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Mikale Instant Porridge's Formulation and Acceptability As a Complementary Breast Milk

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ABSTRACT

Background: *The quality of human resources can be impacted by nutritional status. A condition known as lack of protein energy occurs when a person consumes insufficient amounts of nutrient-rich food to meet their needs. Supplementary food for breast milk that is high in energy and protein is one way to ensure that children receive a healthy diet, especially those aged 6 to 24 months.*

Research Purposes: *This research aims to determine the formulation, acceptability, and analysis of the dietary fiber and macronutrient content (protein and carbohydrates) in MiKaLe instant porridge.*

Research Methods: *This research method is an experimental study using a completely randomized design (CRD) that is non-factorial, with 35 panelists who are organoleptic test subjects and three formulations.*

Research Result: *The results of the organoleptic test indicated that the chosen MiKaLe instant porridge, made with 15 grams of yellow millet flour, 25 grams of catfish flour, and 20 grams of soybean flour, was formula 1 (F1). Based on the Comstock acceptability test results, 90% of children left less than 50% of the product, and 10% left more than 75%. The product's nutritional facts state that every 100 grams has 397.99 kcal of energy, 18.52% protein, 14.55% fat, 48.24% carbs, and 16.60% dietary fiber. According to the Friedman test, there is a correlation between color, aroma, flavor, and texture.*

Conclusion: *The results of this research indicate that instant MiKaLe porridge is suitable for breast milk substitutes for infants between the ages of six and eleven months.*

BACKGROUND

One of Indonesia's nutritional issues that needs to be addressed and impact human resources is malnutrition. Protein-energy malnutrition, also known as protein-energy deficiency, is a condition that develops when a person is ill or does not consume enough nutrient-rich food, which prevents the body from properly absorbing and using the nutrients. According to the findings of the 2021 Indonesian Toddler Nutritional Status Study, the percentage of toddlers who are underweight or malnourished has increased from 16.3% to 17% in comparison to 2019 (RI Ministry of Health, 2021).

Increased morbidity and mortality rates can result from prolonged protein energy malnutrition. In addition, children with this condition are less intelligent and productive, have slower growth and cognitive development, and are more susceptible to infectious diseases (Salameh et al., 2019).

Ensuring a nutrient-rich diet (macro and micronutrients) can help prevent this condition. This is known as complementary food for breast milk, and it can be achieved by giving extra food. Nutrient-dense

food or beverages provided to babies between the ages of 6 and 24 months are known as complementary food for breast milk. Complementary food for breast milk is served gradually, progressing from purees, porridge, fruit juices, and steamed meals to regular meals. It is intended that the complementary food for breast milk will be high in energy and protein and that it can be customized by utilizing locally grown food that is easily accessible in the neighborhood (Yustiyani & Setiawan, 2014).

Foods high in protein and energy that are based on what is available locally include yellow millet, catfish, and soybeans. When processed into flour, yellow millet (Pennisetum gray) is a cereal plant that can be used to make foods high in carbohydrates (Anandito et al., 2016). After being dried, ground, and sifted to create a fine texture similar to flour, yellow millet seeds are processed to develop yellow millet flour (Malinda et al., 2013).

In the meantime, the primary sources of vegetable and animal protein that can also be used as flour are soybeans (Glycine max (L.) Merril) and catfish (Clarias sp.). Catfish meat that has had its water content lowered by drying and then finely grinding is used to make catfish flour (Salman et al., 2019). Similarly, soybean flour is made by grinding soybeans until smooth after drying them in an oven or outdoors (Puspita et al., 2021). Instant porridge is one of the highly nutritious complementary foods for breast milk that can be made with these three ingredients.

A food product known as instant porridge is specially processed so that it does not need to be reheated before serving (Yenrina & Krisnatuti, 2001). It is envisaged that creating instant porridge with soybean flour, catfish flour, and yellow millet flour will result in a beneficial complementary food for breast milk that is high in protein and energy and derived from local foods.

Thus, this research aims to determine how to formulate, evaluate, and analyze the macronutrients (protein and carbohydrates) and food fiber for MiKaLe instant porridge. The product's name, MiKaLe, is a combination of the names of the regional foods that were used, namely Yellow Millet (Millet), Soybean (Kedele), and Catfish (Lele Fish).

MATERIAL AND METHODS

As shown in Table 1, this research design is an experimental study using a CRD with three MiKaLe instant porridge formulations. The three formulas contain various main ingredients: millet, soybean, and catfish flour.

