

Development of instant noodles based on moringa, soybean flour, and mackerel flour as an emergency food alternative in post-disaster situations

Halimum MASRUR, Ulfah NAJAMUDDIN, Hasan BASRI, Veni HADJU, Nurhaedar JAFAR

Department of Nutrition Science, Faculty of Public Health, Hasanuddin University, Makassar, Indonesia.

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ABSTRACT

Background: Indonesia, located in the Ring of Fire, has approximately 64% of its territory at high risk of disasters, making increased preparedness, especially in terms of emergency food supply, very important. Based on the 2015–2024 Indonesian Disaster Risk Index, Central Sulawesi Province has a moderate risk level (score of 137.25). This condition disrupts health services and causes nutritional problems among vulnerable groups, necessitating the development of nutritious, durable, and easy-to-prepare emergency food innovations. Instant noodles are a dry food product made from local ingredients, formulated from soybean flour, mackerel flour, and moringa leaf flour, with a long shelf life and nutritional content suitable for disaster victims.

Methodology: This research is a quantitative study that includes several sub-studies with different methodological designs. The acceptance test of the four formulations was conducted using a one-shot case study approach. Proximate analysis and shelf life were analysed descriptively. Furthermore, the effect of the intervention on satiety and blood glucose levels was analysed using a two-group pretest–posttest control group design to compare differences between groups.

Results: The results showed that formulation F1 was the most preferred by the panelists with an average score of 3.47, having a light green colour, light aroma, chewy texture, and savoury taste. The protein (18.19%) and carbohydrate (57.76%) contents were higher than the standard, while the

energy (432 kcal) and fat (7.02%) contents were still below the emergency food standard. The shelf life of the product reached 15 days at 25°C before quality deterioration occurred due to an increase in water content. Satiety tests showed significant differences at 30 and 60 minutes ($p<0.05$), while blood glucose levels remained stable up to 120 minutes.

Conclusion: Instant noodles based on soybean flour, mackerel, and moringa leaves exhibit nutritional characteristics relevant for use as emergency food in the early post-disaster phase. Based on the test results, this product shows a longer satiety response and stable blood glucose levels during the observation period, thus having the potential to be developed as an alternative emergency food based on local ingredients.

KEYWORDS

Emergency food; local instant noodles; food formulation; shelf life; satiety; blood glucose levels.

BACKGROUND

Geologically, Indonesia is located in the *Ring of Fire*, with approximately 64% of its territory classified as high-risk areas for disasters. This condition requires increased national preparedness, especially in terms of providing safe, nutritious, and easily accessible emergency food. Based on the 2015–2024 Indonesian Disaster Risk Index (IRBI), Central Sulawesi Province has a moderate risk level with a score of 137.25, while Donggala Regency is classified as a high-risk area with a score of 165.14 (BNPB, 2025). The high incidence of disasters in these areas causes damage, economic losses, and disruptions to public health services¹.

When large-scale disasters occur, vulnerable groups such as infants, toddlers, children, pregnant and lactating women,

Correspondencia:

Ulfah Najamuddin
ulfahnajamuddin@unhas.ac.id

persons with disabilities, and the elderly are the most affected. Nutritional problems in these groups are often exacerbated by damage to food sources and disruption to food distribution². Research³ shows that the main factors affecting the nutritional status of disaster victims include food intake, infection, socio-economic conditions, sanitation, and age. Of these factors, adequate food intake is the most decisive, as limited food supplies can potentially lead to acute or chronic malnutrition⁴.

In emergency situations, the provision of practical, high-nutritional-value food is essential to prevent hunger, fatigue, and a decline in immune function⁵. According to ⁶, protein intake plays a crucial role in increasing satiety and maintaining stable blood glucose levels through the process of gluconeogenesis. Therefore, ideal emergency food should contain sufficient protein in addition to energy, carbohydrates, and fat.

