Article

Not peer-reviewed version

Development of Analog Rice Made from Cassava and Banana with The Addition of Katuk Leaf (Sauropus androgynous L. Merr.) and Soy Lecithin for Lactating Women

Meta Mahendradatta *, Esra Assa, Jumriah Langkong, Abu Bakar Tawali, Dwi Ghina Nadhifa

Posted Date: 9 April 2024

doi: 10.20944/preprints202404.0660.v1

Keywords: analog rice; Sauropus androgynous; lactating women; banana; cassava

Article

Development of Analog Rice Made from Cassava and Banana with The Addition of Katuk Leaf (*Sauropus androgynous* L. Merr.) and Soy Lecithin for Lactating Women

Meta Mahendradatta *, Esra Assa, Jumriah Langkong, Abu Bakar Tawali and Dwi Ghina Nadhifa

Department of Agricultural Technology, Hasanuddin University, Makassar 90245, Indonesia; esraassakalapadang@gmail.com (E.A.); jumriah_langkong@yahoo.com (J.L.); abubakar_tawali@yahoo.com (A.B.T.); dgnadhifa@gmail.com (D.G.N.)

* Correspondence: meta-mahendradatta@unhas.ac.id (M.M.); Tel.: 62-821-8932-9160

Abstract: The development of analog rice, apart from being an effort to diversify food, also has the potential to be develop as functional food in fulfilling the nutrients needed by a community. Katuk leaf is known for its ability to accelerate breast milk production for lactating women which is inseparable from sterol as bioactive content. This study aimed to determine the best formulation of analog rice made from cassava flour, banana flour, Katuk leaf powder and soy lecithin that was sensory acceptable, in a shape resembling rice, and able to fulfill the nutritional needs of lactating women. Analog rice was produced using extruder machine before the physical and sensory properties analyses were carried out, followed by the chemical properties analysis. Formulation C (80% cassava flour, 20% banana flour, 3% Katuk leaf powder and 0.5% soy lecithin) was obtained as the best or most preferred formulation based on sensory analysis which the grain shaped oval round resembling original rice and had green-brownish color, fluffy texture, distinct aroma and taste derived from the raw material used. Therefore, this research is expected to support the development of analog rice for providing the main staple food for fulfilling the lactating women's nutrition.

Keywords: analog rice; *Sauropus androgynous*; lactating women; banana; cassava

1. Introduction

Analog rice is a processed product shaped like rice grains that can be made from a mixture of rice and non-rice flour with the addition of water and has a nutritional content that approaches or exceeds that of paddy rice [1]. The increasing consumption of rice as a staple food is in line with the increasing population in Indonesia hence resulting in increased rice imports due to the high dependence on rice consumption [2,3]. Analog rice is one of the alternatives to substitute paddy rice and to overcome the food availability, all the more its nutritional content can be easily designed to fulfill the specific nutrients needed [2,4]. One of the groups of people who need certain nutrients is lactating women. Insufficient breast milk production is a problem that many lactating women face [5–7]. Nutritional fulfilment for lactating women to increase their breast milk supply can be achieved by consuming Katuk leaves whose ability to facilitate breast milk is inseparable from its active compounds, namely alkaloids and sterols [8,9]. The addition of Katuk leaves in making analog rice is carried out to be one of the efforts to fulfil nutrition for lactating women.

Analog rice can be made by utilizing local food ingredients as carbohydrate sources that are available in abundance such as tubers, cereals, pulses, and other materials whose composition and properties will determine the nutritional content and characteristics of the analog rice produced [10–12]. Some of the carbohydrate sources that can be utilized are cassava and bananas. Cassava is a type of tropical plant whose tubers contain lots of nutrients such as carbohydrates, calories, vitamins, minerals, protein, and fat in small amounts, as well as various types of fiber (complex fiber, soluble dietary fiber, and insoluble fiber) [13–15]. The amount of carbohydrates contained in cassava is higher than that in other types of food, such as rice and corn (40% and 20% higher than rice and corn, respectively) [14,16]. Moreover, bananas also contain relatively high nutritional content, such as calories and carbohydrates, making bananas an opportunity to be used as an alternative source of carbohydrates in the form of analog rice [17,18]. In addition to adding the main ingredients, it is also necessary to add additional ingredients to reduce the rehydration time and obtain rice grains with a soft, firm texture that do not break easily when cooked [19]. Soy lecithin can be added to analog rice extrusion products to improve texture, reduce adhesive power, and improve the shape of the final product after the hydration process [20]. Another benefit of soy lecithin is that it helps increase milk production for lactating women because lecithin is composed of choline, which acts to prevent plugged ducts without unpleasant side effects for lactating women [21,22]. This shows the potential of both cassava and banana as sources of calories and can be an alternative to rice, which has quite an important role in supporting the food security of a region and can be used as a staple food diversification program through the development of analog rice with the addition of soy lecithin to improve its texture.

The development of analog rice by utilizing local ingredients has previously been carried out. Sada et al. made analog rice with the substitution of mocaf, mung bean and purple corn [23], Rumitasari made analog rice with a combination of white corn and mung bean [24], Hasbullah et al. with the analog rice formulation consisting of mocaf flour and modified suweg flour [25], and analog rice made by Sulfi et al. consisted of cassava and mung bean [26]. The manufacturing of analog rice with a combination of cassava flour and banana flour, with the addition of Katuk leaf powder, has never been carried out before where the analog rice produced has added value as a functional food for fulfilling the nutrition of lactating women.

The supply of breast milk to nursing women is very important for the fulfillment of baby nutrition during the growth and development period [27,28]. Women who breastfeed need 500-1000 more calories than women who don't breastfeed [29]. Based on this description, it is necessary to carry out further research regarding the proper formulation in the manufacture of analog rice originating from Indonesia local food ingredients as a source of carbohydrates to replace rice and be able to meet the nutritional needs of lactating women with a taste that can be accepted by consumers. Therefore, this study aimed to obtain the best formulation of analog rice based on lactating women's preferences, and to produce analog rice that resembles rice in general, as well as to obtain the physical and chemical properties of the analog rice produced.

2. Materials and Methods

2.1. Production of Analog Rice

The analog rice formulation refers to [17] with modifications. The formulation for making analog rice can be seen in Table 1.

Table 1. Analog rice formulation of cassava and banana flours ratio. A: 60%:40%, B: 70%:30%, C: 80%:20%.

Sample Code	Cassava Flour		Banana Flour		Katuk Leaf Powder	Soy Lecithin	Water	Total
	G	%*	g	%*	%*	%*	%*	%*
A	46.20	60	30.80	40	3	0	20	100
B	53.72	70	22.83	30	3	0.25	20	100
C	61.20	80	15.30	20	3	0.50	20	100

*Percentages based on total flour weight.

Preprints.org (www.preprints.org) | NOT PEER-REVIEWED | Posted: 9 April 2024 doi:10.20944/preprints202404.0660.v1

The literature of analog rice production refers to Damat et al. [30] with modification. Analog rice was produced using extrusion technology, which consists of several process stages (Figure 1) including material preparation, mixing, steaming, molding using an extruder machine, and drying. The preparation of the material begins with sifting the Katuk leaf powder using a 100-mesh sieve. Furthermore, the ingredients, namely cassava flour, banana flour, Katuk leaf powder, and soybean lecithin, were weighed according to the formulation. The next stage is the mixing process. The ingredients, consisting of flour and soy lecithin, are mixed first and stirred for 3 minutes until evenly distributed. Then, 20% water is added little by little to the ingredients that have been mixed and stirred again for 10 minutes until the ingredients are evenly mixed and form a dough with a slightly wet texture. Next, the dough is wrapped in a filter cloth and steamed in the boiler for 30 minutes. After that, it is printed using an extruder machine, and during the extrusion process, the dough will flow and print through the die (mold). The obtained analog rice grains were then dried in a blower oven at 60 °C for 3 hours to reduce the moisture content of the analog rice to 14%.

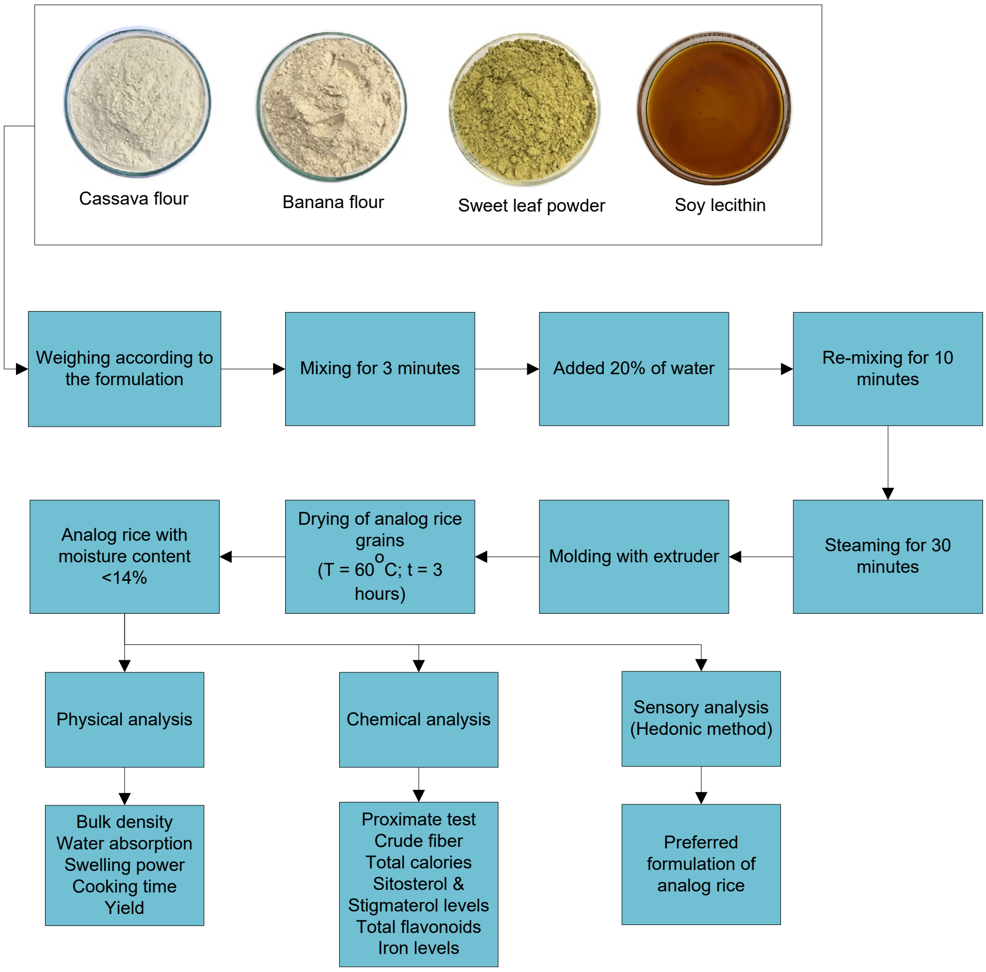


Figure 1. Detailed illustration of the experimental method.

