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Physical and chemical properties of instant porridge with added moringa leaf flour

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ABSTRACT

Background: Moringa leaves are rich in macro and micronutrients; it is expected to produce weaning food that meets nutritional needs. This study aimed to produce an instant porridge formula that meets the terms and conditions of weaning food, including physical characteristics and nutrient contents.

Methods: This study employed a completely randomized design experiment with three replications to evaluate the impact of moringa leaf flour (0, 5, 7.5, and 10 g/recipe) on infant weaning food prepared from soybeans and wheat. Soybean and moringa leaf flours were prepared following established protocols. Instant porridge production involved mixing, baking, drying, and grinding, followed by density and water absorption analysis using standard methods. Nutritional content was analyzed by a certified laboratory. Descriptive statistics and data visualization will be used to present the findings.

Results: Formula F1 (5 g) has a preference category above 88% of panelists who accepted it based on aspects of color, texture, aroma, and taste. The average density of instant porridge is 0.53 g/ml, and the water absorption capacity is 1.74 ml/g. The nutritional content per 100 g of energy is 471 Kcal, protein 19.7 g, total fat 19.7 g, linolenic fatty acid 464 mg, total carbohydrates 54.7 g, sucrose 21.24 g, water content 3.5 g, iron 44.6 g, and calcium 117.2 mg.

Conclusion: The instant porridge produced meets the essential physical characteristics required for infant weaning foods. Additionally, its nutritional profile, except for total fat, satisfies the energy and nutrient needs for infants aged 6-11 months.

KEYWORDS

Organoleptic Properties, Food Enrichment, Nutritional Composition, Fortification.

INTRODUCTION

Adequate food and nutrition intake is very important for the growth and development of infants and toddlers. Breast milk (in Indonesia: ASI) is the main source of nutrition for infants, but starting at six months, the nutrient content of breast milk is no longer sufficient, while the infants' energy needs increase by 24-30% compared to needs according to age. There are two types of weaning foods (in Indonesia: MP-ASI) in the community: homemade weaning foods and ready-to-eat (instant) weaning foods. The basic ingredients for making ready-to-eat weaning food usually come from instant flour, made from a mixture of rice or brown rice, green beans or soybeans, milk, sugar, and vegetable oil addition with vitamins and minerals, added with flavor and aroma. Requirements for the main nutritional composition in 100 g of this weaning food instant powder for infants aged 6-11 months, contains 400-440 calories of energy, 15-22 g of protein, 10-15 g of fat, carbohydrates (sucrose) maximum 30 g, and maximum fiber 5 g[1].

Grains such as rice and wheat are energy sources with relatively low protein content, so animal and vegetable food sources can supplement their nutritional content. Legumes have long been known as a source of protein and vitamins

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complementary to grains. It has protein, including lysine, leucine, and isoleucine, but is limited in methionine and cystine. Meanwhile, whole grains are high in methionine and cystine but low in lysine[2]. However, the anti-nutrient content of legumes causes poor digestion, preventing these nutrients from being properly absorbed. Anti-Nutrient compounds in legumes can be significantly reduced by microorganisms such as soybean tempeh, germination, and/or fermentation processes[3].

Soybean tempeh has been widely used for formulations in research and food products to help overcome nutritional problems in toddlers, such as the lack of calories and protein, by combining wheat flour and other food sources. The tempeh formula was also listed as a local food for weaning food formula issued by the Ministry of Health of the Republic of Indonesia in 2002. A study found that a tempeh-based weaning formula provided no additional growth benefits for well-nourished infants aged 6-11 months compared to a non-tempeh formula[4]. This means that the tempeh formula has not provided maximum results for changes in nutritional status in children under five. For this reason, nutrient enrichment is still needed from other food sources that are rich in protein, minerals, and vitamins.

Local food ingredients from vegetable sources whose utilization is relatively low in enrichment in food additives such as tempeh formula are Moringa leaves. Moringa leaves are quite common in various areas, which only function as fences and landslide barriers and are only occasionally used as a source of vegetables when there are no other vegetables. Overseas, Moringa leaves have been used to treat nutritional problems in children and pregnant women, and the children show significant weight gain[5]. Adding 3-5 g of moringa leaf powder to food or drink for under-five children can trigger appetite[6]. Pregnant women given moringa leaf extract can increase hemoglobin levels[10]. Breastfeeding mothers who are given moringa leaf extract and powder can increase the volume of breast milk Click or tap here to enter text[7,8], and the nutritional status of infants at the age of 4 months is better[9].

