Sys Rev Pharm 2020;11(7):61-64
A multifaceted review journal in the field of pharmacy

Development of Instant Powder with the Addition of Moringa Oleifera Leaf Powder as Complementary Food for Infants 6-12 Months Old

Zakaria*[1], Suriani Rauf[1], Andi Salim[2], Nurdin Rahman[3], Bohari[3]

[1]Nutrition, Health Polytechnic of Makassar, Indonesia
[2]Nutrition, Health Polytechnic of Mamuju, Indonesia
[3]Nutrition Department, Faculty of Public Health, Tadulako University, Indonesia
Email: zakariagizi@aol.com

ABSTRACT

The right combination of various ingredients types may produce complementary foods that meet the nutritional needs of infants. This study aimed to produce an instant powder formula with the addition of Moringa leaf powder as a complementary food for babies aged 6-12 months. The study used a completely randomized design (CRD). The main ingredients were the dry powders of brown rice, soybean sprouts, mung bean sprouts, and Moringa leaves. The addition of Moringa leaf powder was 7%, 8%, and 9% for each formula. Based on linear programming, there were nine main formulas of the combination of the main ingredient. Parameters measured were physical characteristics, macronutrient composition, and panelist acceptability. The formulation was assessed by the effective index method with a score of each variable 0-1. The instant powder was served after cooking with enough water, then cooked for ± 1-2 minutes. This infant's food contains about 347 - 379 Kcal / 100 g of energy, 20-23% Protein, 2-4% Fat, 62-64% Carbohydrates, 2-3-3% Fiber, and 3-4% Moisture. The average bulk density was 0.6 - 0.7 g / ml, and the water absorption ratio was 1: 1.5. In general, sensory acceptability was slightly like. The nutritional content met the requirements was protein, fiber, and moisture, high carbohydrates, but low energy and fat. All formulas met the physical requirements and water absorption, but acceptability was still low. The best breastfeeding companion food was formula C2, with a score of 0.7.

Keywords: Instant Powder, Moringa oleifera leaf, Infants' Complementary Food.

Correspondence:
Zakaria*[1]
[1]Nutrition, Health Polytechnic of Makassar, Indonesia
Email: zakariagizi@aol.com

INTRODUCTION

Nutrition vulnerable group is the people who required special treatment in fulfillment of basic needs such as infants, toddlers, pregnant women, nursing mothers, and the elderly, either with normal or physical disabilities. One of the nutritional problems in children under five whose prevalence is still high is malnutrition and stunting [1]. The main result of [2] primary health research of Indonesia, revealed that malnutrition status was 19.6% in 2013 and fell by 1.9% in 2018 to 17.7%. In 2013, 37.2% of children were categorized as very short, and 30.8% were categorized as short, then it fell to 6.9% in 2018. The proportion of children aged 6-59 months who received a complimentary food program was 58.3% [2].

Sufficient food quantities consumption and nutritional content are highly necessary for the growth of infants and toddlers. After the baby reaches six months old, the nutritional content of breast milk would be no longer sufficient while the baby's energy requirements increase by 24-30% compared to the needs at 3-5 months of age [3] to meet an increased nutritional needs, complementary foods need to be given to babies after six months. The traditional preparation of weaning food often does not meet the principles of food sanitation hygiene that allows contamination of microorganisms that cause diarrhea in infants [4]. Meanwhile, complementary foods from factories produce baby food that is relatively hygienic and practically easy to serve. The nutritional content in complementary food of the manufacturer may also be formulated based on the baby's dietary adequacy rate [5]. One form of breastfeeding companion food known to the public is instant baby porridge.

The Ministry of Health of Indonesia stipulates that ingredients of instant complimentary food powder could be made from a mixture of rice and or brown rice, mung beans and or soybeans, milk, sugar, vegetable oil, and enriched with vitamins and minerals also added flavors. Macronutrient composition requirements must be fulfilled in 100 g instant food powder for infants 6-12 months, such as energy 400-440 Kcal, protein (protein quality not less than 70% casein quality) 15-22 g, fat 10- 15 g, carbohydrates (maximum 30 g of sucrose sugar and maximum 5 g of fiber) [6]. Complementary feeding is a process of transition from solely milk-based intake to semi-dense foods. Complementary foods must be nutrient-dense and balanced, rich in energy, sufficient protein, and a balanced ratio of fats between saturated and unsaturated fats so it will be easily digested by the infants' digestive organs [7].