Based on the Nutrient Adequacy Rate (NAR), the average daily energy requirement for adults is 2,100 kcal per day, while for women of childbearing age it is around 2,400–2,650 kcal. One type of emergency food that is commonly used is instant noodles because they are easy to prepare, have a long shelf life, and are practical to distribute⁷. However, continuous consumption of instant noodles has the potential to cause health problems due to their low nutritional content and high sodium levels (Chung et al., 2010; Shin et al., (2014) in ⁸. Efforts to improve the nutritional quality of instant noodles can be made by adding local foods rich in protein and micronutrients⁹.

Some potential local ingredients that can be used include moringa leaves, soybeans, and mackerel. Central Sulawesi Province has great potential in the production of these three ingredients. Moringa leaves are easily obtained and have high nutritional value. According to ¹⁰, moringa contains bioactive compounds that support metabolic and immune functions. Soybeans are a high-quality source of plant-based protein that is widely available in Central Sulawesi, with a productivity of 9,317 tonnes per year (Central Sulawesi Food Crops and Horticulture Agency, 2023). In addition, mackerel is also an economical and abundant source of animal protein, with a production of 431,800 tonnes per year¹¹. Research¹² shows that adding mackerel flour to noodle products can increase the protein content by up to 20.22%.

Based on this potential, a combination of moringa leaf flour, soybean flour, and mackerel fish flour can be used as raw materials in the production of high-nutrient instant noodles as emergency food. This formulation is expected to produce a product that not only has high energy and protein content but is also easy to prepare, has a long shelf life, and is based on sustainable local ingredients. Thus, this research has the potential to support food security and Sustainable Development Goal (SDG) 13 on climate change mitigation through the provision of nutritious emergency food from local resources.

MATERIALS

This study utilised various ingredients tailored to the stages of production, testing, and analysis of instant noodles based on moringa leaves, soybean flour, and mackerel flour.

a) Flour Production

The ingredients used in the production of moringa leaf flour, soybean flour, and mackerel flour are fresh moringa leaves, soybeans, and mackerel.

b) Instant Noodle Formulation

The ingredients used in the formulation of instant noodles are wheat flour, moringa leaf flour, soybean flour, mackerel flour, wheat flour, and water.

c) Acceptability Test

The materials used in the acceptability test were test forms and 4 instant noodle formulations based on moringa, soybean flour and mackerel flour (F0, F1, F2, and F3).

f) Proximate Test

The materials used in the proximate test were instant noodle samples, distilled water, 1M NaOH solution, and n-hexane. In addition, carbohydrates were calculated indirectly using the difference method, which is to subtract the total moisture, ash, fat, and protein content from 100%.

g) Shelf life test

The materials used for the shelf life test were selected instant noodle formulas, packaging plastic, sample labels, writing instruments, and documentation.

h) Measurement of satiety level

The materials used to measure satiety levels included instant noodle formulations and conventional noodles for the control group, followed by plain water and the SLIM 100 mm questionnaire.

RESEARCH METHOD

This research is a multi-stage study conducted sequentially, including the development of local food-based instant noodle products, sensory testing and chemical analysis, shelf life studies, and limited human testing to assess satiety and blood glucose levels. Each stage was designed with clear objectives, specific methodological approaches, and sample sizes tailored to the characteristics of each research phase. Sensory testing was conducted by a panel of 30 trained panelists. All stages involving human subjects were carried out after obtaining research ethics code approval and were conducted in accordance with applicable research ethics principles.

Production of kemora noodles

The procedure for making instant noodles is modified from Koswara (2009) and Wahyuli (2017), beginning with mixing wheat flour, moringa leaf flour, mackerel flour, soybean flour, and pandan leaf extract until homogeneous. The dough is left to rest for 15 minutes, rolled out to a thickness of 1.5–2 mm, then cut into noodle strips. Next, the noodles are dried at 65°C for a maximum of 90 minutes until the moisture content is 8–12%, cooled for one hour at room temperature, and packaged in polypropylene (PP) plastic for analysis.