2.2. Physical and Chemical Analyses of Analog Rice

Physical analysis was measured in 1st stage for bulk density [31], absorption [17], swelling power [17], cooking time [30], and yield of cooked analog rice [32]. After the evaluation of consumer preference, a chemical analysis was conducted. Chemical analysis which was measured for 2nd stage were proximate analyses (moisture, ash, protein, fat, and carbohydrate by difference [33], crude fiber [34], total calories [35–37], sitosterol and stigmasterol levels [38], total flavonoids [39], and iron (Fe) levels (Nasution et al., 2022).

Preprints.org (www.preprints.org) | NOT PEER-REVIEWED | Posted: 9 April 2024 doi:10.20944/preprints202404.0660.v1

2.3. Sensory Analysis of Analog Rice

The sensory analysis used in this study was the hedonic method refers to Arifin et al. [41] with 3 levels of scale such as 1 = dislike, 2 = neutral, and 3 = like analog rice samples. The panelists were 25 breastfeeding mothers aged 18-40 years who were asked to observe their preference for raw and cooked analog rice which include color, odor, texture, taste, and overall appearance.

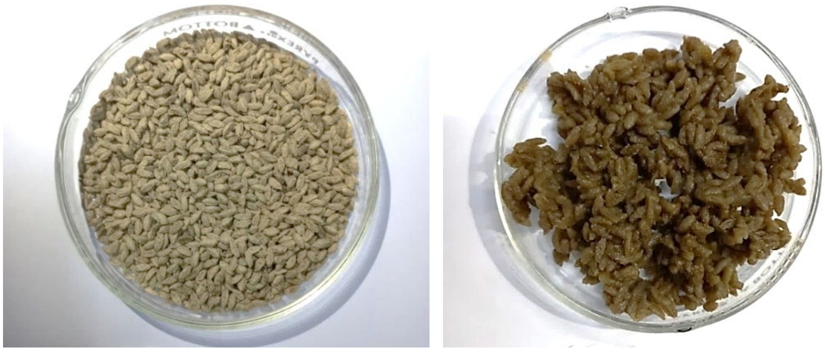
2.4. Statistical Analysis

The resulting data were processed using a completely randomized design (CRD) with three repetitions, and the results obtained for each parameter were analyzed using an ANOVA with three repetitions. Duncan's test was used to confirm the differences between treatments. The software used for data processing was Microsoft Excel 2016 and IBM SPSS Statistics 24.

3. Results and Discussion

3.1. Analog Rice

The manufacture of analog rice in this study used hot extrusion technology which in its processing used temperatures above 70°C obtained from steamed heaters [42]. The preferred analog rice produced in this study (Figure 2) has a shape resembling rice in general, which is oval with a brownish-green color derived from the raw materials of cassava, banana and Katuk leaves used. Analog rice produced after cooking has a fluffy texture like rice in general, a deeper color, as well as the aroma, and the taste produced has distinctive characteristics derived from the ingredients used. Analog rice can be cooked using an electrical rice cooker or the conventional method with a steamer. In this research, the result of analog rice was cooked using a conventional cooking method. The cooking of analog rice using a steamer can be done by filling the steamer pot with water up to the limit of tera and bringing it to a boil, then the analog rice is put in and boiled until half cooked, after which the steamer pot filter is removed and the remaining water from cooking the analog rice is replaced with new water then the analog rice is steamed. The cooking of analog rice lasted for 10-15 minutes and the characteristics of cooked rice are characterized by not having white spots in the middle and the texture of the rice turns chewy [30].



(**a**) (**b**)

Figure 2. Preferred analog rice with ratio of cassava flour and banana flour 80%:20%. (**a**) raw analog rice, (**b**) cooked analog rice.

3.2. Physical Properties

The analog rice formulations produced had no significant effect (P>0.05) on all of the physical parameters consisting of bulk density, water absorption, swelling power, cooking time, and yield of analog rice which can be seen in Table 2. The bulk density obtained in all three analog rice formulations showed no significant differences ranging from 0.55-0.57 g/ml with a ratio of cassava and banana flour of 60%:40% as the highest. Analog rice with greater bulk density indicates that the porosity of analog rice is lower [43–45]. This is attributed to water loss during the drying process in analog rice-making [44,46,47] and is influenced by the moisture content of raw materials and the type of ingredients [48,49]. A large bulk density value will require a smaller storage space, and vice versa [47,50]. Bulk density is also influenced by the addition of soy lecithin that contains more than 90% fat which has a lower density, resulting in a decrease in bulk density [51–53].

Table 2. Physical Analyses Results of Analog Rice.

Physical Properties	Ratio of Cassava and Banana Flours		
	A (60% : 40%)	B (70% : 30%)	C (80% : 20%)
Bulk Density (g/ml)	0,57 ± 0,02	0,56 ± 0,01	0,55 ± 0,02
Water Absorption (%)	76,54 ± 1,78	75,08 ± 1,53	77,27 ± 1,15
Swelling Power (%)	29,45 ± 5,17	27,93 ± 5,01	31,64 ± 5,06
Cooking Time (minutes)	14,15 ± 0,09	14,06 ± 0,07	14,07 ± 0,03
Yield (%)	58,58 ± 9,25	61,73 ± 5,51	67,67 ± 1,91

Generally, the water absorption capacity of a material is related to its bulk density value [45,49]. Low bulk density in analog rice indicates that the analog rice has high porosity [45,54]. According to Yulviatun et al., the higher the porosity of the analog rice produced, the greater the water absorption due to the greater number of cavities between particles [45]. The highest water absorption value of analog rice was obtained in the 80%:20% ratio of cassava and banana flours (77.27%) with no any significant difference from the other two formulas. The high water absorption was influenced by the high starch content of the ingredients used in the formulation, especially the amylose content which has an amorphous region [55–57]. In addition, soy lecithin as a stabilizer can absorb water and increase the water absorption of analog rice because soy lecithin has hydrophilic groups, so its ability to bind water from the air will be faster [58–60].

The highest swelling power value was obtained in the 80%:20% ratio of cassava and banana flour (31.64%) which was influenced by the amylopectin and amylose content contained in the ingredients. Banana has a low amylose content, which is 11.2% [61], while cassava has a higher amylose content, around 30% [62]. The high starch and amylose content found in the ingredients affects the swelling power [63]. Amylose which has amorphous regions is reactive to water molecules causing the amount of water absorbed into starch to increase [64,65]. Analog rice made with a 70:30 ratio of cassava flour and banana flour showed the lowest swelling power (27.93%), which was inconsistent with the increase in starch content. In this case, non-starch components such as the addition of soy lecithin affected the swelling power of the analog rice. Phospholipids present in soy lecithin can easily associate with starch present in the material to form starch-lipid complexes, and these complexes limit the swelling of starch granules [63,66,67].

Cooking time shows the length of time needed to cook the rice until it is cooked. The results obtained in the cooking time of analog rice made from cassava flour and banana flour from the three formulations were around 14 minutes. Analog rice cooking in this study was done conventionally using a steamer pot with boiling and steaming stages. The time needed to cook analog rice in this study was 6 minutes faster when compared to paddy rice which took 20 minutes. Herawati et al. stated that rice requires a longer cooking time of 20.5 minutes [68], while the cooking time required for analog rice is 10-15 minutes faster than paddy rice [69]. This is influenced by the process of making analog rice that has gone through a pre-heating process so that the analog rice starch has been gelatinized [42,70]. As a result, the water absorption of starch increases, thus the cooking time becomes shorter [71]. The higher the water absorption and cooking temperature, the faster the cooking time [72,73].

The yield obtained in the production of analog rice indicates the loss of product during the process. The highest yield was obtained in the analog rice formulation with a ratio of cassava flour and banana flour of 80%:20% (67.67%) followed by 70%:30% ratio (61.73%) and 60%:40% ratio (58.58%). This was influenced by the addition of soy lecithin to the formulation which functions as a binder to improve texture improve the shape of the final product after the rehydration process, and reduce adhesion [20,74], increasing yield. This is following the findings of Aini et al. and Van Buren et al. which state that binders function to reduce cooking loss during the processing process and cause product yields to increase [75,76]. In addition, the yield value can be influenced by temperature, drying time, and moisture content [77,78].

3.3. Proximate Content

The results obtained as shown in Table 3, showed that the three analog rice formulations had no significant effect (P>0.05) on the moisture content, ash content, protein content, and carbohydrate content of analog rice but gave a significant effect (P<0.05) on the fat content of the analog rice produced. The moisture content of the three analog rice formulations (around 7%) met the requirements of safe moisture content for rice according to SNI 01-6128-2008, which is <14%. A moisture content of <14% will prevent mold growth that often grows on rice, cereals, and grains [30,79]. According to Mishra et al. analog rice needs to be dried to a moisture content of 4-15% to achieve optimal moisture content to increase shelf life [80]. The moisture content of a food product can be influenced by the addition of water to the ingredients [42], the steaming process [81,82], and the drying process [81,83].

Table 3. Proximate Analyses Results of Analog Rice.

Proximate Properties (%)	Ratio of Cassava and Banana Flours		
	A (60% : 40%)	B (70% : 30%)	C (80% : 20%)
Moisture content	7,15 ± 0,21	7,36 ± 0,69	7,61± 0,44
Ash content	2,20 ± 0,04	1,54 ± 1,29	2,32 ± 0,10
Protein content	2,77 ± 0,15	2,76 ± 0,12	3,07 ± 0,21
Fat content	0,80 ± 0,02[a]	0,60 ± 0,07[b]	0,48 ± 0,06[c]
Carbohydrate content	87,08 ± 0,29	87,73 ± 1,88	86,53 ± 0,74

Mean values with different letters are significantly different (*P<0.05*).

Ash content is the result that remains from a sample of food that is completely burned in the ashing process. The ash content obtained from the three analog rice formulations (1.54-2.32%) is under the requirements for analysis of ash content in healthy foods according to SNI 01-7111.1-2005 standards, namely 3.50% maximum. According to The Indonesian Food and Drug Authority, ash content below 3.50% is good for consumption because the minerals contained in it are good for health [85]. The ash content in food is influenced by the type of material used [86,87], and the drying process [88,89]. The addition of soy lecithin to the analog rice formulation contains minerals consisting of calcium, sodium, potassium, iron, magnesium, and copper [90]. Besides that, the drying process results in the decomposition of the water molecule bonding components and also increases the mineral content, resulting in an increase in the ash content [91,92]. However, ash content in food can decrease caused by the steaming process due to minerals solubility in water during the heating process, resulting in a lower ash content [93,94].

The protein content results have no significant difference with the highest value were obtained at a ratio of 80%:20% (3.07%), and the lowest value was obtained at a ratio of 70%:30% (1.54%). The value of protein content is affected by the extrusion and heating processes. During the extrusion process or the application of heat such as drying and steaming in the production of analog rice, the protein component in the raw material will experience the breaking of hydrogen bonds, denaturation, and modification of its structure, so that the structure of the protein will be damaged and cause a decrease in protein content [54,95]. Meanwhile, the increase in the protein content of analog rice could be due to the increase in the concentration of soy lecithin in the formulation. Soy lecithin contains a protein content between 232 and 1338 mg/kg [96,97]. This is to the statement of Adelina et al., that the amount of artificial rice protein will increase by adding a protein source [98].