Legumes are known as protein and vitamins source that complement each other with cereals, such as rice and wheat. The protein of legumes is generally rich in lysine, leucine, and isoleucine, but limited methionine and cystine. Thus, this food often being combined with cereals [8]. However, the content of anti-nutrient compounds in those beans causes poor digestion, so these nutrients cannot be adequately absorbed. Anti-nutrient compounds in this food can be significantly reduced through soaking and germination [8].

One of the local vegetable food sources, which relatively low usage in complementary food production is Moringa leaves. This local vegetable has been used successfully to overcome the malnutrition in children and pregnant women. It showed a significant weight gain in children [9].

Protein content in fresh Moringa leaf was about 6.7%, and the dry powder was about 27.1%. The amino acid content in Moringa leaves, such as aspartic acid, glutamic acid, alanine, valine, leucine, isoleucine, histidine, lysine, arginine, phenylalanine, tryptophan, cysteine, and methionine. These leaves also contain macro elements, i.e., potassium, calcium, magnesium, sodium, and phosphorus, as well as microelements, i.e., manganese, zinc, and iron. Moringa leaves known as a source of provitamin A, Vitamin E, Vitamins B, and Vitamin C [10].

Moringa leaves can be processed into a powder, so it can be used as an additional ingredient in companion breastfeeding food. The addition of moringa leaf flour to foods or drinks of under-five malnutrition children as much as 3-5 g triggers an improvement of the child's appetite, so the portion of food consumed may increase, thereby affecting the weight gain of the child [11]. The addition of this vegetable to an instant powder of complementary breastfeeding food can enrich the nutritional composition needed by infants for growth and development, especially essential amino acid proteins and micronutrients (vitamins and minerals). Biscuits developed from tempeh with Moringa leaf powder substitution increased protein, iron, and zinc along with a large amount of leaf powder added [12].

The purpose of this study was to produce an instant powder food product with the addition of Moringa oleifera leaf powder as a complementary breastfeeding food for infants 6-12 months old that meet physical characteristics, organoleptic, and chemical composition (nutrition) with the basic ingredients were dried powder of brown rice, soybean sprout, mung bean sprouts, full cream milk, and other supplementary ingredients.

EXPERIMENTAL

The study design used was a complete randomized design (CRD) two replications. The treatment given was the different types of basic ingredients of instant powder compositions as the basic ingredients of making breastfeeding companion food, i.e., brown rice powder, soybean sprout powder, mung bean sprout powder, and moringa leaf powder, and full cream milk powder. The complimentary food formulation was carried out using a linear programming method using the solver application in the Microsoft Excel 2007 program.

The production of powder form of brown rice, Moringa leaves, soybean sprouts, and mung bean sprouts were conducted at the Laboratory of food technology and nutrition polytechnic Makasar. Nutrient content analysis of those basic ingredients was carried out at the Health Ministry Laboratory Makassar. Analysis of water content was executed by the oven method, the protein was analyzed by Kjeldahl methods, fat analyzed by soxhlet method, ash content determined using furnace[13], the fiber analyzed by filtration, carbohydrates were determined by a different method, and calories determined by multiplying (4 cal / g protein and carbohydrate, and 9 cal / g fat)[14].

The ingredients were formulated into 100 g total weight, (Formula A1, A2, and A3 was 71%, 72%, and 73% brown rice, respectively; Moringa leave powder was 9%, 8%, and 7%, respectively; 15% full cream milk powder for and 5% castor sugar for each formulation); (Formula B1, B2, and B3 was 71%, 72%, and 73% brown rice powder, respectively; 9%, 8% and 7% Moringa leave powder, respectively; 15% mung bean sprout powder and 5% castor sugar for each formulation); (Formula C1, C2, and C3 was 71%, 72%, and 73% brown rice powder, respectively; 9%, 8%, and 7% Moringa leave powder, respectively; 15% soybean sprout powder and 5% castor sugar for each formulation). The production of instant powder was carried out by the dry mixing method according to formula compositions. Bulk density of product defined as a total material in volume (g/ml), water absorption expressed as the ability to absorb water when brewed for a particular time (ml/g). Panelist acceptance was measured based on parameters of color, taste, aroma, and texture. 25-trained judges were selected from the final year students. Rating attributes according to the hedonic scale were very like (score 4), likes (score 3), slightly like (score 2), dislike (score 1). The best treatment determination of all parameters used the De Garmo effective index method.

RESULTS AND DISCUSSION

Nutritional Content of Main Ingredients

The nutritional content of ingredients formulated in instant powder as a complementary food for infants 6-12 months can be seen in Table 1.