Organoleptic Test

The organoleptic test procedure refers to Rahmadiana and Farapti (2024) and was conducted through an acceptance test involving 30 semi-trained panelists. Panelists were selected based on inclusion criteria, namely female students aged 15–20 years with a normal body mass index (BMI), in good health, and willing to participate in the entire research process by signing a consent form as research participants. Before testing, all panelists were given an explanation of the purpose and procedures of the test and received training on sensory testing procedures, including an understanding of sensory attributes and the use of assessment instruments. The panelists were then asked to evaluate the four types of noodles presented using a sensory evaluation questionnaire covering the attributes of colour, aroma, taste, and texture. The evaluation was carried out by ticking boxes, writing comments, and drawing lines on the evaluation sheet provided, so that the acceptance test results could be interpreted validly and consistently.

Proximate analysis

The proximate test is a chemical analysis method used to determine the content of major nutrients in food ingredients or products. The parameters analysed included moisture content, ash content (total minerals), protein content, fat content, and carbohydrate content, which were calculated using the difference method in accordance with the AOAC (1995) method as referred to in Cahyono and Hertati (2018). All proximate analyses in this study were conducted in duplicate to increase accuracy and ensure data reproducibility, and were carried out at the Chemistry Laboratory, Faculty of Mathematics and Natural Sciences, Tadulako University.

Shelf Life Test

The shelf life of Kemora instant noodles was tested using the *Accelerated Shelf Life Test* (ASLT) method with the Arrhenius model approach. The products were packaged in aluminium foil and stored at three accelerated temperatures, namely 25°C, 35°C, and 45°C, for 28 days. Quality observations were carried out periodically to obtain data on quality changes due to the influence of temperature. The shelf life

was determined based on changes in critical quality parameters, namely the moisture content of the product. The data on changes in moisture content was analysed using a reaction kinetics approach, assuming a first-order reaction as the best model. The shelf life was calculated using the first-order reaction kinetics equation, namely $t = \ln(A_0 / A_t) / k$, whereas if the quality change followed zero-order reaction kinetics, the shelf life was calculated using the equation $t = (A_0 - A_t) / k$. The relationship between the reaction rate constant (k) and temperature was analysed using the Arrhenius equation to obtain the activation energy (E_a) value as the basis for predicting shelf life under normal storage conditions.

Satiety test

The satiety test was conducted using a pre-test and post-test design with a control group, modified from Fidela Zahradika Fathimah (2015). Subjects fasted for 8 hours before the intervention and were divided into a treatment group ($n = 30$) that consumed instant noodles made from moringa leaf flour, mackerel flour, and soybean flour, and a control group ($n = 30$) that consumed conventional instant noodles. The serving portions were standardised and had to be consumed in full. During the test, subjects were only allowed to consume water and avoid strenuous physical activity. Fullness was measured before consumption and at 30, 60, 90, and 120 minutes after consumption using the SLIM scale questionnaire. All procedures were approved by the Health Research Ethics Committee.

Fasting blood glucose levels

Blood glucose testing was conducted using a pre-test and post-test design with a control group, referring to Puspaningtyas et al. (2024). Subjects fasted for 8 hours before the intervention and were only allowed to consume plain water and avoid chewing gum, coffee, and tea. Subjects were divided into a treatment group ($n = 30$) who consumed instant noodles made from moringa leaf flour, mackerel flour, and soybean flour, and a control group ($n = 30$) who consumed conventional instant noodles in standardised portions. Blood glucose measurements were taken from finger capillary blood in the morning (07:00–09:00), i.e., before consumption and at 60 and 120 minutes after consumption. All procedures were approved by the Health Research Ethics Committee.

RESULTS AND DISCUSSION

Organoleptic Test

The organoleptic test of instant noodles made from soybean flour, mackerel flour, and moringa leaf flour was conducted on 30 consumer panelists by assessing colour, aroma, texture, and taste. The results of the hedonic test of the four formulations are presented in the following table.

