of microbial activity in that food. It can be overcome by storing the weaning food in the closed and airtight container, also save it in relatively low temperature place[26].

4.2.8. Ash

High content of mineral in golden apple snail flour is related to its ash content which is also quite high[27]. The ash content of golden apple snail flour is 18.78 grams/100 grams, which contribute about 3.25-4.16 grams/100 grams of weaning food. There is no specification requirement of Kepmenkes for ash content of weaning food, but according to the Indonesian National Standards (SNI-01-7111.1-2005) about instant powder weaning food, ash content in baby food aged 6-12 months does not exceed 3.5 grams/100 grams, so that the formulation KM III (15% of golden apple snail substitution) is not eligible[28].

4.2.9. Zinc

Zinc content of 100 grams golden apple snail flour is very high at 76.7 mg/100 grams which is equivalent to the oysters zinc content[29]. Golden apple snail flour substitution proved to increase the zinc content of weaning food, but inconsistency with the initial formulation estimation which is only the last formulation (KM III with 15% substitution of golden apple snail flour) in accordance with the specification requirement (2.5-4 mg/100 grams). However, the zinc content can fulfill 12-15% RDA of children aged 7-11 months in one serving (20 grams)[10].

The lack of zinc content could be caused by the mixing process with the other ingredients, especially with vegetable oil, which is high in phytoestrogen content like ligand, resulting in a binding process between zinc and ligand causing the zinc content of weaning food decreasing[30]. Children aged > 6 months require zinc intake with high bioavailability[31]. Animal proteins in golden apple snail tend to contain less phytic content, thus increasing the absorption of zinc in cell membrane[32][33].

4.2.10. Iron

The amount of iron content in 100 grams weaning food is 66 mg which is known to be higher than the previous research (48 mg/100 grams)[7]. The iron content of weaning food with golden apple snail flour substitution ranged 6.85-17.76 mg/100 grams that can fulfill 19-5-% RDA of children aged 7-11 months in one serving (20 gram)[10]. Iron content in the last two formulation (KM II and KM III which has 10% and 15% golden apple snail substitution) higher than the specification requirement (8 grams/100 gram)[9]. The results are also higher than the initial formulation estimation which ranged 3.98-10.52 mg/100 grams, it may due to the processing that tends to use iron-cookware[34].

The iron content of golden apple snail flour included in heme irons that can easily absorption sue to the low content of phytic in animal food[35]. Excessive intake of iron in children can lead to poisoning and indigestion such as nausea, vomiting and chronic diarrhea while for long-term can cause liver damage[34].

4.3 Acceptance Level

4.3.1. Color

The statistical results show that there are color differences from the four treatments of weaning food with golden apple snail flour substitution. The panelist tend to prefer formulation KM 0 (control) and very dislike the color of formulation KM III (15 % substitution of golden apple snail flour) because of the darker color (tend to approach the color of gray sand). This is because the color of golden apple snail meat is dark (blackish brown)[36] and the drying process causes the color of the golden apple snail flour to be darken[37].

4.3.2. Aroma

There is no effect of golden snail flour substitution with the aroma of weaning food. Almost all panelists like the four treatments of weaning food. The flavor of golden apple snail flour that was originally fishy can be removed after cooking process for \pm 15-20 minutes. The typical scent of golden apple snail caused by compounds such as volatile fatty acids and amino acids, the aroma is the result of enzymatic reactions and the content of the components derived from the living environment[37]. The antioxidant content of the golden apple snail is known to prevent the reduction of aroma quality[38].

4.3.3. Texture

The golden apple snail flour is significantly affect the texture of weaning food. Panelists tend to like the texture of formulation KM 0 (control), the higher percentage of golden apple snail flour substitution the more thicken the texture. The coagulated texture is produced form actomiosin content of the golden apple snail protein[37]. It is also due to the high carbohydrate content in golden apple snail that decreases the protein thermodynamic affinity in the aqueous solution and increases the gelling capacity of the weaning food[39]. The cooking process of the weaning food with water causes the crystallization or starch to produce a coagulant texture. Therefore, this baby porridge should be consumed quickly in a warm state so that the texture is not increasingly agglomerate[25].