The nutritional composition of Moringa leaves, enriching it into instant complimentary food porridge, can enrich the nutritional composition needed by infants in growth and development, especially protein, essential amino acids, and micronutrients (vitamins and minerals). Tempe formula biscuit products with moringa leaf flour substitution increased protein, iron, and zinc along with the amount of moringa leaf flour added[10]. The researchers are interested in reformulating instant porridge using various cereal and legume formulas enriched with moringa leaf flour as weaning foods for infants aged 6-11 months. It is expected to obtain instant porridge with a balanced nutritional composition according to adequacy standards, meet physical characteristics, be safe for consumption, and be accepted by consumers.

The research problem is to determine the optimal level of enrichment of Moringa leaf flour in instant porridge for babies aged 6-11 months in order to achieve balanced nutritional content according to standards. This study aimed to determine the physical characteristics (density, water absorption) and macro-nutrient content of instant porridge enriched with moringa leaf flour.

METHOD

This research was an experiment using a one-factor of completely randomized design (CRD) with three replications. The treatment reformulation was addition moringa leaf flour 0 g, 5 g, 7.5 g, and 10 g per recipe. The fortification formulation of Moringa leaf flour in instant porridge as weaning food is shown in Table 1.

The materials used in this study consisted of the main materials and supporting materials. Soybeans were purchased from the Transmark Supermarket, and fresh young Moringa leaves were obtained from the Moringa garden in Maros under the guidance of CV. Brilliant Production. Other ingredients, such as full cream flour and powdered sugar, vegetable oil, wheat flour, mocaf flour, sugar, salt, baking powder, and ovalet. Materials for physical analysis included distilled water.

Table 1. The formula for Moringa leaf flour fortification and the composition of the basic ingredients for making instant porridge

Ingredients	Formula composition (g)			
	F0 (g)	**F1(g)**	F2 (g)	F3 (g)
Moringa Leaf Powder (TDK)	0	**5**	7,5	10
Wheat Flour (TTg)	20	**20**	20	20
Mocaf flour (TMc)	20	**20**	20	20
Soybean flour (TKK)	30	**30**	30	30
Full cream milk flour (TSFc)	10	**10**	10	10
Refined Sugar (GHS)	25	**25**	25	25
Egg	40	**40**	40	40
butter	10	**10**	10	10
Baking powder (BF)	1	**1**	1	1
ovalet	1	**1**	1	1
Salt	0.5	**0.5**	0.5	0.5
Total	157.5	**162.5**	165.0	167.5

Note: F0 = Formula without moringa flour; F1 = Addition formula 5 g/recipe; F2 = Addition Formula 7.5 g//recipe; F3 = Addition Formula 10 g/recipe.

Soybean flour was prepared by soaking for 12 hours. Moringa leaf powder was prepared according to the procedure by Zakaria (2012), which was modified by an oven temperature of 55 °C[11]. The equipment used in the study consisted of drying cabinets, 80 mesh sieve. For analysis of physical properties and completeness of sensory analysis of acceptability, it used measuring cups, test tubes, centrifuges, vibrators.

Production of Moringa leaf flour and soybean flour, also analysis of physical characteristics, was carried out in the Food and Nutrition technology laboratory of the Makassar Polytechnic of Health by trained panelists. Making instant porridge successively prepared all the ingredients in powder and weighs each ingredient according to the formula dosage. Mixed and stirred until it became a smooth dough in a basin. The dough was formed as desired (thin rectangles) evenly on the baking sheet with a thickness of 0.5 cm. Bake in the oven at 180 °C until cooked ±20 minutes. Cut into small pieces for drying in the oven at 60 °C for approximately 8 hours. Mashed using a flour meal disk, sifted using 80 mesh size. Instant porridge was packaged using aluminum foil clamps 60 g/sachet.