The Kruskal–Wallis test results show significant differences between treatments in all sensory attributes ($p = 0.023$;

Table 1. Results of organoleptic testing of instant noodles made from moringa, soybean flour, and mackerel flour as emergency food alternatives in post-disaster situations

Organoleptic Test	Instant Noodle Formula			p value
	F1	F2	F3	
Colour	3.7 ± 0.53 ^a	3.4 ± 0.72 ^a	3.1 ± 0.83 ^{a,b}	0.023*
Aroma	3.3 ± 0.83 ^a	2.9 ± 0.82 ^b	2.2 ± 0.67 ^{a,b}	0.001*
Texture	3.8 ± 0.61 ^a	3.5 ± 0.72 ^a	2.4 ± 0.62 ^b	0.001*
Taste	3.1 ± 0.80 ^a	2.8 ± 0.74 ^a	1.9 ± 0.25 ^b	0.001*

1 = Strongly dislike, 2 = Dislike, 3 = Neutral, 4 = Like, 5 = Strongly like.

a,b = Similar letter notation indicates no significant difference at the Mann-Whitney test level with a value > 0.05.

* Kruskal-Wallis Test significant at α 0.05.

$p < 0.001$; $p < 0.001$; $p < 0.001$; $\alpha = 0.05$). Because the p-value was less than α , the analysis was continued with the Mann-Whitney test as a post hoc test with Bonferroni correction to determine the treatment pairs that were significantly different.

Colour

The organoleptic test results showed that the addition of moringa leaf powder had a significant effect on the colour of instant noodles (p-value 0.008). Formula F1 (5 g of moringa leaves) obtained the highest score of 3.7 (like) with a fresh light green colour, F2 (7 g) obtained a score of 3.4 (neutral) with a natural green colour, while F3 (9 g) only obtained a score of 3.1 (neutral) with a dark green colour. This difference is influenced by an increase in chlorophyll pigment, which makes the colour darker at high levels, thereby reducing visual appeal. These findings are in line with the studies ¹⁵ and ¹⁶, which state that the higher the concentration of moringa leaves, the lower the level of preference for the colour due to the unattractive dark green appearance and the drying process of the ingredients.

Aroma

The organoleptic test results showed differences in the panelists' acceptance of the aroma of instant noodles made from soybean flour, mackerel, and moringa leaves. Formula F1 scored 3.3 (neutral) with a slightly pungent aroma, F2 scored 2.9 (neutral) with a dominant moringa aroma, while F3 scored 2.2 (disliked) with a very strong aroma. The increase in moringa leaf flour strengthened the pungent aroma, thereby reducing the panelists' acceptance. Statistical analysis showed a p-value of 0.000, indicating a significant effect on the aroma attribute. This finding is in line with ¹⁷, which reported that the higher the substitution of moringa leaf flour in mackerel fish balls, the stronger the pungent aroma due to the content of essential oils and lipoxygenase

enzymes. These volatile compounds at high concentrations can produce a sharp aroma that is less desirable. This is similar to the results of the study ¹⁶, which found that beverage formulas with a lower percentage of moringa leaves were preferred by panelists because the overly dominant characteristic aroma of moringa reduced product acceptability.

Texture

Organoleptic test results showed differences in panelist acceptance of the texture of instant noodles based on soybean flour, mackerel, and moringa leaves. Formula F1 received the highest score (3.8) with a very chewy texture and was the most preferred, F2 received a score of 3.5 with a slightly chewy texture but was still comfortable to chew, while F3 received a score of 2.4 with a harder texture and was less preferred. Statistical analysis showed a p-value of 0.000, indicating a significant effect of soybean flour addition on texture attributes. These findings align with the study by ¹⁸, which states that adding soybeans to purple sweet potato cookies increases protein and fibre content, resulting in a more fibrous yet still soft texture. Thus, soybeans play a role in improving nutritional quality while creating a texture more preferred by consumers.