The results of the fat content obtained in this study showed a low value when compared to rice in general, namely 1.37%. As the concentration of cassava flour increases and the concentration of banana flour decreases, the fat content of the analog rice produced decreases. The highest fat content was obtained at a ratio of 60%:40% cassava and banana flour (0.80%), followed by a ratio of 70%:30%

Preprints.org (www.preprints.org) | NOT PEER-REVIEWED | Posted: 9 April 2024 doi:10.20944/preprints202404.0660.v1

(0.60%), and a ratio of 80%:20% (0.48%) with a significant (P<0.05) difference. The use of flour ingredients added to the formulation causes a decrease in moisture content, which causes an increase in solids, increasing the fat content of the material. This is in line with Novrini, that the total fat content is inversely proportional to the total moisture content in the ingredients. The fat content in the material used can function as a lubricant in the extruder machine, making it easier to produce and mold the dough [99].

The carbohydrate content obtained in the analog rice production was higher when compared to rice, which contained 80.14% carbohydrates [100]. The analog rice produced from cassava and banana flours has no significant difference of carbohydrate content, ranging from 86-87%. The high carbohydrate content of the analog rice obtained indicates that the analog rice can be used as an alternative source of carbohydrates and calories to rice. Budi et al. in their research related to analog rice made from corn flour, sorghum flour, and starch obtained a carbohydrate content of 91% [42], while Noviasari et al. producing analog rice with the combination of sorghum and mocaf flours with the addition of arenga starch and corn starch obtained a carbohydrate content of 91-94% [101]. The high carbohydrate content was influenced by the type of material used in the manufacture of analog rice. Where in this study cassava flour and banana flour were used as high carbohydrate sources so that the carbohydrate content of the resulting analog rice was also high [102].

3.4. Total Calories

Calories can be interpreted as an energy unit that describes the amount of potential energy contained in a food. The results of the total calorie analysis can be seen in Figure 3. The results of the analysis of variance showed that the comparison of cassava flour and banana flour in the formulation of analog rice had no significant effect (P>0.05) on the total calories of analog rice with a ratio of 70%:30% as the highest value (367.36 Kcal). The high results obtained on total calories are influenced by the levels of carbohydrates, proteins, and fats contained in the ingredients used. The higher the three components, the higher the energy contributed, and likewise, the total calories produced will be higher. Analog rice calories obtained in this study were around 362-367 Kcal, which was higher than refined rice, namely 360 kcal [30]. The high total calories in analog rice can be used as energy intake in carrying out activities, especially for lactating women who require a higher calorie intake of 500–1000 [29]. This is in line with the statement by Jannah et al., that analog rice can be used as an alternative to rice because it contains high calories [103]. At a ratio of 80%:20%, the caloric value obtained decreased, which was influenced by the low acquisition of fat and carbohydrate content, so that when the calculation was carried out, it resulted in a low total caloric gain. This is confirmed by Schriani & Yulianti, who say that the energy value of food is determined by calculating the composition of carbohydrates, fats, and proteins [104].

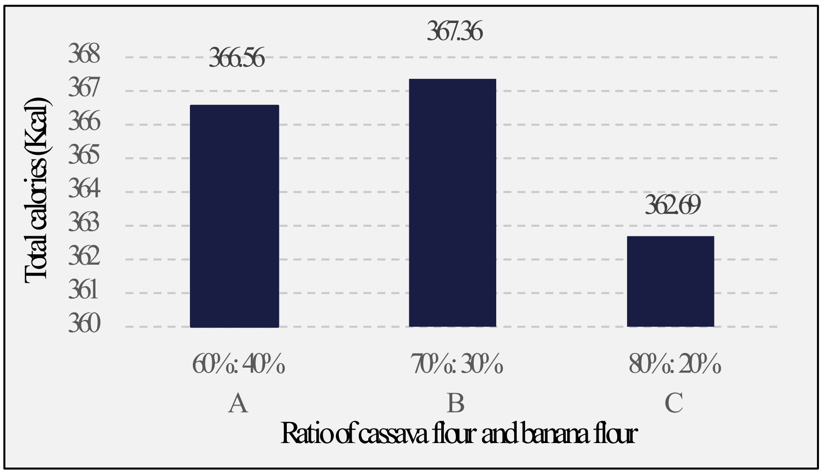


Figure 3. Ratio correlation of cassava flour and banana flour to the total calories of analog rice.

3.5. Crude Fiber Content

Crude fiber is a part of dietary fiber that cannot be hydrolyzed by certain chemicals, namely sulfuric acid (H_2SO_4) and NaOH. The results of the analysis for crude fiber content can be seen in Figure 4. The analog rice formulation, in comparison to cassava flour and banana flour, had no significant effect (P>0.05) on the crude fiber content of the analog rice. The crude fiber content in this study which ranged from 6.45-7.01% was higher when compared to several rice varieties of Indonesia which ranged from 0.43-1.83% [105].The crude fiber content obtained in this study indicated that the more additional ingredients used, the higher the analog rice's crude fiber content. This is caused by the ingredients used, which consist of cassava flour, banana flour, and Katuk leaf powder. The crude fiber content found in cassava flour is 2.41% [106], and in banana flour is 2.0% [107], while Katuk leaf contains between 1.07-1.87% of crude fiber [108].

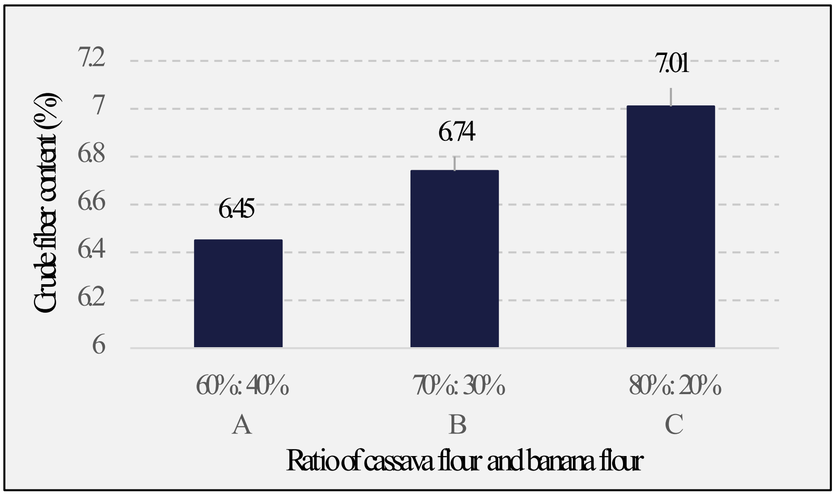


Figure 4. Ratio correlation of cassava flour and banana flour to the crude fiber content of analog rice.

3.6. Phytosterol Levels

The phytosterol analysis carried out in this study consists of sitosterol and stigmasterol levels. The results of the phytosterol analyses can be seen in Figure 5. The results showed that the comparison of cassava flour and banana flour with the addition of soybean lecithin had no significant effect (P>0.05) on the β-sitosterol levels of analog rice, whereas on stigmasterol levels had significant effect (P<0.05) in the analog rice. The increase of phytosterol levels contained in analog rice can be caused by the addition of Katuk leaf powder. Katuk leaf powder contains 2433.4 mg/100 g dry of phytosterol [109], which contributes to the sterol and stigmasterol levels in analog rice. In this study, the higher the addition of soy lecithin, the higher the sitosterol content of analog rice obtained, ranging from 1.50-1.37% with a ratio of 80%:20% as the highest. Sitosterol can be obtained from soybean lecithin, which is the residue from the processing of soybean oil and contains sitosterol. This is in accordance with Krisnawati, soybean oil contains 300–400 mg of sterols per 100 grams, with levels of β-sitosterol (53-56%), stigmasterol (17–21%), and campesterol (20–23%) [110]. This is also confirmed by the statement of Sihmawati & Rosida, that soy lecithin contains a sterol component of 2-5% [111].

Preprints.org (www.preprints.org) | NOT PEER-REVIEWED | Posted: 9 April 2024 doi:10.20944/preprints202404.0660.v1

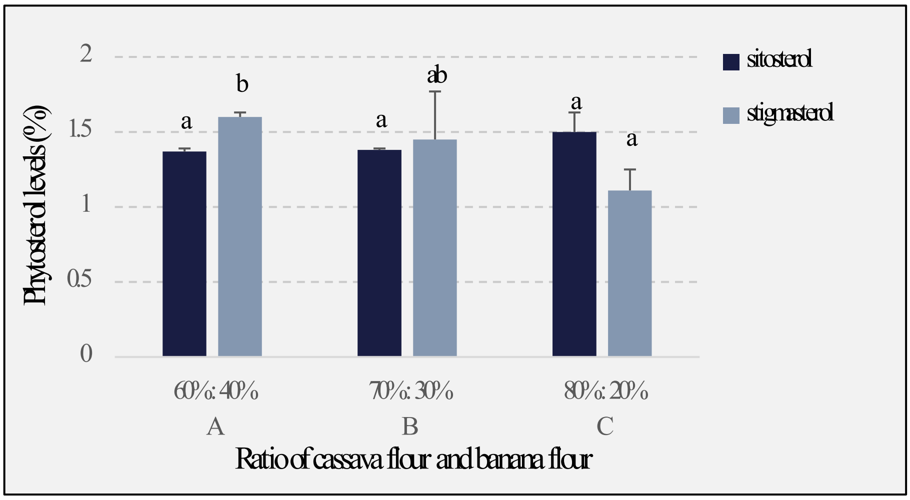


Figure 5. Ratio correlation of cassava flour and banana flour to the phytosterol level of analog rice. Mean values with different letters are significantly different (*P<0.05*).

Analog rice with a ratio of 60%:40% showed high stigmasterol content (1.60%), and significantly (P<0.05) higher than an 80%:20% ratio (1.11%). The decline in stigmasterol content in analog rice is due to the reduced ratio of banana flour in the analog rice formulation. The study by Ramu et al., found that banana extract contains a fairly high stigmasterol content of 21.91% [112]. As a result, the lower the concentration of banana flour, the lower the stigmasterol content in the analog rice produced. In addition, Katuk leaves contain stigmasterol, which can be used to increase lactation in lactating women. According to Petrus, one of the stigmasterol component in Katuk leaves is stigmasta-5,22-dien-3β-ol [113], which has the same way of working as cholesterol in its function in the process of steroidogenesis, namely converting free cholesterol into pregnenolone (precursor of all hormones) including for producing breast milk [114,115]. Furthermore, sterol has a function in modulating gut microbiota (Figure 6), hence it's beneficial for health and could improve breast milk quality [116]. β-sitosterol enhances the variety of *Staphylococcus* and *Streptococcus* bacteria found in colostrum, which are highly nourishing for infants [116,117].