Table 1. The nutritional content of the main ingredients of the infants (6-12 months) instant powder formula (100g)

NO	Nutrient content	Ingredients					
		MLP*	MBP*	SBP*	BRP*	FCM**	CSg **
1	Energy (Kcal)	224.5	302.4	382.4	370.1	502.0	387.0
2	Carbohydrate (g)	19.9	50.3	12.9	69.0	27.0	99.9
3	Protein (g)	27.9	24.4	41.3	19.7	26.0	0
4	Fat (g)	3.7	0.4	18.4	1.7	40.0	0
5	Moisture (g)	2.1	1.9	0.8	2.9	4.0	4.0
6	Ash (g)	10.8	4.0	4.6	1.0	-	-
7	Fiber (g)	13.4	6.5	7.5	1.0	0	0

Source: *Result of proximate composition determination from BLKM Laboratory, **Indonesia List of Food Composition (DKBM Indonesia)

Note:

MLP = Moringa leaf powder MBP = Mung beans sprout powder SBP = Soybeans sprout powder	BRP= Brown rice powder FCM= Full cream milk powder CSg= castor sugar

Table 1 shows the highest calorie content among these ingredients come from FCM (502.0 Kcal). The highest protein was from SBP (41.3 %) and MLP (27.9 %). The highest carbohydrate found in CSg 99.9 %, BRP 69 %, and MBP 50.3 %, respectively. The highest fat content was on FCM and SBP (40 % and 18.4 %).

Macro Nutrient content of Instant Powdered Formula

The nutritional content of each formula based on the

instant powder formulation results as complementary foods for infants 6-12 months can be seen in Table 2.

Table 2. Nutritional composition of infants (6-12 months) instant powder formula

No	Nutrient contents	Formula A				Formula B				Formula C			
		A1	A2	A3	Means	B1	B2	B3	Means	C1	C2	C3	Means
1	Energy (Kcal)	378	379	381	379	347	349	351	349	360	361	363	361
2	Protein (g)	21	21	20	20	20	20	20	20	23	23	23	23
3	Fat (g)	5	5	5	5	2	2	2	2	4	4	4	4
4	Carbohydrate (g)	62	62	62	62	63	64	64	64	58	58	59	58
5	Fiber (g)	2	2	2	2	3	3	3	3	3	3	3	3
6	Moisture (g)	4	3	3	3	3	3	3	3	3	3	3	3

Table 2 shows that Formula A had the highest average energy content (379 Kcal), the highest protein content in Formula C (23 g), the highest fat content in Formula A (5 g), the highest carbohydrate content in Formula B (64 g). Macronutrient content of instant powdered formula as breastfeeding infants aged 6-12 months who meet the target of interest was a protein, fiber, and water in all formulas. Formulas whose energy content was below 360 Kcal (<90% goal target) were Formula B1, B2, B3, and C1. Fat content in all formulas had not met the target goal (10-15%), and all formulas contain high carbohydrates compared to the target of interest (30 g of sucrose sugar).

Physical Characteristics

The physical characteristics of products were assessed as the bulk density and water absorption. The average density of 0.6 to 0.7 g/ml, while the ratio of water absorption/minute in formula A was 1:1, formulas B and C were 1:1.5 per minute, and formula D was 1:1.4 per minute.

Acceptability

The result of the organoleptic test against preference level by panelists on aspects of color had an average score between 2-3, which means descriptively slightly like—the lowest score found in formula B1 and the highest in formula A1. Based on the aspect of aroma, the average score was between 2-3, which means descriptively slightly like. Based on the aspect of texture, the average score was between 2-3 and descriptively slightly like. For the taste aspect, the average score ranged from 1-3 (quite like).

The Best Formula

According to the effective index method, the best formula was the formula C2 with a score of 0.7 consisting of 72% brown rice powder, 8% Moringa leaf powder, 15% soybean sprout powder, and 5% castor sugar. It contains 361.1 Kcal of energy, 22.6% protein, 4.3% fat, 58.2% carbohydrate, 2.9% moisture, and 2.9% fiber. Bulk density was 0.6 and water absorption was 1:1.5, and the panelists' acceptance was quite like with the average score about 2.6. The energy content in this formulated product was between 347.0 - 380.5 Kcal, still low compared to the required standard of 400-440 Kcal per 100 g [6]. The energy requirements of babies 6-12 months increase by 24-30% compared to the needs at the age of 3-5 months [15]. To meet the increasing energy requirements, infants should receive high energy complementary feeding intake. A baby 6-8 months requires an energy intake of 783 Kcal, 437 Kcal is obtained from daily breastfeeding, and the rest 346 Kcal is expected to be obtained from breastfeeding companion food. Therefore, the minimum requirement for the amount of energy in complementary food is 400 Kcal. Although the total energy of instant complimentary food powder produced is lower than the minimum requirement for the specified amount of energy (400 Kcal), the total energy value of complimentary food powder may fulfill the energy needs (346 Kcal).