Taste

Based on taste parameters, formula F1 obtained an average score of 3.1 (neutral category) with a savoury taste that was liked by the panelists, F2 scored 2.8 (neutral) with a slightly savoury but less strong taste, while F3 only scored 1.9 (disliked) due to the dominant bitter taste of moringa leaves. Statistical analysis results showed a p-value of 0.000, indicating a significant effect of moringa leaf flour addition on taste attributes. These findings are in line with ¹⁹, which states that increasing the concentration of moringa leaf flour in white sweet potato instant noodles reduces the level of taste preference due to the emergence of the characteristic bitter taste of moringa. In addition, processing methods such

as mixing, steaming, and frying also affect the final taste intensity of the product.

After Taste

The aftertaste test results showed that the addition of moringa leaf flour had a significant effect on the residual taste of instant noodles. Formula F1 with the lowest moringa content produced a mild savoury aftertaste that was still liked by the panelists, F2 began to show a distinctive moringa flavour with a slight bitterness but was still neutral, while F3 left a strong, unpleasant aftertaste that was less liked. Thus, the higher the proportion of moringa leaf flour, the more dominant the residual flavour became, but this reduced consumer acceptance.

Proximate analysis

A Proximate analysis was performed on the best instant noodle formula (F1) from the hedonic test, with a composition of 40 g wheat flour, 35 g soybean flour, 7 g mackerel flour, and 3 g moringa leaf flour. This analysis aimed to assess the nutritional composition of the emergency food formula and compare it with the standards of Zoumas et al. (2002) and the World Health Organisation ², which recommend an energy intake of 1800–2100 kcal/day with a distribution of 10–15% protein, 35–45% fat, 40–50% carbohydrates, and a maximum water content of 14%.

Formula F1 contains 57.76% carbohydrates, higher than the standard (40–50%), so it can provide quick energy in emergency conditions. These results are in line with Mufarrohah, et al (2025), which states that sufficient carbohydrate intake increases physical endurance ($p = 0.002$). The protein content of 18.19% also exceeds the standard (10–15%) and provides important physiological benefits. ²¹ and ²² confirm that protein plays a role in maintaining muscle mass, repairing tissue, boosting immunity, and prolonging satiety.

Conversely, the fat content is only 7.02%, far below the standard (35–45%). Fat is important as a dense energy source and helps maintain nutritional balance. ²³ states that macronutrient balance, including healthy fats, is important for meeting nutritional needs comprehensively. Therefore, the

formulation can be adjusted by adding healthy fat sources such as vegetable oils or nuts.

The ash content of 2.56% indicates a fairly high mineral content, in line with the statement by Erni et al. (2018) in ²⁴ that an increase in ash content is influenced by the duration of drying. The moisture content of 12.3% also meets the SNI limit (<14%), supporting the shelf life and stability of the product ²⁵.

The total energy per 100 g of product reaches 432 kcal, which is close to the emergency food standard according to Zoumas et al. (2002) and ². Although the F1 formula shows adequacy in terms of carbohydrates, protein, and moisture content in accordance with the criteria, overall this formula does not yet meet energy and fat requirements. The fat content in F1 is still below the expected limit, necessitating improvements or the addition of appropriate fat sources. Nevertheless, F1 still holds great potential as a nutritious emergency food based on local functional ingredients, as its carbohydrate, protein, and water content meet the standards.