4.3.4. Flavor

In flavor assessment, the panelist also selected formulation KM 0 (control) as the most preferred flavor and formulation KM III (15% golden apple snail substitution) as the least favored weaning food flavor. There are significant differences in ach formulation. The combination of the savory flavor and the sweet taste of the powdered sugar is still no acceptable to young adult panelists. The process of cooking the weaning food causes the taste becomes more tasty, because the denaturation of protein into amino acids. The glutamate amino acids contained in the golden apple snail cause tasty taste in the weaning food[37]. The content of the glutamate amino acid in the golden apple snail is 10%/100 grams[14].

4.4 Formulation Selection

Weaning food with golden apple snail flour substitution has approached the specification requirement of Indonesian Ministry of Health Decision is formulation KM I with 5% of golden apple snail flour substitution, while other formulation (KM II and KM III) are not suitable because of the water, iron and fat content are exceeding form the specification requirement. For the acceptance level test of weaning food with substitution of golden apple snail flour, the formulation that could be acceptable besides the control formulation (KM 0) is the formulation KM I. So the selected formulation is KM I by 5% golden apple snail flour substitution. The formulation KM I is

also selected based in the presentation graphic of the nutrient content data and the acceptance level test of weaning food presented in Figures 2 and 3.

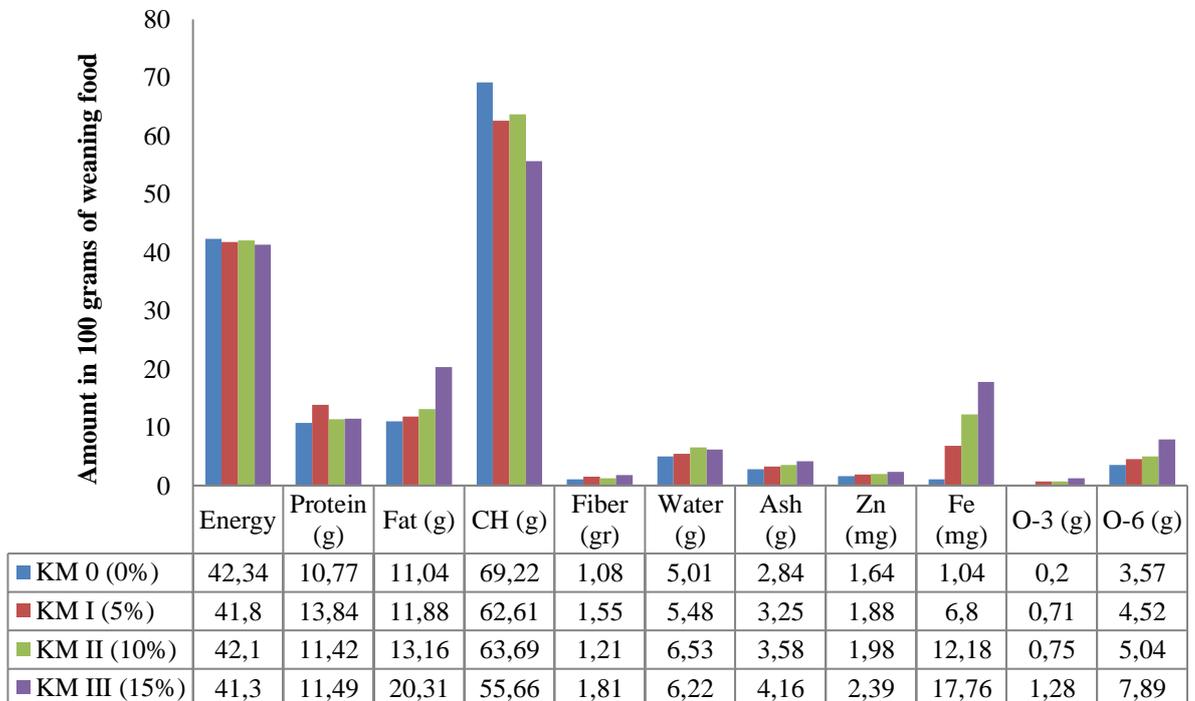


Figure 2. Nutrients Content Analysis Test Results of Weaning Food

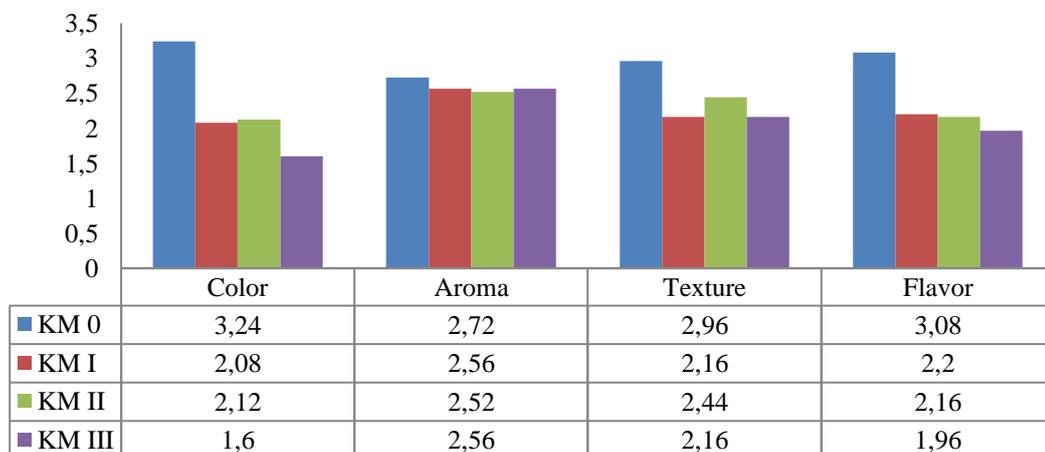


Figure 3. Acceptance Level Test Results of Weaning Food

4.5 Contribution of Nutritional Adequacy