The protein content of Moringa leaf powder, according to proximate analysis results, was 27.9% (Table 1), slightly higher than the results of finding carried out by Fuglie [9] that was 27.1%. The results of this study were almost the same as the results of the Stadtlander finding which was 27.7% [16] Addition of 8% Moringa leaf powder to the best formula (Formula C2) might contribute 2.2 g of protein (10%) in 100 g of instant powder formula. Fortification of 5% Moringa leaf powder on bread was known increase protein content by 17% [17]. Protein needed for tissue growth and deficiency, which may cause growth retardation, kwashiorkor, etc. Moringa leaves contain a high amount of crude protein and amino acids, compared to soybeans [18]. This leaf powder may improve the nutritional status of children aged 2-5 years. The most significant protein contributor to the best instant powder formula was soybean sprouts powder, which was 27.4% [9]. The results of other studies showed the highest soybean powder sprouts had the most top protein content (37.4%) compared to other legume sprout powder or flour [19].

The protein content of all complementary feeding formulated to meet the standard (20-22.7%) of the requirements of 15-22%. The difference in protein content between formulas was caused by the variations of the basic ingredient proportion of each formula. Protein has several functions, among which are growth and maintenance, the formation of essential body bonds, regulating water balance, maintaining body neutrality, forming antibodies, transporting nutrients, and as a source of energy [20].

The fat requirement for complementary food is 10-15%, while the fat in the formulated infants' food was lower than the predetermined requirements, which were between 1.6 - 5.4%. This is due to the basic ingredients used were relatively low in fat content. In contrast, carbohydrates in these infant's formula were greater (57.7 - 64.3%) than the requirement (Max 30%), caused by the usage of brown rice flour as a source of carbohydrates was quite large.

The fiber content in breastfeeding food companion is required to be a maximum of 5%, the crude fiber content of these instant powder food in all formulas fulfilled the requirements of ≤ 5%. The high fiber content has the potential to interfere with the absorption of the nutrient needed by infants such as fat, vitamins, and minerals that

the body needs. High fiber content leads satiety quickly because fiber has a high uptake of water, so the baby will be quickly full even though nutritional intake has not been met [5]. The physical properties of instant complementary feed powder from the bulk density aspect have an average value of 0.6 - 0.7 g/ml. This shows that instant powder products were following the bulk density range of general instant powder products, which are 0.3 - 0.7 g/ml [5]. The result of this study was in line with the finding of research carried out by Nurul M [21] the formulation of selected instant infants food porridge had a bulk density value of 0.5 g/ml. Particularly for infants' complementary food products, bulky is not recommended, where large volume but low nutritional content. It may have an impact on the baby, such as quickly full, while nutrition has not been met [22].

The brewing power of instant powder formula ranges from 0.7-1 ml/g, with the brewing test that was 20 g weight per serving size requires 20 ml water, ratio of 1:1, and the calculation of the rehydrating time of instant powder takes 23 seconds. This study found the same results of other studies that are instant milk porridge products with 25 g weight per serving that requires 20 ml of water or 0.8 ml/g to achieve consistency by different brands of milk porridge products [21]. Overall, the panelists' acceptance was categorized as slightly. This case allegedly caused by the panelists unfamiliar with instant powder products were added with Moringa.

CONCLUSION

Instant powdered nutritional content qualified by the Indonesian National Standard nutrient was protein, fiber, and water content. Energy and fat were lower, but carbohydrates were high. All instant powder formulas had met the physical requirements and water absorption. Nevertheless, the acceptability was low. The best-chosen instant powder formula was the formula C2 with a score of 0.7.

ACKNOWLEDGMENT

The researcher would like to thank the Makassar Health Polytechnic for providing funding in conducting this research.