Shelf Life Test

Based on the analysis results, the shelf life of instant noodles at temperatures of 25°C, 35°C, and 45°C is estimated

Table 3. Analysis of shelf life testing with moisture content parameters for instant noodles based on moringa flour, soybean flour, and mackerel flour as alternative emergency food following a disaster

Day	Temperature 25°C	Temperature 35°C	Temperature 45°C
7	12.47	11.11	10.3
14	11.96	10.62	9.93
21	11.56	10.26	9.41
28	10.84	9.56	8.96
Shelf life	15 days	14 days	days

Table 2. Proximate analysis of instant noodles based on moringa leaf flour, soybean flour, and mackerel flour selected from organoleptic testing compared to emergency food nutrition standards

Selected Formula	Total Energy (kcal)	% of Total Calories			Moisture Content (%)
		Protein	Fat	Carbohydrates	
Standard Food Emergency (%)	700 kcal	10-15	35-45	40-50	Max. 14
Result	432 kcal	18.19%	7.02%	57.76%	12.3%
Description	Not yet met	Meets	Not yet met	Meets	Meets

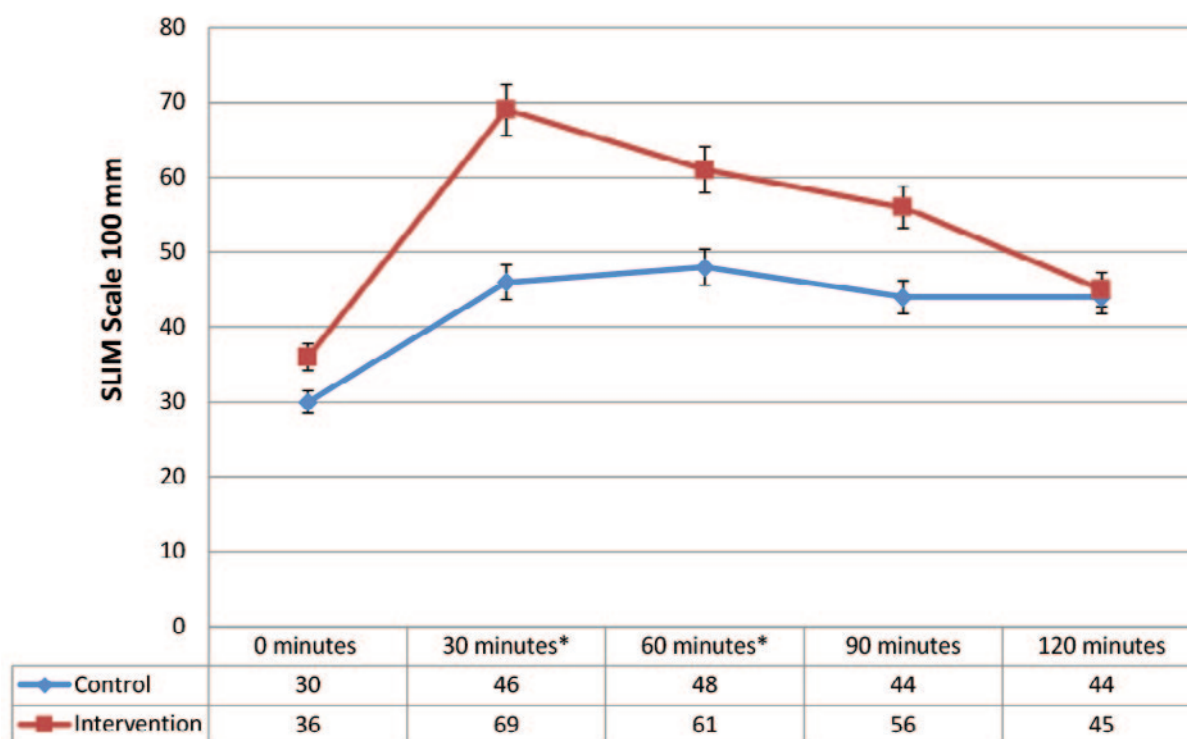
to be 15, 14, and 13 days, respectively. Increased temperatures accelerate the rate of change in moisture content, which affects product quality. Estimating shelf life using the Accelerated Shelf-life Testing (ASLT) method with the Arrhenius approach shows that after 13–15 days of storage, the moisture content has the potential to exceed the critical limit and product quality begins to decline. These findings are in line with the research²⁶ on purple sweet potato porridge, where the product was still physically viable for up to 30 days, but microbiologically did not meet SNI standards after two weeks.²⁷ also states that after a disaster, the fulfilment of basic food needs only stabilises after 1–2 weeks, while access to fresh food remains limited, especially in low-income communities. Therefore, with a shelf life of 13–15 days at room temperature, Kemora instant noodles are categorised as early-phase post-disaster emergency food that can meet nutritional needs up to the 14th day of storage.