Table 1. MiKaLe Instant Porridge Formulation

Material	F0	F1	F2	F3
Yellow Millet Flour	-	15	20	25
Catfish Flour	-	25	20	15
Soybean Flour	-	20	20	20
Rice flour	40	-	-	-
Skim Milk	45	25	25	25
Fine granulated sugar	15	15	15	15
VCO oil	10	10	10	10

The research was conducted in the Rafflesia Integrated Healthcare Center work area for organoleptic tests and acceptability tests, as well as at the Ministry of Health's Palembang Health Polytechnic Nutrition Department Laboratory. Dietary and proximate fiber analysis was done at the Saraswanti Indo Genetech Laboratory in Bogor. The Ministry of Health's Health Polytechnic's Health Research Ethics Committee approved this study on May 30, 2023, Palembang No:0602/KEPK/Adm2/V/2023.

This research was conducted in multiple phases, including the formulation of the MiKaLe instant porridge, organoleptic testing of the porridge on breastfeeding mothers, proximate and food fiber analysis, and the Comstock method acceptability test on infants. In Figure 1, instant porridge is made.

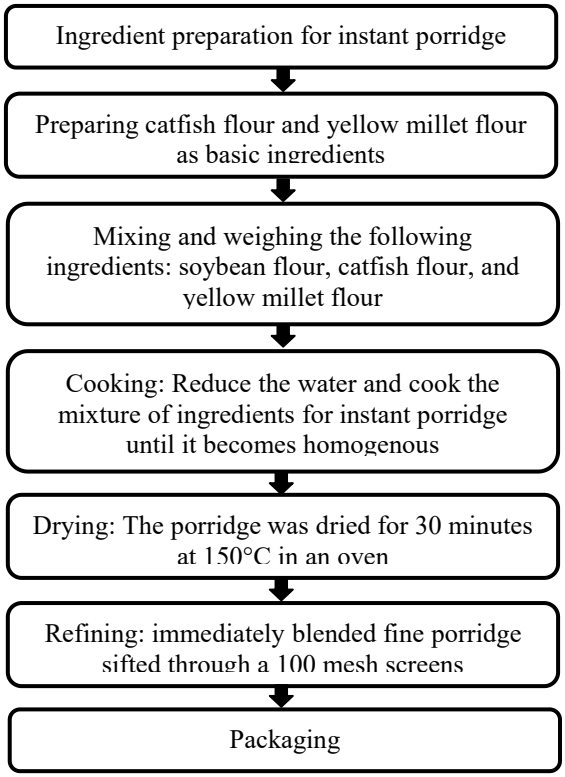

Figure 1. MiKaLe Instant Porridge Preparation Flow

The organoleptic test is a hedonic evaluation conducted on 35 mothers of infants between the ages of 6 and 24 months to determine the chosen formulation based on four factors: color, flavor, aroma, and texture. Using the following scale: (5) like it very much, (4) like it, (3) like it somewhat/neutrally, (2) do not like it, and (1) do not like it. Ash content, water content, dietary fiber content, protein, fat, carbs, and proximate energy are all included in the chemical analysis. The acceptability of instant porridge was tested on ten infants, ages six to eleven months, using the Comstock method. Using the following categories: fully consumed (0%), leftover ¼ portion (25%), leftover ½ portion (50%), leftover ¾ portion (75%), and not consumed (100%).

The acquired data will be statistically analyzed using the Friedman test ($p<0.05$). If a difference is found, the test Kruskal Wallis with a significance level of $\alpha=0,05$ will be performed; if the result is meaningful, the test Mann Whitney will be performed.