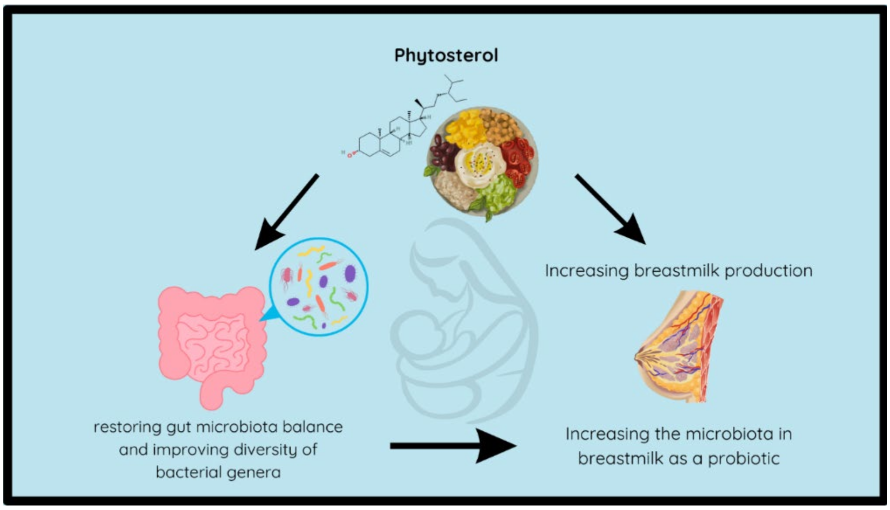


Figure 6. The schema of phytosterol in increasing breast milk production and quality of lactating women.

3.7. Total Flavonoids

Flavonoids are phenolic compounds with the chemical structure C6-C3-C6 that are found in many plants and foods. The results of the analysis (Figure 7) showed that the rice analog formulations had no significantly different effect (P>0.05) on flavonoids, ranging from 0.17-0.21% with the highest value obtained in the 80%:20% ratio. Flavonoids can be obtained from the addition of Katuk leaves which contain flavonoids of the quercetin and kaempferol types. Those flavonoids affect the hormone prolactin, which works actively in the formation of breast milk so that milk production can run smoothly [118,119]. This was confirmed in the study by Magdalena et al., which found that the flavonoid type quercetin with an amount of 4.5 mg and 138.14 mg of kaempferol was found in Katuk leaves [120]. Moreover, the addition of soy lecithin to analog rice formulations increases the activity of flavonoids. Soy lecithin is a phospholipid that acts as a barrier against oxygen, thereby reducing the oxidation process or acting as an antioxidant during heating [121,122]. Furthermore, flavonoid levels in food are also influenced by the heating process such as steaming and drying. Heating causes the flavonoids to easily oxidize, and phenol decomposition will occur, which will affect the flavonoid content [123–125].

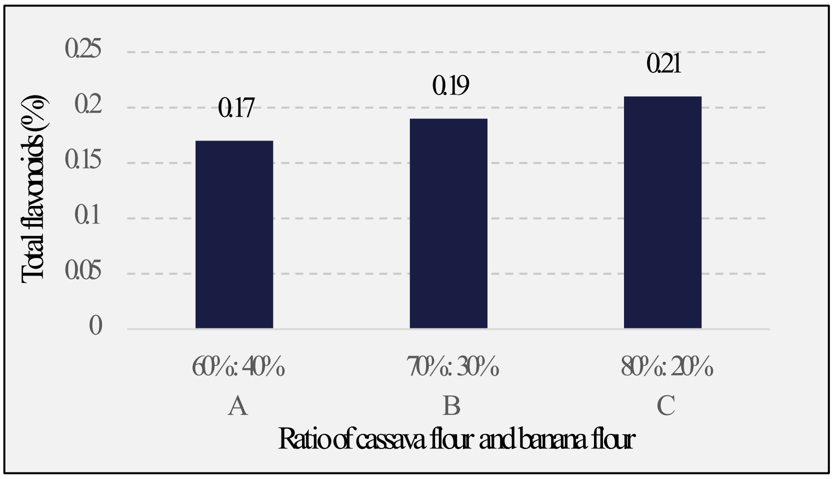


Figure 7. Ratio correlation of cassava flour and banana flour to the total flavonoids in analog rice.

3.8. Levels of Iron (Fe)

Iron is a macro mineral that is needed by the body and plays a role in the formation of red blood cells, especially in the synthesis of hemoglobin [126,127]. The results of the iron analysis (Figure 8) showed that the rice analog formulation consisting of different ratios of cassava flour and banana flour had no significant effect (P>0.05) on iron levels, which the iron level obtained ranging from 65.87-84.32 ppm with a ratio of 70%:30% as the highest. The results obtained have fulfilled the nutritional adequacy of the iron needs of lactating mothers consuming at least 30 mg of iron [128]. Iron is needed by lactating women to fulfill nutritional adequacy in producing breast milk. Iron content in food is strongly influenced by environmental factors both during processing and storage. According to Astuti et al., the stability of iron depends on several environmental factors, namely exposure to air, light, and humidity, as well as the nature of the material [129]. In addition, analog rice processing consists of a steaming process that can also affect the iron content in analog rice produced. Kusnadi stated that processing with traditional steaming can affect nutritional content such as iron [130]. The decrease in iron levels in foodstuffs during the boiling process was also shown from the results of Prasetyo et al., there was a decrease in the iron content of beef liver and tempeh by 22.43 - 34.61% in the boiling process [131].

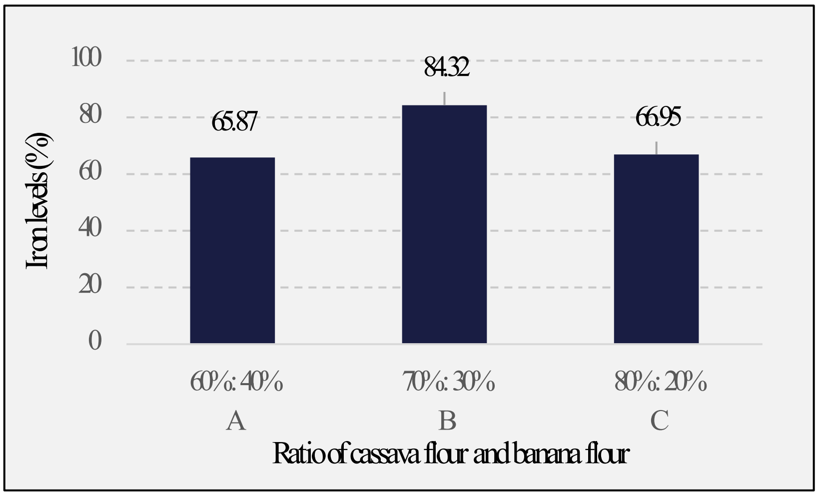


Figure 8. Ratio correlation of cassava flour and banana flour to the iron levels of analog rice.

3.9. Sensory Analysis

Sensory analysis is a method of testing that uses the human senses as the primary tool for measuring consumer acceptance or evaluating product quality. Overall, as shown in the sensory radar chart (Figure 9), the best formulation of analog rice based on the panelist's acceptance of four sensory parameters was obtained at a ratio of 80%:20% of cassava and banana flours. The dominant color produced by analog rice was brownish green. This was due to the addition of Katuk leaf powder and other ingredients. In general, Katuk leaves can be used as a natural green colorant as well as a source of calcium and protein [108,132]. The food color become fainter after cooking due to starch gelatinization which influenced by cooking time and temperature (Alvarez-Ramirez et al., 2018).

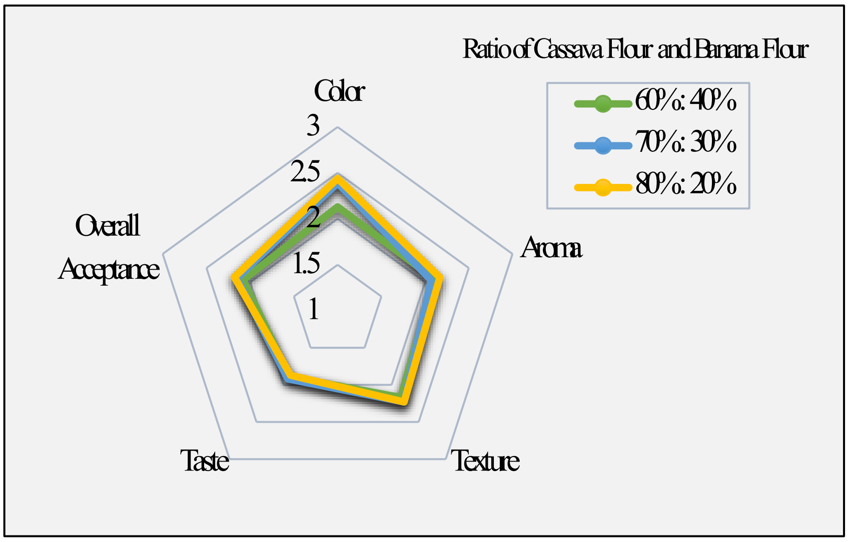


Figure 9. The radar chart of sensory analysis on the average scores of three ratio analog rice formulation of cassava and banana flours.

Texture is an important food quality parameter for the acceptance of analog rice which includes the fluffiness and stickiness of the rice. The results obtained indicate that the addition of soy lecithin made the texture of the analog rice produced more favorable which had a fluffy texture. Soy lecithin as an amphiphilic compound has a hydrophilic group that can bind water to make the texture of food ingredients more stable [60]. According to Wang et al., lecithin as an emulsifier in analog rice functions to improve texture, reduce adhesiveness, and improve the shape of the final product after the hydration process [20].

 doi:10.20944/preprints202404.0660.v1

Aroma is a sensation that is formed from the combination of the forming ingredients and their composition in a food ingredient captured from the sense of smell. The dominant aroma in the analog rice produced was due to the addition of Katuk leaf powder and other ingredients in the formulation, making the aroma present in the analog rice difficult to distinguish. The addition of Katuk leaf powder gave a distinctive aroma, namely a languorous aroma to analog rice. The strong aroma in the flour is caused by the enzymes lipoxygenase and chlorophyllase which is caused by cyanide compounds (HCN) [2,134]. Katuk leaves have a distinctive and pungent aroma even though the addition is in small amounts [135,136]. Meanwhile, another dominant aroma that appeared was the aroma of cassava flour as the main constituent ingredient in analog rice produced.

Taste is formed from the combination of ingredients used in a product. The addition of several ingredients in making analog rice caused panelists difficult to distinguish the taste of analog rice which the taste was dominated with cassava as the main raw material used. Naknean and Meenune stated that the factors that affect food's flavor are temperature, chemical compounds, concentration, and their interaction with other components [137]. While Kusmiandany reported that cassava gave bitter taste due to its toxins, Arief et al. on their research found out that the flavor of analog rice made of cassava was almost the same with the original rice [138,139].

5. Conclusions

The best formulation obtained was formulation C with a ratio of 80% cassava flour and 20% banana flour, which was produced through analog rice sensory analysis based on the preference levels of panelists who were lactating women. Formulations with a ratio of 80%:20% can be used as an alternative to original rice for lactating women by consuming analog rice of around 300 g per day to meet the calories needed which around 500–1000 kcal, 20% protein, and 30–60% iron. The analog rice produced had a shape resembling rice grains with oval characteristics. The physical, chemical, and sensory properties of analog rice produced varied according to flour ratio and the addition of soy lecithin. All the three analog rice formulations had similarity in the physical properties. Meanwhile, for the chemical properties of moisture, ash, and protein contents increased insignificantly with the same carbohydrate content in all three formulations. However, fat content showed a significant decrease as the ratio of cassava flour and soy lecithin increased. Furthermore, in the phytosterol content of analog rice, the sitosterol content of the three formulations shared similar results while the stigmasterol content decreased significantly with increasing ratios of cassava flour and soy lecithin addition. The sensory of analog rice produced had a brownish-green color and fluffier texture, as well as a distinctive aroma of Katuk and a distinctive taste of analog rice from the ingredients used. However, more efforts are needed to improve the sensory quality of analog rice to make it more acceptable to the public so that it can replace the availability of rice.