Density was determined by putting the product material into a measuring cup until the volume reached 100 ml, then the material was weighed. The density of instant flour was expressed in g/ml. Modified water absorption analysis from Rauf and Sarbini (2015) was conducted by weighing 3 g of instant powder, putting it into the Sanites tube, adding 15 ml of distilled water, and then homogenizing using a vibrator until it was evenly dispersed[12]. The tube was centrifuged at 200 rpm for 15 minutes. The supernatant obtained was poured into another container while the centrifuge tube and the residue were heated in the oven. The tube was placed in an oblique position (25°), and the oven was set at 50 °C for 25 minutes, and the final stage was the centrifuge tube which was weighed to determine the residual weight. Water absorption was determined by the equation of the weight of the tube plus residue after the oven minus the tube plus the initial sediment divided by the weight of the sample (ml/g).

Sensory Evaluation

The level of preference is analyzed by panelists based on the aspects of color, aroma, texture and taste. The panelists used were somewhat trained panelists who were selected from final year Nutrition Department students who had passed the Food Sensory Analysis course. The selected panelists must meet the requirements, including being willing to spend time willingly, not being sick (fever), and liking Moringa leaf vegetables. The assessment attributes according to the panelists' level of liking use a hedonic scale, namely: really like (4), like (3), don't like (2), really don't like (1) which the researcher then divides into two categories, namely like (scale 3 and 4) and Dislike (scale 1 and 2).

Data Analysis

The nutritional content examined was Energy (Kcal/100 g), Protein (c), Fat (g), Linoleic acid (mg), Total carbohydrates (g), Sucrose (g), Water (g), Iron (mg/ kg), Calcium (mg/kg) and analyzed at the Laboratory of PT. Sukopindo Center in Cibutung-Bekasi West Java (KAN (National Accreditation Committee) certified laboratory as the implementation of the duties and functions of the Indonesian National Standardization Agency (BSN). Methods and analysis procedures adapted to the methods that apply in the laboratory. Data were analyzed descriptively, then presented in tabular form accompanied by narration.

RESULTS

Physical Characteristics (Density and Water Absorption)

The average density in the instant porridge study with the addition of selected moringa leaf flour was 0.54 g/ml, and the water absorption capacity was 1.63 ml/g. The selected instant slurry formula has a 0.53 g/ml density and a water absorption capacity of 1.74 ml/g. The density and water absorption are presented in Table 2.

Table 2. Density and water absorption of Instant Porridge formula with addition Moringa leaf flour

Moringa leaf fortification	Density (g/ml)			Water absorption (ml/g)		
	U1	U2	Average	U1	U2	Average
F0 (0 g)	0.52	0.53	0.53	1.46	1.89	1.68
F1 (5 g)	**0.55**	**0.51**	**0.53**	**1.69**	**1.78**	**1.74**
F2 (7.5 g)	0.57	0.53	0.55	1.60	1.39	1.50
F3 (10 g)	0.55	0.52	0.54	1.91	1.27	1.60
Average			0.54			1.63

The nutritional content

The nutritional content of instant powder products with addition moringa leaf flour was selected presented in Table 3. Table 3. shows the macro and micronutrient content of instant porridge with addition moringa leaf flour 5 g, which was selected as weaning food for babies 6-11 months consecutively energy 471 Kcal/100 g, protein 19.7 g, fat 19.7 g, linoleic fatty acid 464 mg, total carbohydrates 54.7 g, sucrose 21.2 g, water content 3.5 g, iron 44.7 mg, and calcium 117.2 mg.

Table 3. Macro and micro - nutrient content of selected instant porridge with addition moringa leaf flour

Selected instant porridge		Standard in Indonesia
Parameter	**Total**	
Energy (Kcal/100g)	471	400-440
Protein (g)	19.7	15-22
Fat (g)	19.7	10-15
Linoleic acid (mg)	464	300
Carbohydrate total (g)	54.7	-
Sucrose (g)	21.2	Max 30
Water (g)	3.5	5
Iron (mg/kg)	44.6	5-8
Calcium (mg/kg)	117.2	200-400

Sensory Evaluation

Figure 1 shows that there is a tendency for panelists' acceptance of formula to increase in F0, namely the formula without the addition of Moringa leaf flour and F1 with the addition of 5 g Moringa leaf flour per standard recipe, namely above 88% of panelists accepted it from all aspects assessed, namely color, texture, aroma and taste.