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RESULTS

Organoleptic Test

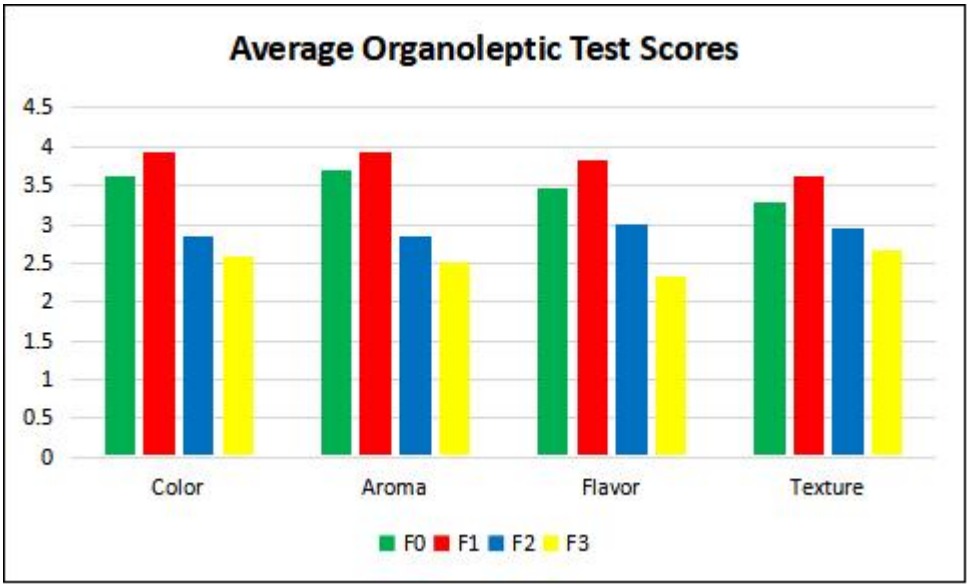

Figure 2. Average Organoleptic Test Scores

Color

The research findings showed that the like category, which included 18 panelists (51.4%), had the highest control formula score (F0). Next, in formula one (F1), the like category had the highest score, with 23 panelists (65.7%); in formula two (F2), the somewhat like/neutral category had the highest score, with 25 panelists (71.4%); and in formula three (F3), the somewhat like/neutral category had the highest score, with 21 panelists (60%).

Based on Figure 2, which shows that panelists' average acceptance ranges from 2.60 to 3.94, it can be inferred that, out of the three MiKaLe instant porridge formulations, formula one (F1) has the color the panelists prefer.

Aroma

The data analysis results indicated that the likes category, which included 18 panelists (51.4%), had the highest score for aroma assessment in the control formula (F0). The highest score in formula one (F1) was then recorded by 25 panelists (71.4%) in the like category; the highest score in formula two (F2) was recorded by 13 panelists (37.1%) in the do not like category; and the highest score in formula three (F3) was recorded by 18 panelists (51.4%) in the somewhat like/neutral category.

Figure 2 shows that panelists' average acceptance ranges from 2.51 to 3.94. Formula One (F1) has the aroma that most appeals to them.

Flavor

According to the research, 17 panelists (48.6%) gave the MiKaLe instant porridge in the control formula (F0) the highest rating for flavor. Twenty-three panelists (65.7%) gave formula one (F1) the highest score in the like category, 15 panelists (42.9%) gave formula two (F2) the highest score in the somewhat like/neutral category, and 19 panelists (54.3%) gave formula three (F3) the highest score in the do not like category. Figure 2 shows the panelists' average acceptance ranges from 2.34 to 3.83. The panelists' favorite formula, it can be concluded, is formula one (F1).

Texture

A texture assessment score for MiKaLe instant porridge was obtained through the hedonic test analysis in the control formula (F0). Most panelists (14 or 40%) were neutral. In formula one (F1), the highest score was obtained by 18 panelists (51.4%) in the like category; in formula two (F2), the highest

score was obtained by 17 panelists (48.6%) in the somewhat like/neutral category; and in formula three (F3), the highest score was obtained by 20 panelists (57.1%) in the like category.

Figure 2 shows that panelists' average acceptance ranges from 2.66 to 3.63. Therefore, formula one (F1) is the texture that panelists prefer the most.

Table 2. MiKaLe Instant Porridge's Average Acceptability Quality

Parameter	Rate-rate			
	F0	F1	F2	F3
Color	3,63±0,61[a]	3,94±0,701[c]	2,86±0,631[b]	2,60±0,568[b]
Aroma	3,69±0,541[a]	3,94±0,736[b]	2,86±0,879[c]	2,51±0,667[c]
Flavor	3,46±0,547[a]	3,83±0,853[b]	3,00±0,874[c]	2,34±0,657[d]
Texture	3,29±0,718[a]	3,63±0,750[b]	2,94±0,891[b]	2,66±0,747[b]

Explanation: 1. The most liked is indicated by the higher number.
2. Signif Significant differences ($p \leq 0.05$) are indicated by numbers followed bydifferent Letters when using the Kruskal Wallis test and the Man-Whitney test, respectively.