Author Contributions: Conceptualization, M.M.; writing-original draft, M.M. and A.B.T.; formal analysis, E.A., J.L.; writing-review and editing, M.M., D.G.N.; supervision, M.M., J.L.; validation, A.B.T.; funding acquisition, M.M., A.B.T. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the Indonesia Ministry of Education, Culture, Research and Technology Number 0054/E5/AK.04/2022.

Data Availability Statement: Data sets produced and assayed in this research were obtained from corresponding authors according to rightful requirements.

Acknowledgments: This work was a part of research supported by the Indonesia Ministry of Education, Culture, Research and Technology Number 0054/E5/AK.04/2022. The authors would like to thank the Ministry for the funding.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Budijanto, S.; Yuliyanti Study of Preparation Sorghum Flour and Application for Analogues Rice Production. *Jurnal Teknologi Pertanian* **2012**, *13*, 177–186.
2. Anggraeni, D.; Solahudin, M.; Sutrisno Ingredients Formulation of Analogue Rice Based on Location Spesific Flour, Case Studies in the Purworejo District. *IOP Conf Ser Earth Environ Sci* **2020**, *542*, 1–9. https://doi.org/10.1088/1755-1315/542/1/012015.
3. Ruvananda, A.R.; Taufiq, M. Analysis of Factors Affecting Rice Imports in Indonesia. *KINERJA* **2022**, *19*, 195–204. https://doi.org/10.30872/jkin.v19i2.10924.
4. Pudjihastuti, I.; Sumardiono, S.; Supriyo, E.; Kusumayanti, H. Quality Analog Rice Composite Flour: Modified Starch, Colocasia Esculenta, Canna Edulis Ker High Protein. In Proceedings of the AIP Conference Proceedings; 2018; Vol. 1977.
5. Gunanegara, R.; Suryawan, A.; Sastrawinata, U.; Surachman, T. Efektivitas Ekstrak Daun Katuk Dalam Produksi Air Susu Ibu Untuk Keberhasilan Menyusui. *Jurnal Kedokteran Maranatha* **2010**, *9*, 104–117.
6. Idris, F.P.; Kanang, B.; Adriani, F.; Asrina, A. Mother's Behavior in Breastfeeding in Gowa Regency, South Sulawesi (Study on Mothers with Insufficient Breastmilk Production). *Gac Sanit* **2021**, *35*, S472–S474. https://doi.org/10.1016/j.gaceta.2021.06.011.
7. Kent, J.C.; Ashton, E.; Hardwick, C.M.; Rea, A.; Murray, K.; Geddes, D.T. Causes of Perception of Insufficient Milk Supply in Western Australian Mothers. *Matern Child Nutr* **2021**, *17*, 1–11. https://doi.org/10.1111/mcn.13080.
8. Mustofa; Yuliani, F.S.; Purwono, S.; Sadewa, A.H.; Damayanti, E.; Heriyanto, D.S. Polyherbal Formula (ASILACT®) Induces Milk Production in Lactating Rats through Upregulation of α-Lactalbumin and Aquaporin Expression. *BMC Complement Med Ther* **2020**, *20*, 1–8. https://doi.org/10.1186/s12906-020-03152-7.
9. Soka, S.; Alam, H.; Boenjamin, N.; Agustina, T.W.; Suhartono, M.T. Effect of Sauropus Androgynus Leaf Extracts on the Expression of Prolactin and Oxytocin Genes in Lactating BALB/C Mice. *Lifestyle Genom* **2010**, *3*, 31–36. https://doi.org/10.1159/000319710.
10. Nugraheni, M.; Purwanti, S.; Ekawatiningsih, P. Impact of Analog Rice Derived from Different Composite Flours from Tubers, Germinated Legumes, and Cereals on Improving Serum Markers in Alloxan-Induced Diabetic Rats. *Prev Nutr Food Sci* **2021**, *26*, 296–306. https://doi.org/10.3746/PNF.2021.26.3.296.
11. Pudjihastuti, I.; Sumardiono, S.; Supriyo, E.; Kusumayanti, H. Analog Rice Made from Cassava Flour, Corn and Taro for Food Diversification. In Proceedings of the E3S Web of Conferences; 2019; Vol. 125, pp. 1–4.
12. Sumardiono, S.; Budiyono; Kusumayanti, H.; Prakoso, N.I.A.; Paundrianagari, F.P.; Cahyono, H. Influence of Composite Flour Constituents and Extrusion Temperature in the Production of Analog Rice. *Food Sci Nutr* **2021**, *9*, 4385–4393. https://doi.org/10.1002/fsn3.2411.
13. Adesina, B.S.; Bolaji, O.T. Effect of Milling Machines and Sieve Sizes on Cooked Cassava Flour Quality. *Nigerian Food Journal* **2013**, *31*, 115–119. https://doi.org/10.1016/S0189-7241(15)30065-5.
14. Lu, H.; Guo, L.; Zhang, L.; Xie, C.; Li, W.; Gu, B.; Li, K. Study on Quality Characteristics of Cassava Flour and Cassava Flour Short Biscuits. *Food Sci Nutr* **2020**, *8*, 521–533. https://doi.org/10.1002/fsn3.1334.
15. Munandar, A.; Haryanti, I.; Ilham, I.; Yusuf, M.; Alwi, A.; Muhajirin, M. Community Empowerment Through Training in Processing Cassava into Cassava Flour. *Lumbung Inovasi: Jurnal Pengabdian kepada Masyarakat* **2022**, *7*, 56–64. https://doi.org/10.36312/linov.v7i1.538.
16. Bala, A.; Gul, K.; Riar, C.S. Functional and Sensory Properties of Cookies Prepared from Wheat Flour Supplemented with Cassava and Water Chestnut Flours. *Cogent Food Agric* **2015**, *1*, 1019815. https://doi.org/10.1080/23311932.2015.1019815.
17. Yudanti, R.Y.; Waluyo, S. The Producing of Analog Rice Based on Banana Flour (Musa Paradisiaca). *Jurnal Teknik Pertanian Lampung* **2015**, *4*, 117–126.
18. Mamuaja, C.F.; Inkiriwang, D.; Lamaega, J. Quality and Preference of Innovative Analog Rice from Purple Sweet Potato, Goroho Banana, and Baruk Sago Section. *Eur. Chem. Bull* **2023**, *12*, 1554–1561. https://doi.org/10.31838/ecb/2023.12.4.118.
19. Kurniasari, I.; Kusnandar, F.; Budijanto, S. Physical Characteristics of Corn-Based Instant Analog Rice with Addition of κ-Carrageenan and Konjac. *agriTECH* **2020**, *40*, 64–73. https://doi.org/10.22146/agritech.47491.
20. Wang, J.P.; An, H.Z.; Jin, Z.Y.; Xie, Z.J.; Zhuang, H.N.; Kim, J.M. Emulsifiers and Thickeners on Extrusion-Cooked Instant Rice Product. *J Food Sci Technol* **2013**, *50*, 655–666. https://doi.org/10.1007/s13197-011-0400-6.
21. Lawrence, R.A.; Lawrence, R.M. Breastfeeding: A Guide for the Medical Profession; 2022;.
22. Younes, M.; Aquilina, G.; Castle, L.; Engel, K.H.; Fowler, P.; Fernandez, M.J.F.; Furst, P.; Gurtler, R.; Husøy, T.; Manco, M.; et al. Opinion on the Re-Evaluation of Lecithins (E 322) as a Food Additive in Foods for Infants below 16 Weeks of Age and Follow-up of Its Re-Evaluation as Food Additive for Uses in Foods for All Population Groups. *EFSA Journal* **2020**, *18*. https://doi.org/10.2903/j.efsa.2020.6266.