DISCUSSION

Physical Characteristics (Density and Water Absorption)

Density is the weight of the material in a certain volume, including the air volume in the space between the materials (g/ml). Density is influenced by particle size, material properties, material composition, and degradation of molecules in the material due to processing[13]. The density of instant porridge for addition Moringa leaf flour is about 0.53 g/ml; the density of this instant porridge is close to instant baby porridge produced between 0.543-0.588 g/ml[14]. The density is in the range of commercial instant porridge, generally 0.30-0.70[15]. Instant porridge with a low density below 0.30 is not recommended because it has a large volume but a low nutritional density. This is because it will impact the baby quickly feeling full while the nutritional intake is insufficient. The higher the density, the denser the product (concise).

The low water content is due to the large volume of water that evaporates during drying, resulting in the lower the water content that is formed, the smaller the volume of the flour grains so that the resulting density is greater[16]. Addition moringa flour instant slurry is around 3.52%, related to the resulting density. One of the characteristics of instant porridge is water absorption (rehydration). Water absorption is the ability of a material to absorb water. According to Farida SN, 2016[17] good water absorption means that the rehydration time will be shorter so that the product absorbs water more quickly. The water absorption capacity of this selected instant powder is about 1.74 ml/g lower than the results of research by Farirda SN, 2016; Premesta, 2014[17,18], which ranges from 3.60 to 6.20 ml/g. The ingredients used in making weaning food instant porridge are generally hygroscopic, such as wheat flour, mocaf flour, soybean flour, and milk flour. Fortification of moringa leaf flour does not affect water absorption because the composition is relatively small. Carbohydrate levels in the form of sugar, sucrose, and protein can increase water absorption[18]. Water absorption is related to the constituents' solubility and the material's composition.

The nutritional content

Requirements for the nutritional composition of instant porridge as weaning food, according to Kementerian Kesehatan RI (2019)[19], in 100 g for infants 6-11 months should include energy 400-440 kcal, protein (quality protein not less than 70% of the quality of casein) 15-22 g, fat 10-15 g, carbohydrates (maximum sucrose 30 g, fiber maximum 5 g), iron 5-8 mg, calcium 200-400 mg, and water a maximum of 4 g. The purpose of giving weaning food is to meet the nutritional needs of infants aged 6-11 months due to decreased milk production after six months[20].

The nutritional content of instant powder with the addition of Moringa leaf flour as selected weaning food for babies 6-11 months contains energy 471 kcal/100 g, protein 19.7 g, total fat 19.7%, linoleic fatty acid 464 mg, total carbohydrates 54.70 g, sugar (sucrose) 21.24 g, water content 3.5 g, iron (Fe) 44.6 mg/kg, calcium (Ca) 117.2 mg/kg. The nutritional content meets the nutritional requirements according to the standards of the Indonesian Ministry of Health (2007) (16). Energy is one of the results of the metabolism of carbohydrates, proteins and fats; it serves as a power substance for metabolism, growth, temperature regulation, and physical activity[21]. Giving too many calories to babies can lead to obesity