***Comstock* Acceptance Method**

Table 3. Comstock Method MiKaLe Instant Porridge Acceptability Test Results

Food name	Comstock Acceptability Test Results											
	0 %		25%		50%		75%		100%		Total	
	n	%	n	%	n	%	n	%	N	%	n	%
MiKaLe Instant Porridge	0	0	9	90	0	0	1	10	0	0	10	100

Analysis of Nutrient Content

Table 4. Proximate and Fiber Analysis of MiKaLe Instant Porridge per 100 grams

No	Parameter	MiKaLe Instant Porridge (F1)	INS Quality Standar (Indonesian Minister of Health No.24/Menkes/SK/II 2007)
1.	Protein	18,52 %	15-22 %
2.	Total Fat	14.55 %	10-15 %
3.	Carbohydrate	48,24 %	35 %
4.	Total Energy	397,99 Kcal	400-440 kcal
5.	Ash	5.00 %	Max 3.5%
6.	Water	13,69 %	Max 4%
7.	Food Fiber	16.60 %	Max 5%

DISCUSSION

Organoleptic Test

Yellow millet flour, catfish flour, and soybean flour are the main ingredients in MiKaLe Instant Porridge, along with a few additional complementary ingredients specially processed to create an instant porridge-like product. This food item, also known as complementary food for breast milk, is meant for kids starting to eat something other than breast milk. Because of their relatively high nutritional content in energy and protein, yellow millet flour, catfish flour, and soybean flour were selected as the main ingredients in this research. In addition, these three ingredients are easily accessible in the community and can be used as local food ingredients.

As a substitute for rice or wheat flour, yellow millet flour is made by processing the plant's seeds, which are dried and then ground into a fine flour-like consistency. The carbohydrate content of yellow millet

is nearly identical to that of wheat or rice7. The human body uses carbohydrates as its primary energy source (Husnah et al., 2022). Animal and vegetable protein can be obtained from soybean and catfish flour, which are excellent sources of other nutrients. Omega-3, omega-6, leucine, and lysine fatty acids are present in catfish, which is advantageous (Santoso et al., 2019). In addition, soybeans are a good source of dietary fiber, probiotics, and isoflavones and have unsaturated fatty acids (oleic and linoleic) (Astuti et al., 2014).

The panelists preferred the yellowish cream color produced by MiKaLe formula 1 (F1) instant porridge because it tends to be bright rather than too dark, like formulas F2 and F3. One possible reason for the dark color of instant porridge is the quantity of yellow millet flour added to the porridge mixture. Reaction Maillard, a chemical reaction between carbohydrate substances (reducing sugars) and protein substances that can happen at heating temperatures, is the cause of yellow millet flour's darkening (Anandito et al., 2016). This is consistent with the three instant porridge formulations that have undergone hedonic quality testing; F1 (15 grams), F2 (20 grams), and F3 (25 grams) are the formulations that have been chosen because they use the least amount of yellow millet flour. Therefore, the color will be darker the more yellow millet flour you use.

MiKaLe formula 1 (F1) instant porridge has an aroma that panelists claimed smelled like catfish meat. Since the proportion of yellow millet flour to catfish flour was not significantly different in any of the three formulas, the panelists did not perceive any discernible differences in the aromas of the three. Panelists prefer the flavor of MiKaLe formula (F1) instant porridge because it tends to be sweeter and palatable than other formulas, particularly formula 3 (F3), which leaves a slightly bitter aftertaste. The quantity of yellow millet flour added to the mixture may give MiKaLe instant porridge its bitter flavor. Due to its starch and tannin content, yellow millet has an astringent and bitter flavor (Mahendra et al., 2019). This is consistent with the three instant porridge formulations that have undergone hedonic quality testing; F1 (15 grams), F2 (20 grams), and F3 (25 grams) are the formulations that have been chosen because they use the least amount of yellow millet flour. Therefore, the flavor of the result will be better with the more yellow millet flour you use.

Panelists prefer the texture of MiKaLe instant porridge formula (F1) over F2 and F3, noting that F1's texture is generally smoother and less gritty. One possible reason for the grainy texture of MiKaLe instant porridge is the quantity of yellow millet flour mixed into the porridge mixture. According to Malinda's (2012) research, yellow millet flour has a sandy texture (Malinda et al., 2013). A rough texture in the porridge can also result from a grinding process that could be better. Therefore, the texture of MiKaLe instant porridge can be influenced by the amount of yellow millet flour used and the grinding method.

Comstock Acceptance Method

Food waste is defined as the quantity of food that is not consumed, and it can serve as a gauge for consumer acceptance of the product. Comstock weighs the amount of food before and after it is served to assess food waste visually. MiKaLe instant porridge is consumed by 90% of children, or 9 of them, with ¼ portion, or 25% remaining, according to food waste calculations. On the other hand, 10% of adults, or one person, consume MiKaLe instant porridge with ¾ portion, or 75% remaining. Although the MiKaLe instant porridge formulation cannot be complete, babies between the ages of 6 and 11 months can tolerate it as long as it meets the target of having less than 50% left.