23. Sada, Z.P.; Mahendradatta, M.; Latief, R. Physicochemical Characteristics and Anthocyanin Content of Analog Rice Made from Mocaf, Mung Beans (Vigna Radiata), and Purple Corn (Zea Mays L.). *IOP Conf Ser Earth Environ Sci* **2021**, *807*, 022061. https://doi.org/10.1088/1755-1315/807/2/022061.
24. Rumitasari, A.; Tawali, A.; Laga, A.; Langkong, J.; Mahendradatta, M. Formulation of Analog Rice Made of White Corn (Zea Mays Ceratina) and Mung Beans (Vigna Radiata L) Flour as an Alternative Food in Maintaning a Complete Nutrition. In Proceedings of the Proceedings of The Food Ingredient Asia Conference (FiAC); SCITEPRESS - Science and Technology Publications, 2020; pp. 92–96.
25. Hasbullah, U.H.A.; Surayya, L.; Syah, I.T. Physical and Nutritional Properties of Analog Rice Based on Modified Cassava Flour and Modified Suweg Flour. *Indonesian Food and Nutrition Progress* **2023**, *19*, 9. https://doi.org/10.22146/ifnp.65606.
26. Sulfi; Nurhisna, N.I.U.; Abdullah, N.; Tawali, A.B.; Langkong, J.; Mahendradatta, M. Formulation of Analog Rice Using Cassava (Manihot Esculenta) and Mung Bean (Vigna Radiata L.) for Breastfeeding Mothers. In Proceedings of the AIP Conference Proceedings; 2023; Vol. 2596, p. 040029.
27. Amir, Y.; Hasneli, Y.; Erika Hubungan Pemberian ASI Ekslusif Terhadap Tumbuh Kembang Bayi. *Jurnal Ners Indonesia* **2010**, *1*, 90–98.
28. Mehlawat, U.; Puri, S.; Rekhi, T.K. Breastfeeding Practices among Mothers at Birth and at 6 Months in Urban Areas of Delhi-Ncr, India. *Jurnal Gizi dan Pangan* **2020**, *15*, 101–108. https://doi.org/10.25182/jgp.2020.15.2.101-108.
29. Radharisnawati, N.; Kundre, R.; Pondaag, L. The Relationship Between Fulfillment of Mother's Nutritional Needs with the Smooth Delivery of Mother's Milk in Breastfeeding Mothers at the Bahu Community Health Center, Manado City. *Jurnal Keperawatan UNSRAT* **2017**, *5*.
30. Damat, D.; Natazza, R.A.; Wahyudi, V.A. Kajian Pembuatan Beras Analog Berbasis Tepung Komposit Dengan Penambahan Konsentrasi Bubur Rumput Laut (Gracilaria Sp.) Dan Gliserol Monostearat. *Food Technology and Halal Science Journal* **2020**, *3*, 174–187. https://doi.org/10.22219/fths.v3i2.13218.
31. Khalil Pengaruh Kandungan Air Dan Ukuran Partikel Terhadap Sifat Fisik Pakan Lokal: Sudut Tumpukan, Daya Ambang Dan Faktor Higroskopis. *Media Peternakan Fakultas Peternakan Institut Pertanian Bogor* **1999**, *22*, 33–42.
32. Hawa, L.C.; Rhomadhona, W.; Putranto, A.W. Physicochemical Characteristics of Instant Boiled Rice: Study of Sodium Citrate Concentration and Soaking Time. *Jurnal Teknik Pertanian Lampung (Agricultural Engineering University of Lampung)* **2022**, *11*, 561–573. https://doi.org/10.23960/jtep-l.v11i4.561-573.
33. Association of Official Analytical Chemist (AOAC) *Official Methods of Analysis of The Association of Official Agriculture Chemist*; 16th ed.; AOAC Inernational: Virginia, 2006;.
34. SNI. Standar Nasional Indonesia 01-2891-1992 *Cara Uji Makanan Dan Minuman*; Jakarta, 1992;.
35. Andika, A.; Kusnandar, F.; Budijanto, S. Physicochemical and Sensory Characteristics of High Protein Multigrain Analog Rice. *Jurnal Teknologi dan Industri Pangan* **2021**, *32*, 60–71. https://doi.org/10.6066/jtip.2021.32.1.60.
36. Lieberman, H.R.; Fulgoni, V.L.; Agarwal, S.; Pasiakos, S.M.; Berryman, C.E. Protein Intake Is More Stable than Carbohydrate or Fat Intake across Various US Demographic Groups and International Populations. *Am J Clin Nutr* **2020**, *112*, 180–186. https://doi.org/10.1093/ajcn/nqaa044.
37. Pramono, Y.B.; Nurwantoro; Handayani, D.; Mulyani, S.; Hari Wibowo, C. Physical, Chemical, Stickiness and Organoleptic Characteristics of Analog White Sweet Potato Rice with the Addition of Pumpkin Flours. *IOP Conf Ser Earth Environ Sci* **2021**, *803*. https://doi.org/10.1088/1755-1315/803/1/012039.
38. Indrayanto, G.; Studiawan, H.; Cholies, N. Isolation and Quantitation of Manogenin and Kammogenin from Callus Cultures of Agave Amaniensis. *Phytochemical Analysis* **1994**, *5*, 24–26. https://doi.org/10.1002/pca.2800050107.
39. Sri Widyawati, P.; Maya Suteja, A.; Putut Suseno, T.I.; Monica, P.; Saputrajaya, W.; Liguori, C. Effect of Pigment Color Difference in Organic Rice on Antioxidant Activity. *Jurnal Agritech* **2015**, *34*, 399–406. https://doi.org/10.22146/agritech.9434.
40. Nasution, M.A.; M, M.; Putra, E.D.L. Determination of Iron Content, Potassium, Calcium, and Sodium In Chinese Date Fruit (Ziziphus Jujuba Miller.) Fresh and Boiled In Atomic Adsorption Spectrophotometry. *Asian Journal of Pharmaceutical Research and Development* **2022**, *10*, 1–5. https://doi.org/10.22270/ajprd.v10i2.1110.
41. Arifin, M.Z.; Maharani, S.; Widiaputri, S.I. UJI SIFAT FISIKO KIMIA DAN ORGANOLEPTIK MINUMAN YOGHURT NGEBOON PANORAMA INDONESIA. *EDUFORTECH* **2020**, *5*. https://doi.org/10.17509/edufortech.v5i1.23924.
42. Budi, F.S.; Hariyadi, P.; Budijanto, S.; Syah, D. Extrusion Process Technology of Analog Rice. *Food Journal* **2013**, *22*, 263–274.
43. Bhattacharya, K.R. Analysis of Rice Quality. In *Rice Quality*; Elsevier, 2013; pp. 431–530.
44. Loebis, E.H.; Junaidi, L.; Susanti, I. Characterization of Quality and Nutrition Value of Cooked Rice Mocaf from Rice Analog. *Jurnal Biopropal Industri* **2017**, *8*, 33–46.

45. Yulviatun, A.; Purnamasari, S.; Ariyantoro, A.R.; Atmaka, W. Physical, Chemical, and Organoleptic Characteristics of Rice Analog Made from Mocaf, Corn Flour (Zea Mays L.), and Mung Bean Sprout Flour (Vigna Radiata L.). *Jurnal Teknologi Hasil Pertanian* **2022**, *15*, 46. https://doi.org/10.20961/jthp.v15i1.55394.
46. Pudjihastuti, I.; Supriyo, E.; Devara, H.R. Pengaruh Rasio Bahan Baku Tepung Komposit (Ubi Kayu, Jagung Dan Kedelai Hitam) Pada Kualitas Pembuatan Beras Analog. *Gema Teknologi* **2021**, *21*, 61–66. https://doi.org/10.14710/gt.v21i2.32923.
47. Putri, R.D.A.; Mahanani, T.A.; Simatupang, E.F.; Rohmah, K.A.N.; Lestari, I.P.; Astuti, W.; Prasetiawan, H. Synthesis of Cassava Analog Rice Fortified with Protein Tempe Flour Using Cold Extrusion Method. *IOP Conf Ser Earth Environ Sci* **2021**, *700*, 012066. https://doi.org/10.1088/1755-1315/700/1/012066.
48. Kantrong, H.; Charunuch, C.; Limsangouan, N.; Pengpinit, W. Influence of Process Parameters on Physical Properties and Specific Mechanical Energy of Healthy Mushroom-Rice Snacks and Optimization of Extrusion Process Parameters Using Response Surface Methodology. *J Food Sci Technol* **2018**, *55*, 3462–3472. https://doi.org/10.1007/s13197-018-3271-2.
49. Sasmitaloka, K.S.; Widowati, S.; Sukasih, E. Characterization of Physicochemical, Sensory, and Functional Properties of Instant Rice from Low Amylose Rice. *Jurnal Penelitian Pascapanen Pertanian* **2020**, *17*, 1–14. https://doi.org/10.21082/jpasca.v17n1.2020.1-14.
50. Suri, S.; Singh, A. Colored Cereals: Beyond Nutritional Values. In *Functionality and Application of Colored Cereals*; Elsevier, 2023; pp. 47–72.
51. Dogan, M.; Aslan, D.; Aktar, T.; Goksel Sarac, M. A Methodology to Evaluate the Sensory Properties of Instant Hot Chocolate Beverage with Different Fat Contents: Multi-Criteria Decision-Making Techniques Approach. *European Food Research and Technology* **2016**, *242*, 953–966. https://doi.org/10.1007/s00217-015-2602-z.
52. Hailu, Y.; Maidannyk, V.A.; Murphy, E.G.; McCarthy, N.A. Improving the Physical and Wettability Properties of Skim Milk Powders through Agglomeration and Lecithination. *J Food Eng* **2023**, *357*, 111597. https://doi.org/10.1016/j.jfoodeng.2023.111597.
53. Hartono, Y.; Sugiyono, S.; Wulandari, N. Formulation and Improvement of Solubility Properties of Chocolate Beverage Powder. *Jurnal Teknologi dan Industri Pangan* **2018**, *29*, 185–194. https://doi.org/10.6066/jtip.2018.29.2.185.
54. Sumardiono, S.; Pudjihastuti, I.; Supriyo, E.; Amalia, R. Physico-Chemical Properties of Calcium-Fortified Analog Rice from Composite Flour (Cassava, Corn, and Snakehead Fish) for Osteoporosis Prevention. *Journal of Vocational Studies on Applied Research* **2020**, *2*, 10–15.
55. Chandra, S.; Singh, S.; Kumari, D. Evaluation of Functional Properties of Composite Flours and Sensorial Attributes of Composite Flour Biscuits. *J Food Sci Technol* **2014**, *52*. https://doi.org/10.1007/s13197-014-1427-2.
56. Li, C.; Dhital, S.; Gilbert, R.G.; Gidley, M.J. High-Amylose Wheat Starch: Structural Basis for Water Absorption and Pasting Properties. *Carbohydr Polym* **2020**, *245*, 116557. https://doi.org/10.1016/j.carbpol.2020.116557.
57. Patty, M.D.; Murtini, E.S.; Putri, W.D.R. Physicochemical Characteristics of Starch Noodles Based on Sorghum Flour (Sorghum Bicolor L. Moench) and Sago Flour (Metroxylon Sp). *Jurnal Pangan dan Agroindustri* **2023**, *11*, 147–157. https://doi.org/10.21776/ub.jpa.2023.011.03.5.
58. Nilsuwan, K.; Benjakul, S.; Prodpran, T. Emulsion Stability and Properties of Fish Gelatin-based Films as Affected by Palm Oil and Surfactants. *J Sci Food Agric* **2016**, *96*, 2504–2513. https://doi.org/10.1002/jsfa.7371.
59. Voelker, A.L.; Verbeek, G.; Taylor, L.S.; Mauer, L.J. Effects of Emulsifiers on the Moisture Sorption and Crystallization of Amorphous Sucrose Lyophiles. *Food Chem X* **2019**, *3*, 100050. https://doi.org/10.1016/j.fochx.2019.100050.
60. Yussof, N.S.; Tan, C.P.; Tan, T.B.; Utra, U.; Ramli, uhammad E. Influence of Soy Lecithin and Sodium Caseinate on The Stability and in Vitro Bioaccessibility of Lycopene Nanodispersion. *Food Technol Biotechnol* **2023**, *61*, 39–50. https://doi.org/10.17113/ftb.61.01.23.7538.
61. Zhang, P.; Hamaker, B.R. Banana Starch Structure and Digestibility. *Carbohydr Polym* **2012**, *87*, 1552–1558. https://doi.org/10.1016/j.carbpol.2011.09.053.
62. Jayanti, U.; Dasir; Idealistuti Kajian Penggunaan Tepung Tapioka Dari Berbagai Varietas Ubi Kayu (Manihot Esculenta Crantz.) Dan Jenis Ikan Terhadap Sifat Sensoris Pempek. *Jurnal Edible* **2017**, *6*, 59–62.
63. Annan, H.A.; Oduro-Yeboah, C.; Annan, T.; Akonor, P.T. Sensory Optimization of an Instant Brown Rice Cereal Containing Tigernut and Soybean. *J Agric Food Res* **2023**, *14*, 1–7. https://doi.org/10.1016/j.jafr.2023.100808.
64. Mandasari, R.; Amanto, B.S.; Ridwan, A. Study of Physical, Chemical, Physicochemical Characteristics and Sensory Properties Black Potato (Coleus Tuberosus) Flour Modified by Lactic Acid Solution. *Teknosains Pangan* **2015**, *4*, 1–15.
65. Vamadevan, V.; Bertoft, E. Observations on the Impact of Amylopectin and Amylose Structure on the Swelling of Starch Granules. *Food Hydrocoll* **2020**, *103*, 105663. https://doi.org/10.1016/j.foodhyd.2020.105663.