Contribution in one serving (20 gram) of weaning food with golden apple snail flour substitution has fulfill RDA of children aged 7-11 months. In addition, it is in accordance with commercial instant baby porridge product with chicken and fish flavor for children aged 6-12 months while higher on the omega-3 and omega-6 fatty acids. So that, the formulation KM I can compete with the other commercial products. The presentation of contribution data on nutritional adequacy is presented in Table 5.

Table 5. Presentation of Formulation KM I Data Adjusted with Indonesian Ministry of Health Decision and % Fulfillment of Children RDA

	Formulation KM I (5%)	Specification Requirement of Indonesian Ministry of Health Decision	% Fulfillment of RDA Children in One Serving (20 gram)
Energy	418.05 kcal	400-440 kcal	11.5%
Protein	13.84 gram	15-22 gram	15.3%
Fat	11.88 gram	10-15 gram	6.6%
Omega 3	0.71 gram	-	28.4%
Omega 6	4.52 gram	Min. 1.4 gram	20.5%
Carbohydrate	62.61 gram	-	15.2%
Fiber	1.56 gram	5 gram	3.1%
Water	5.48 gram	4 gram	-
Ash	3.25 gram	3.5 gram (SNI terms)	-
Zinc	1.88 gram	2.5-4 gram	12.5%
Iron	6.85 gram	5-8 gram	19.5%

5. Conclusion

1. Golden apple snail flour substitution with four treatments level (0%, 5%, 10%, 15%) could increase water, ash, fat, zinc, iron, omega-3 fatty acids and omega-6 fatty acids contents while decreases carbohydrate content. There is no relation between golden apple snail flour substitution and the content of energy, protein, fiber of weaning food.
2. There are differences in panelist acceptance level test on the color, texture and flavor of the weaning food with organoleptic properties test, while there is no effect on the assessment of aroma of the weaning food.
3. Selected formulation (KM I with 5% of golden apple snail flour substitution) can comply 80-100% the specification requirement of Indonesian Ministry of Health Decision and panelists of acceptance level test are reasonably accepted

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