This may be because infants do not like the flavor of catfish meal and the aftertaste of yellow millet flour, which has a potentially bitter taste. In addition, the acceptability of a product can also be influenced by its texture. For example, babies do not like the slightly gritty texture of MiKaLe instant porridge. According to research by Aprilia (2016), infants are more receptive to complementary food for breast milk that has a soft texture, tastes savory and sweet, and is resistant to bitter flavors (Aprilia & Hati, 2016).

Nutrient content

According to laboratory test results, the formula (F1) chosen for MiKaLe instant porridge has 397.99 kcal of energy per 100 grams of product. This means it fulfills 99.4% of the 400 kcal Indonesian National Standard (INS) (Minister of Health of the Republic of Indonesia No.24/Menkes/SK/II 2007) for porridge instant complementary food for breast milk.

Based on laboratory testing, the chosen formula (F1) of MiKaLe instant porridge has a protein content of 18.52 grams per 100 grams. The protein content of MiKaLe instant porridge is high and meets the requirements of the INS (Minister of Health of the Republic of Indonesia No.24/Menkes/SK/II 2007) porridge instant complementary food for breast milk, which is 8–22 grams of protein. Protein is vital for kids because it is the body's building block, metabolism regulator, and antibody (Asmira et al., 2019). According to lab testing, miKaLe instant porridge's chosen formula (F1) has a fat content of 14.55 grams per 100 grams. The fat content of MiKaLe instant porridge is high and meets the requirements of the INS (Minister of Health of the Republic of Indonesia No.24/Menkes/SK/II 2007) porridge instant complementary food for breast milk, which is 6–15 grams of fat. Several fat-soluble vitamins, including A, D, E, and K, are better absorbed and transported when fat is used as an efficient energy source (Sari et al., 2018). Laboratory tests have determined that the carbohydrate content of MiKaLe instant porridge in formula (F1) is 48.24 grams per 100 grams. The carbohydrate content of MiKaLe instant porridge is relatively high and meets the requirements of the INS (Minister of Health of the Republic of Indonesia No.24/Menkes/SK/II 2007) porridge instant complementary food for breast milk, which is 35 grams of carbohydrate. Since carbohydrates are the body's primary energy source, a diet low in them increases the risk of stunting in children (Husnah et al., 2022). Laboratory tests indicate that the chosen formula (F1) of MiKaLe instant porridge has a water content of 13.69%. A maximum of 4% of the water content in MiKaLe instant porridge does not meet INS (Minister of Health of the Republic of Indonesia No.24/Menkes/SK/II 2007). According to research by Azis (2015) and Mahendra (2019), yellow millet seeds have a high water content. Even after being ground into flour, Mahendra et al. (2019) noted that the water content of the ground millet seeds remains relatively high. Another factor that may contribute to high water content in instant porridge is the uneven heat distribution in the oven. High water content may reduce the quality of a food product's shelf life because it keeps the product stable and humid (Henggu et al., 2021).

Lab tests indicate that the chosen formula (F1) of MiKaLe instant porridge has an ash content of 5%. The instant porridge's ash content, which is limited to 3.5%, meets the INS (Minister of Health of the Republic of Indonesia No.24/Menkes/SK/II 2007) for complementary food for breast milk. It is well known that soybean flour has approximately 3.87% more ash than yellow millet flour (Simanjuntak & Pato, 2020).

Based on laboratory testing, MiKaLe instant porridge's food fiber content in the chosen formula (F1) is 16.60%. The fiber content of the instant porridge does not meet the INS (Minister of Health of the Republic of Indonesia No.24/Menkes/SK/II 2007) for complementary food for breast milk, which states that the fiber content should not exceed 3-5%. High dietary fiber contents have been reported for soybean and yellow millet flour (Mawati et al., 2017; Pratiwi & Sugitha, 2020). In the human digestive system, dietary fiber is a crucial tissue component. A child's digestive system's capacity to digest may be impacted by the high dietary fiber content of complementary food for breast milk instant porridge (Setiawan et al., 2022).

CONCLUSIONS

Formula 1 (F1), with a treatment ratio of 15 grams of yellow millet flour, 25 grams of catfish flour, and 20 grams of soybean flour, is the optimal formulation for MiKaLe instant porridge. In 100 grams of product, MiKaLe formula 1 (F1) instant porridge has 397.99 kcal of energy, 18.52% protein, 14.55% fat, 48.24% carbs, 13.69% water content, 5% ash content, and 16.60% dietary fiber. MiKaLe instant porridge with a residual Comstock yield of less than 50% is acceptable as a complementary breast milk food in infants aged 6 to 11 months.

With 15 grams of millet flour, Formula 1's Mikale instant porridge has the perfect flavor and does not taste bitter. To get past the porridge's grainy texture, use a flour sieve with 200 mesh.

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