66. Hu, X.; Li, Z.; Wang, F.; Mu, H.; Guo, L.; Xiao, J.; Liu, Y.; Li, X. Formation of Starch–Lipid Complexes during the Deep-Frying Process and Its Effects on Lipid Oxidation. *Foods* **2022**, *11*, 3083. https://doi.org/10.3390/foods11193083.
67. Niu, M.; Hou, G.G.; Kindelspire, J.; Krishnan, P.; Zhao, S. Microstructural, Textural, and Sensory Properties of Whole-Wheat Noodle Modified by Enzymes and Emulsifiers. *Food Chem* **2017**, *223*, 16–24. https://doi.org/10.1016/j.foodchem.2016.12.021.
68. Herawati, H.; Kusnandar, F.; Adawiyah, D.R.; Budijanto, S. Processing Technology of Artificial Rice Supporting Food Diversification. *Jurnal Penelitian dan Pengembangan Pertanian* **2014**, *33*, 87–94.
69. Srihari, E.; Sri Lingganingrum, F.; Alvina, I. Rekayasa Beras Analog Berbahan Dasar Campuran Tepung Talas, Tepung Maizena Dan Ubi Jalar. *Jurnal Teknik Kimia* **2016**, *11*, 14–19.
70. Budi, F.S.; Hariyadi, P.; Budijanto, S.; Syah, D. Crystallinity and Hardness of Rice Analogue Produced from Corn Flour through Hot Extrusion Processes. *Jurnal Teknologi dan Industri Pangan* **2017**, *28*, 46–54. https://doi.org/10.6066/jtip.2017.28.1.46.
71. Hedayati, S.; Shahidi, F.; Koocheki, A.; Farahnaky, A.; Majzoobi, M. Influence of Pregelatinized and Granular Cold Water Swelling Maize Starches on Stability and Physicochemical Properties of Low Fat Oil-in-Water Emulsions. *Food Hydrocoll* **2020**, *102*, 105620. https://doi.org/10.1016/j.foodhyd.2019.105620.
72. Batista, C. de S.; dos Santos, J.P.; Dittgen, C.L.; Colussi, R.; Bassinello, P.Z.; Elias, M.C.; Vanier, N.L. Impact of Cooking Temperature on the Quality of Quick Cooking Brown Rice. *Food Chem* **2019**, *286*, 98–105. https://doi.org/10.1016/j.foodchem.2019.01.187.
73. Romero, H.M.; Zhang, Y. Physicochemical Properties and Rheological Behavior of Flours and Starches from Four Bean Varieties for Gluten-Free Pasta Formulation. *J Agric Food Res* **2019**, *1*, 100001. https://doi.org/10.1016/j.jafr.2019.100001.
74. Hedayati, S.; Mazaheri Tehrani, M. Effect of Total Replacement of Egg by Soymilk and Lecithin on Physical Properties of Batter and Cake. *Food Sci Nutr* **2018**, *6*, 1154–1161. https://doi.org/10.1002/fsn3.656.
75. Aini, N.; Munarso, J.; Annisa, F.S.; Jayanthi, T.T. Karakteristik Beras Analog Dari Tepung Jagung-Kacang Merah Menggunakan Agar-Agar Sebagai Bahan Pengikat. *Jurnal Penelitian Pascapanen Pertanian* **2020**, *16*, 1. https://doi.org/10.21082/jpasca.v16n1.2019.1-9.
76. Van Buren, J.B.; Puga, K.J.; Hoffman, K.C.; Nasados, J.A.; Bass, P.D.; Colle, M.J. Water Binders in Beef Patties Increase Yield and Extend Shelf Life. *Transl Anim Sci* **2023**, *7*, 1–7. https://doi.org/10.1093/tas/txad091.
77. Erni, N.; Kadirman, K.; Fadilah, R. The Influence of Temperature and Length of Drying to the Chemical Characteristic and Organoleptic of Taro Flour (Colocasia Esculenta). *Jurnal Pendidikan Teknologi Pertanian* **2018**, *1*, 95–105. https://doi.org/10.26858/jptp.v1i1.6223.
78. Nithyalakshmi, V.; Preetha, R. Effect of Cooking Conditions on Physico-Chemical and Textural Properties of Emu (Dromaius Novaehollandiae) Meat. *Int Food Res J* **2015**, *22*, 1924–1930.
79. Thielecke, F.; Nugent, A.P. Contaminants in Grain—A Major Risk for Whole Grain Safety? *Nutrients* 2018, *10*, 1–23.
80. Mishra, A.; Mishra, H.N.; Srinivasa Rao, P. Preparation of Rice Analogues Using Extrusion Technology. *Int J Food Sci Technol* **2012**, *47*, 1789–1797. https://doi.org/10.1111/j.1365-2621.2012.03035.x.
81. Wickramasinghe, Y.W.H.; Wickramasinghe, I.; Wijesekara, I. Effect of Steam Blanching, Dehydration Temperature & Time, on the Sensory and Nutritional Properties of a Herbal Tea Developed from *Moringa Oleifera* Leaves. *Int J Food Sci* **2020**, *2020*, 1–11. https://doi.org/10.1155/2020/5376280.
82. Xu, Y.; Chen, Y.; Cao, Y.; Huang, W.; Zhang, S.; Xia, W.; Jiang, Q. Effect of Steam Cooking on Textural Properties and Taste Compounds of Shrimp (Metapenaeus Ensis). *Food Sci Technol Res* **2016**, *22*, 75–81. https://doi.org/10.3136/fstr.22.75.
83. Afifah, N.; Ratnawati, L.; Indrianti, N.; Sarifudin, A. The Effect of Pre-Drying Treatments on the Quality of Dehydrated Ground Beef. *IOP Conf Ser Earth Environ Sci* **2021**, *924*, 012006. https://doi.org/10.1088/1755-1315/924/1/012006.
84. SNI. Standar Nasional Indonesia 01-7111.1-2005 *Makanan Pendamping Air Susu Ibu (MP-ASI)-Bagian 1: Bubuk Instan*; Jakarta, 2005;.
85. The Indonesian Food and Drug Authority Rencana Aksi Nasional: Gerakan Menuju Pangan Jajanan Sekolah Yang Aman, Bermutu, Dan Bergizi; Jakarta, 2014;.
86. Damanik, M.; Rosmiati, R.; Permatasari, T.; Surbakti, T.A.; Ayuni, S. Ash , Protein And Salinity Analysis Of Integrated Formulation Of Herbs And Spices In Typical Simalungun " Tinuktuk " North Sumatera - Indonesia. *International Journal of Health and Pharmaceutical* **2023**, 545–549.
87. Nurwin, A.F.; Dewi, E.N.; Romadhon, R. The Effect of Carrageenan Flour Addition on the Making of Blood Cockles (Anadara Granosa) Meatballs. *Jurnal Ilmu dan Teknologi Perikanan* **2019**, *1*, 39–46. https://doi.org/10.14710/jitpi.2019.6745.
88. Ismail, B.P. Food Analysis Laboratory Manual- Ash Content Determination. *Food Analysis Laboratory Manual* **2017**.

89. Liu, K. Effects of Sample Size, Dry Ashing Temperature and Duration on Determination of Ash Content in Algae and Other Biomass. *Algal Res* **2019**, *40*, 1–5. https://doi.org/10.1016/j.algal.2019.101486.
90. Butina, E.A.; Gerasimenko, E.O.; Bugaets, I.A.; Dubrovskaia, I.A. Comparative Analysis of the Physiological Value of Lecithins Obtained from Different Types of Raw Materials. *Journal of Pharmaceutical Sciences and Research* **2017**, *9*, 2493–2497.
91. Asgar, A.; Musaddad, D.; Rahayu, S.; Levianny, P.S. Effect of Temperature and Drying Time on Chemical, Physical and Organoleptic Characteristics of Dry Winged Beans. *IOP Conf Ser Earth Environ Sci* **2022**, *1024*, 012004. https://doi.org/10.1088/1755-1315/1024/1/012004.
92. Sonkamble, M.; Pandhure, N. Effect of Drying Methods on Ash Contents and Moisture Content of Leafy Vegetables. *International Journal of Science and Research* **2015**, *6*, 936–938.
93. Barciela-Alonso, M.C.; Bermejo-Barrera, P. Variation of Food Mineral Content during Industrial and Culinary Processing. In *Handbook of Mineral Elements in Food*; Wiley, 2015; pp. 163–176.
94. Nurjanah; Suwandi, R.; Aisyah, E.N.; Hidayat, T. Changes in Mineral Content and Vitamin A of Cobia (Rachycentron Canadum) Due to the Steaming Process. *IOP Conf Ser Earth Environ Sci* **2023**, *1137*, 012032. https://doi.org/10.1088/1755-1315/1137/1/012032.
95. Finirsa, M.A.; Warsidah, W.; Sofiana, M.S.J.; Risko Physicochemical Characteristics of Analogue Rice from the Combination of Seaweeds Eucheuma Cottonii, Mocaf, and Sago. *Oseanologia* **2022**, *1*, 69–76.
96. Martín-Hernández, C.; Bénet, S.; Marvin-Guy, L.F. Characterization and Quantification of Proteins in Lecithins. *J Agric Food Chem* **2005**, *53*, 8607–8613. https://doi.org/10.1021/jf0510687.
97. Mortensen, A.; Aguilar, F.; Crebelli, R.; Di Domenico, A.; Frutos, M.J.; Galtier, P.; Gott, D.; Gundert-Remy, U.; Lambré, C.; Leblanc, J.; et al. Re-evaluation of Lecithins (E 322) as a Food Additive. *EFSA Journal* **2017**, *15*, 1–80. https://doi.org/10.2903/j.efsa.2017.4742.
98. Adelina, F.; Estiasih, T.; Widyaningsih, T.D.; Harijono, H. Cassava Based Artificial Rice : A Review. *Jurnal Teknologi Pertanian* **2019**, *20*, 11–24. https://doi.org/10.21776/ub.jtp.2019.020.01.2.
99. Novrini, S. The Quality of Analog Corn Rice with the Addition of Several Types of Flour. *J. Ilmu Pertanian* **2020**, *8*, 267–271.
100. Rasyid, M.I.; Yuliana, N.D.; Budijanto, S. Sensory and Physicochemical Characteristics of Sorghum Rice Analogue by Mixed Spices Addition. *Agritech* **2017**, *36*, 394–403. https://doi.org/10.22146/agritech.16762.
101. Noviasari, S.; Kusnandar, F.; Setiyono, A.; Budijanto, S. Physical, Chemical, and Sensory Characteristics of Rice Analogue from Non Rice Ingredients. *Food Journal* **2017**, *26*.
102. Septyaningsih, D.H.; Wirasti, H.; Rahmawati; Wibowo, E.A.P. Analisis Kandungan Beras Analog Berbahan Dasar Umbi Gembili (Dioscorea Esculenta). *Prosiding Seminar Nasional XI "Rekayasa Teknologi Industri dan Informasi* **2016**, 363–367.
103. Jannah, M.; Tamrin, T.; Sugianti, C.; Warji, W. The Production and Physical Characteristics Test of Analog Rice Made from Cassava Flour Containing Protein of Shrimp. *Jurnal Teknik Pertanian Lampung* **2015**, *4*, 51–56.
104. Sachriani, S.; Yulianti, Y. Analisis Kualitas Sensori Dan Kandungan Gizi Roti Tawar Tepung Oatmeal Sebagai Pengembangan Produk Pangan Fungsional. *JST (Jurnal Sains Terapan)* **2021**, *7*, 26–35. https://doi.org/10.32487/jst.v7i2.1235.
105. Kusmiyati, F.; Lukiwati, D.R.; Kristanto, B.A.; Herwibawa, B. Glycemic Index of Ten Commercially Indonesian Rice Cultivars. *IOP Conf Ser Earth Environ Sci* **2019**, *250*, 012028. https://doi.org/10.1088/1755-1315/250/1/012028.
106. Novitasari, E.; Arief, R.W. Analysis of Chemical Characteristic of Casava Flour from Klenteng and Casessart (UJ5) Varieties. *Jurnal Penelitian Pertanian Terapan* **2018**, *18*, 52–58. https://doi.org/10.25181/jppt.v18i1.1227.
107. Rosalina, Y.; Susanti, L.; Silsia, D.; Setiawan, R. Characteristics of Banana Flour from Bengkulu Local Banana Varieties. *Industria: Jurnal Teknologi dan Manajemen Agroindustri* **2018**, *7*, 153–160. https://doi.org/10.21776/ub.industria.2018.007.03.3.
108. Anju, T.; Rai, N.K.S.R.; Kumar, A. Sauropus Androgynus (L.) Merr.: A Multipurpose Plant with Multiple Uses in Traditional Ethnic Culinary and Ethnomedicinal Preparations. *Journal of Ethnic Foods* **2022**, *9*, 10. https://doi.org/10.1186/s42779-022-00125-8.
109. Handayani, S.; Setyawati, I.; Ariendha, D.S.R.; Pratiwi, Y.S.; Idyawati, S.; Fatmawati, N. The Effect of Katuk Leaf (Sauropusandrogynus L. Merr.) Biscuit Consumption toward Increasing Breastmilk Volume on the 10th Day. *J Phys Conf Ser* **2020**, *1594*, 012051. https://doi.org/10.1088/1742-6596/1594/1/012051.
110. Krisnawati, A. Soybeans as Source of Functional Food. *Iptek Tanaman Pangan* **2017**, *12*, 57–65.
111. Rahayu Sihmawati, R.; Agustiyah Rosida, D. Proximate Analysis of Shredded Banana Corm With Tempeh Flour And Lechitin Fortification. *STIGMA: Jurnal Matematika dan Ilmu Pengetahuan Alam Unipa* **2020**, *13*, 1–7. https://doi.org/10.36456/stigma.13.1.2416.1-7.
112. Ramu, R.; Shirahatti, P.S.; Nayakavadi, S.; R, V.; Zameer, F.; Dhananjaya, B.L.; Prasad MN, N. The Effect of a Plant Extract Enriched in Stigmasterol and β-Sitosterol on Glycaemic Status and Glucose Metabolism in Alloxan-Induced Diabetic Rats. *Food Funct* **2016**, *7*, 3999–4011. https://doi.org/10.1039/C6FO00343E.