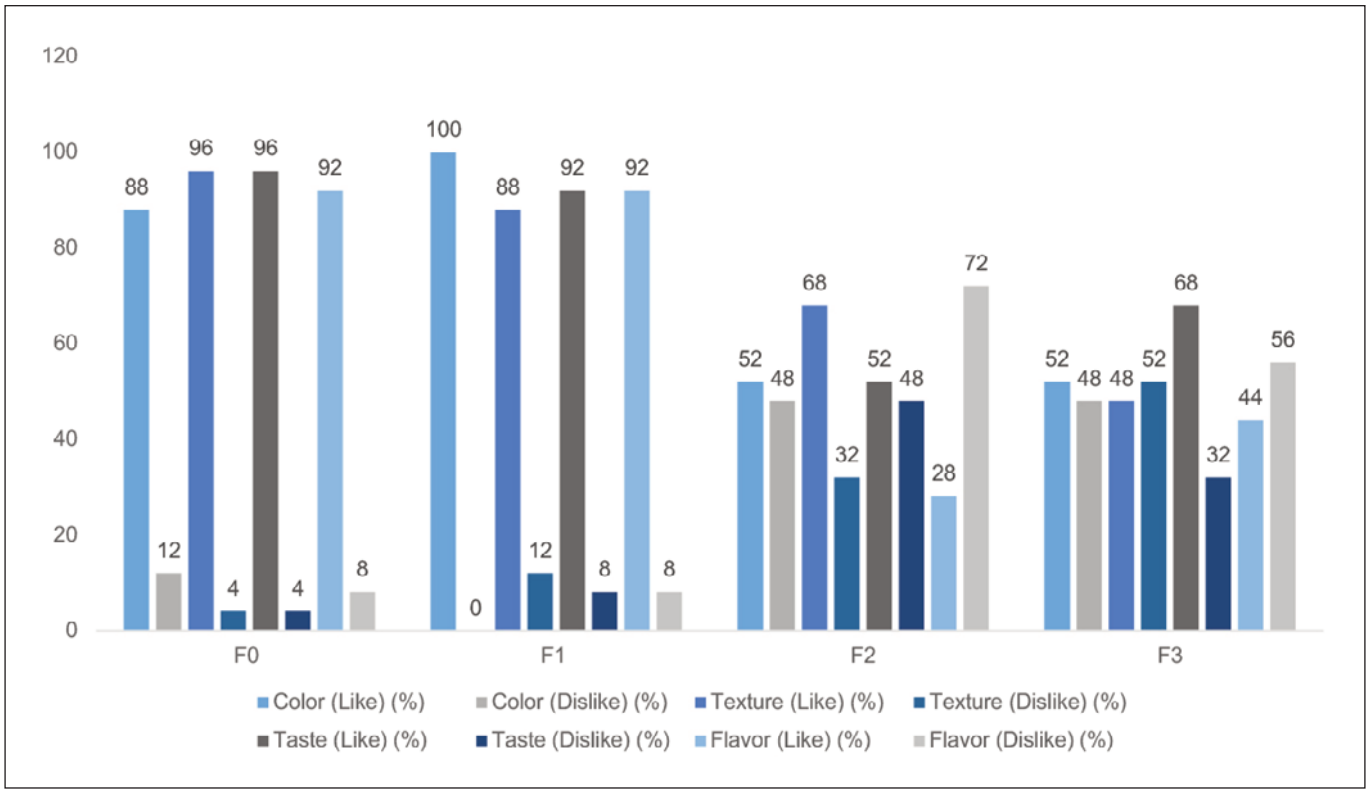

Figure 1. Sensory Evaluation of instant flour porridge (%)

or overweight, especially if children eat lots of foods that only contain many calories without important nutrients.

The energy balance of carbohydrates, protein, and fat in this instant porridge is contributed by ingredients that make up instant porridge, including wheat flour, mocaf, refined sugar, soybean flour, eggs, milk, vitamins, and minerals. Moringa leaves can prevent stunting in the first 1000 years of birth[22]. Zakaria's research (2022) shows that giving moringa extract to breastfeeding mothers can positively affect the baby's weight, health, and exclusive breastfeeding[23]. Other research shows that consumption of achira porridge with heme iron affects increasing hemoglobin levels in children aged 6 to 11 months, during six weeks of intervention[24]. Then, providing Moringa leaves with nutritional content must be utilized as well as possible by including them in various nutritious recipes which can function as iron supplements for growing teenagers. Then, providing Moringa leaves with nutritional content must be utilized as well as possible by including them in various nutritious recipes which can function as iron supplements for growing teenagers[25].

Instant powder with the addition of Moringa leaf flour after brewing with water ready for consumption was tested by somewhat tired panelists from final year applied nutrition and dietetics undergraduate students. Panelists accepted/liked (88-100%) the concentration of adding 5 g Moringa leaf flour per standard recipe (F0) for instant porridge based on aspects of color, texture, aroma and taste, almost comparable to instant powder without adding Moringa leaf flour (F0).

CONCLUSION AND RECOMMENDATIONS

The physical characteristics of the instant porridge produced meet the requirements as weaning foods for infants aged 6-11 months based on density (0.53 ml/g) and water absorption (1.74 ml/g). The nutritional content per 100 g of instant porridge produced fulfills the energy requirements of 471 kcal; protein 19.7 g; linolenic fatty acid 464 mg; sucrose 21.24 g; water content 3.5 g, iron 44.6 g; except for total fat 19.7 g. However, the calcium content of 117.2 mg is still low. Instant porridge addition with Moringa leaves as a weaning food for babies aged 6-11 months can be utilized for babies after exclusive breastfeeding at least once a week to introduce the natural taste of Moringa while at the same time contributing to nutritional intake.

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