REFERNCES

1. Kemenkes, R. I. (2012). Pedoman kegiatan gizi dalam penanggulangan bencana. *Jakarta: Kementerian Kesehatan Direktorat Jenderal Bina Kesehatan Masyarakat*.
2. Riskesdas, L. N. (2018). Kementerian Kesehatan RI Badan Penelitian dan Pengembangan Kesehatan.
3. World Health Organization. WHO. Complementary feeding: family foods for breastfed children. WHO, Geneva, 1998.
4. Kusumawardani, B. (2010). *Hubungan Praktik Higiene Sanitasi Makanan Pendamping Air Susu Ibu (MP-ASI) Tradisional dengan Kejadian Diare pada Anak usia 6-24 Bulan di Kota Semarang* (Doctoral dissertation, Diponegoro University).
5. Hadiningsih, N. (2004). Optimasi formula makanan pendamping asi dengan menggunakan response surface methodology. *Sekolah Pascasarjana Institute Pertanian Bogor*.
6. Kementerian Kesehatan RI, "kepmenkes RI Nomor 224/Menkes/SK/II/2007 tentang spesifikasi Tehnis Makanan Pendamping ASI." pp. 1–10, 2007.
7. A. Khomsan, *Solusi Makan Sehat*. Jakarta: Erlangga., 2006.
8. Mubarak, A. E. (2005). Nutritional composition and antinutritional factors of mung bean seeds (Phaseolus aureus) as affected by some home traditional processes. *Food chemistry*, *89*(4), 489-495. https://doi.org/10.1016/j.foodchem.2004.01.007
9. Fuglie, L. J. (2005). The Moringa Tree: a local solution to malnutrition. *Church World Service in Senegal*, *75*.
10. Krisnadi, A. D. (2012). Kelor Super Nutrisi. Pusat Informasi dan Pengembangan Tanaman Kelor Indonesia Lembaga Swadaya Masyarakat. *Media Peduli Lingkungan (Lsm-Mepeling)*.
11. Z Zakaria, A. T., & Sirajuddin, R. H. (2012). Penambahan tepung daun kelor pada menu makanan sehari–hari dalam Upaya penanggulangan gizi kurang pada anak balita. *Media Gizi Pangan*, *8*, 190.
12. Suhartini, T., Zakaria, Z., Pakhri, A., & Mustamin, M. (2018). Kandungan Protein dan Kalsium Pada Biskuit Formula Tempe dengan Penambahan Tepung Daun Kelor (Moringa oleifera) Sebagai Makanan Pendamping ASI (MP-ASI). *Media Gizi Pangan*, *25*(1), 64-68. https://dx.doi.org/10.32382/mgp.v25i1.63
13. Marshall, R. J. (2005). Food And Nutritional Analysis| Dairy Products.
14. Hart, F. L., & Fisher, H. J. (2012). *Modern food analysis*. Springer Science & Business Media.
15. Ismayanti, M., & Harijono, H. (2014). Formulasi Mpasi Berbasis Tepung Kecambah Kacang Tunggak Dan Tepung Jagung Dengan Metode Linear Programming [In Press JULI 2015]. *Jurnal Pangan dan Agroindustri*, *3*(3).
16. Stadtlander, T., & Becker, K. (2017). Proximate composition, amino and fatty acid profiles and element compositions of four different Moringa species. *Journal of Agricultural Science*, *9*(7), 46-57. https://doi.org/10.5539/jas.v9n7p46
17. Alam, M., Alam, M., Hakim, M., Huq, A. O., & Moktadir, S. G. (2014). Development of fiber enriched herbal biscuits: a preliminary study on sensory evaluation and chemical composition. *International Journal of Nutrition and Food Sciences*, *3*(4), 246-250. https://doi.org/10.11648/j.ijnfs.20140304.13
18. P. P. Joy, J. Thomas, C. S. Varghese, S. S. Indumon, and D. George, (1998). "Medicinal Plants," no. 0484.
19. Aminah, S., & Hersoelistyorini, W. (2012). Karakteristik Kimia Tepung Kecambah Serealia dan Kacang-kacangan dengan Variasi Blanching. In *Prosiding Seminar Nasional & Internasional* (Vol. 1, No. 1).
20. Muchtadi, T. R. Sugiono. 1992. Ilmu Pengetahuan Bahan Pangan. Departemen Pendidikan dan Kebudayaan Direktorat Jendral Pendidikan Tinggi. Pusat Antar Fakultas Pangan dan Gizi. *Ilmu Pertanian Bogor, Bogor*.
21. Nurul Maulida, (2016). "Formulasi Bubur Instan Dengan Penambahan Tepung Daun Kelor (Moringa Oleifera) Sebagai Makanan Tambahan Bagi Kelompok Rentang Gizi,".
22. Yenrina, R., & Krisnatuti, D. (2001). Menyiapkan Makanan Pendamping ASI. *Jakarta: Rineka Cipta*.