113. Petrus, A.J.A. Sauropus Androgynus (L.) Merrill-A Potentially Nutritive Functional Leafy-Vegetable. *Asian Journal of Chemistry* **2013**, *25*, 9425–9433. https://doi.org/10.14233/ajchem.2013.15405.
114. Bassi, G.; Sidhu, S.K.; Mishra, S. The Expanding Role of Mitochondria, Autophagy and Lipophagy in Steroidogenesis. *Cells* **2021**, *10*, 1851. https://doi.org/10.3390/cells10081851.
115. Kang, E.-J.; Hong, S.-H.; Lee, J.-E.; Kim, S.C.; Yang, H.-S.; Yi, P. in; Lee, S.-M.; An, B.-S. Pregnenolone Sulfate Regulates Prolactin Production in the Rat Pituitary. *Journal of Endocrinology* **2016**, *230*, 339–346. https://doi.org/10.1530/JOE-16-0088.
116. Manoppo, J.I.C.; Nurkolis, F.; Gunawan, W. Ben; Limen, G.A.; Rompies, R.; Heroanto, J.P.; Natanael, H.; Phan, S.; Tanjaya, K. Functional Sterol Improves Breast Milk Quality by Modulating the Gut Microbiota: A Proposed Opinion for Breastfeeding Mothers. *Front Nutr* **2022**, *9*, 1–6. https://doi.org/10.3389/fnut.2022.1018153.
117. van den Elsen, L.W.J.; Garssen, J.; Burcelin, R.; Verhasselt, V. Shaping the Gut Microbiota by Breastfeeding: The Gateway to Allergy Prevention? *Front Pediatr* **2019**, *7*, 1–10. https://doi.org/10.3389/fped.2019.00047.
118. Indrayani, D.; Shahib, M.N.; Husin, F. The Effect of Katuk (Sauropus Androgunus (L) Merr) Leaf Biscuit on Increasing Prolactine Levels of Breastfeeding Mother. *Jurnal Kesehatan Masyarakat* **2020**, *16*, 1–7. https://doi.org/10.15294/kemas.v16i1.11324.
119. Lutfiani, L.; Nasrulloh, N. Total Flavonoids and Antioxidant Activity of Torbangun - Katuk Food Bar on the Effectiveness of Breast Milk Production. *Amerta Nutrition* **2023**, *7*, 88–97. https://doi.org/10.20473/amnt.v7i1.2023.88-97.
120. Magdalena, S.; Yuwono, B.; Dharmayanti, A.W.S. The Effect of Star Gooseberry (Sauropus Androgynus (L.) Merr.) to Bleeding Time of Male Wistar Rats as an Alternative Antithrombotic Drug. *e-jurnal Pustaka KesehatanPustaka Kesehatan* **2015**, *3*, 212–216.
121. Pragasam, A.; Prithvi, J.; Majalikar, P.; Tallur, P.N.; Naik, V.M. Chemical Science Review and Letters Secondary Anti-Oxidative Effect of Soya Lecithin in Bulk Soya Bean Oil. *Chem Sci Rev Lett* **2018**, *7*, 892–899.
122. Choe, J.; Oh, B.; Choe, E. Effect of Soybean Lecithin on Iron-Catalyzed or Chlorophyll-Photosensitized Oxidation of Canola Oil Emulsion. *J Food Sci* **2014**, *79*. https://doi.org/10.1111/1750-3841.12683.
123. ElGamal, R.; Song, C.; Rayan, A.M.; Liu, C.; Al-Rejaie, S.; ElMasry, G. Thermal Degradation of Bioactive Compounds during Drying Process of Horticultural and Agronomic Products: A Comprehensive Overview. *Agronomy* **2023**, *13*, 1–21. https://doi.org/10.3390/agronomy13061580.
124. Gao, Y.; Xia, W.; Shao, P.; Wu, W.; Chen, H.; Fang, X.; Mu, H.; Xiao, J.; Gao, H. Impact of Thermal Processing on Dietary Flavonoids. *Curr Opin Food Sci* **2022**, *48*, 100915. https://doi.org/10.1016/j.cofs.2022.100915.
125. Syafarina, M.; Taufiqurrahman, I.; Edyson Perbedaan Total Flavonoid Antara Tahapan Pengeringan Alami Dan Buatan Pada Ekstrak Daun Binjai (Mangifera Caesia). *Kedokteran Gigi* **2017**, *1*, 84–88.
126. Erningtyas, C.; Amalia, R.B.; Faizah, Z. Overview of Protein and Fe Intake With The Event of Anemia In Adolescent: Systematic Review. *PLACENTUM: Jurnal Ilmiah Kesehatan dan Aplikasinya* **2023**, *10*, 170–179. https://doi.org/10.20961/placentum.v10i3.58355.
127. Savarino, G.; Corsello, A.; Corsello, G. Macronutrient Balance and Micronutrient Amounts through Growth and Development. *Ital J Pediatr* **2021**, *47*, 1–14. https://doi.org/10.1186/s13052-021-01061-0.
128. Jorgensen, J.M.; Yang, Z.; Lönnerdal, B.; Chantry, C.J.; Dewey, K.G. Effect of Iron Supplementation during Lactation on Maternal Iron Status and Oxidative Stress: A Randomized Controlled Trial. *Matern Child Nutr* **2017**, *13*. https://doi.org/10.1111/mcn.12394.
129. Astuti, R.; Aminah, S.; Syamsianah, A. Nutritional Composition of Soyben Tempeh Fortified with Iron and Vitamin A on Uncook and Cook Soyben Tempeh. *AGRITECH* **2014**, *34*. https://doi.org/10.22146/agritech.9505.
130. Kusnadi, K.; Tivani, I.; Amananti, W. Analisa Kadar Vitamin Dan Mineral Buah Karika Dieng (Carica Pubescens Lenne) Dengan Menggunakan Spektrofotometri UV-Vis Dan AAS. *Parapemikir : Jurnal Ilmiah Farmasi* **2016**, *5*, 81–87. https://doi.org/10.30591/pjif.v5i2.384.
131. Prasetyo, A.F.; -, F.; Isaura, E.R. The Difference of Iron Level Based on the Cooking Time and Methods Applied on the Tempeh and Beef Liver: An Experimental Study. *Media Gizi Indonesia* **2022**, *17*, 159–167. https://doi.org/10.20473/mgi.v17i2.159-167.
132. Kwartiningsih, E.; Ramadhani, A.N.; Putri, N.G.A.; Damara, V.C.J. Chlorophyll Extraction Methods Review and Chlorophyll Stability of Katuk Leaves (Sauropus Androgynous). *J Phys Conf Ser* **2021**, *1858*, 012015. https://doi.org/10.1088/1742-6596/1858/1/012015.
133. Alvarez-Ramirez, J.; Vernon-Carter, E.J.; Carrillo-Navas, H.; Meraz, M. Effects of Cooking Temperature and Time on the Color, Morphology, Crystallinity, Thermal Properties, Starch-Lipid Complexes Formation and Rheological Properties of Roux. *LWT* **2018**, *91*, 203–212. https://doi.org/10.1016/j.lwt.2018.01.038.
134. Salsabila, A.; Agustin, R.; Budiati, T. Effect of Addition Katuk Flour on Organoleptic and Physical Quality of Bread. *JOFE : Journal of Food Engineering* **2022**, *1*, 66–79. https://doi.org/10.25047/jofe.v1i2.3179.
135. Utari, A.C.A.; Moviana, Y.; Judiono, J.; Hastuti, W.; Fauziyyah, R.N.; Mulyo, G.P.E. Analysis Quality of Boba (Tapioca Pearl) Katuk Leaves (Sauropus Androgynus) and Mung Beans (Vigna Radiata l.) As an

Alternative Snack Rich in Protein and Iron for Anemic Teenagers. *Jurnal Gizi dan Dietetik* **2023**, *2*, 38–45. https://doi.org/10.34011/jgd.v2i1.1305.
136. Arza, P.A.; Satriana, N.; Ilham, D. Pengaruh Penambahan Ekstrak Daun Katuk (Sauropus Androgynus L. Merr) Terhadap Mutu Organoleptik Dan Kadar Vitamin C Pada Donat. *Prosiding Seminar Kesehatan Perintis E* **2018**, *1*.
137. Naknean, P.; Meenune, M. Factors Affecting Retention and Release of Flavour Compounds in Food Carbohydrates. *Int Food Res J* **2010**, *17*, 23–34.
138. Arief, R.W.; Novitasari, E.; Asnawi, R. Food Diversification of Cassava as Functional Food Instead of Rice in Lampung. *Planta Tropika: Journal of Agro Science* **2018**, *6*, 62–69. https://doi.org/10.18196/pt.2018.081.62-69.
139. Kusmiandany, E.; Pratama, Y.; Pramono, Y.B. The Effect of Gatot (Fermented Dried Cassava) and Red Bean Ratio on Water Content and Organoleptic Characteristics of The "Gatotkaca" Analog Rice. *Journal of Applied Food Technology* **2019**, *6*. https://doi.org/10.17728/jaft.4444.