The decrease in water content during storage can be explained by the difference between the water activity (a_w) of the product and the relative humidity (RH) of the environment. When the a_w of the noodles is higher than the RH of

the storage environment ($a_w > RH$), water will migrate out into the environment until equilibrium is reached, causing the water content of the product to decrease. This water transfer is faster in starch- or gluten-based products when the a_w –RH gradient increases, which can accelerate water loss and cause deformation of the noodle structure. Furthermore, even though water mobility in the starch matrix is low in the glass state, significant water loss can still occur, resulting in greater changes in product dimensions. Packaging factors also play an important role if the humidity inside the packaging is higher than the environment and the packaging is not airtight, as water will escape following the principle of vapour pressure gradient, causing the product's water content to decrease during storage²⁸.

Satiety test

The results showed that instant noodles based on soybean flour, mackerel, and moringa leaves provided a higher satiety level compared to control noodles at 30 minutes (control 46.05 ± 20.03 ; intervention 47.86 ± 18.75 ; $p < 0.05$) and at the 60th minute (control 47.86 ± 18.75 ; intervention 61.64 ± 19.85 ;



* Independent samples test, significant at $\alpha 0.05$.

The symbol (*) indicates a significant difference at 30 minutes and 60 minutes in both the control group and the intervention group.

Figure 1. Graph of the average satiety test analysis after consumption of instant noodles based on moringa flour, soybean flour, and mackerel flour, both in the control group and the intervention group

$p < 0.05$) after consumption. However, at 90 to 120 minutes, the difference in satiety between the groups was no longer significant ($p > 0.05$), indicating that the satiating effect of the intervention product was short to medium term.

The intervention product had a protein content of 18% (15.3 g/100 g), which was much higher than commercial noodles, which only had 8 g/100 g. This higher protein content contributed to increased satiety because the satiating effect of protein is stronger than that of carbohydrates or fats. These findings are in line with ²⁹, which states that protein increases satiety by stimulating the hormones CCK, PYY, and GLP-1 and suppressing ghrelin. Thus, the intervention instant noodles have the potential to be an effective emergency food formulation in increasing short- to medium-term satiety, as well as helping to maintain nutritional adequacy and reduce hunger in disaster victims.

Fasting blood glucose levels

Fasting blood glucose levels in adolescent girls in the control and intervention groups showed a relatively stable pattern of change at three measurement points (0, 60, and 120 minutes). In the control group, the average glucose increased

from 94 mg/dL at minute 0 to 106 mg/dL at minute 60, then decreased to 93 mg/dL at minute 120. Meanwhile, in the intervention group, the average glucose increased from 93 mg/dL at minute 0 to 102 mg/dL at minute 60, then decreased to 95 mg/dL at minute 120. The change in glucose in the intervention group was smaller than in the control group. In line with ³⁰ and ³¹, the respondents' glucose levels were within the normal range (70–99 mg/dL), indicating good glucose metabolism regulation without signs of diabetes, as well as the ability to maintain physiological glucose homeostasis.

CONCLUSION

The organoleptic test showed that the F1 formula was the most preferred by the panelists (score 3.47; $p < 0.05$) with a soft light green colour, light aroma, chewy texture, and savoury taste. An increase in the proportion of moringa leaf flour was found to decrease the panelists' preference, so F1 was assessed as the most optimal formula. In addition to having the best taste, F1 also showed a nutritional composition that supports energy needs in disaster conditions, with high protein (18.19%) and carbohydrate (57.76%) content. However, the total energy (312.9 kcal) and fat (7.02%) were still

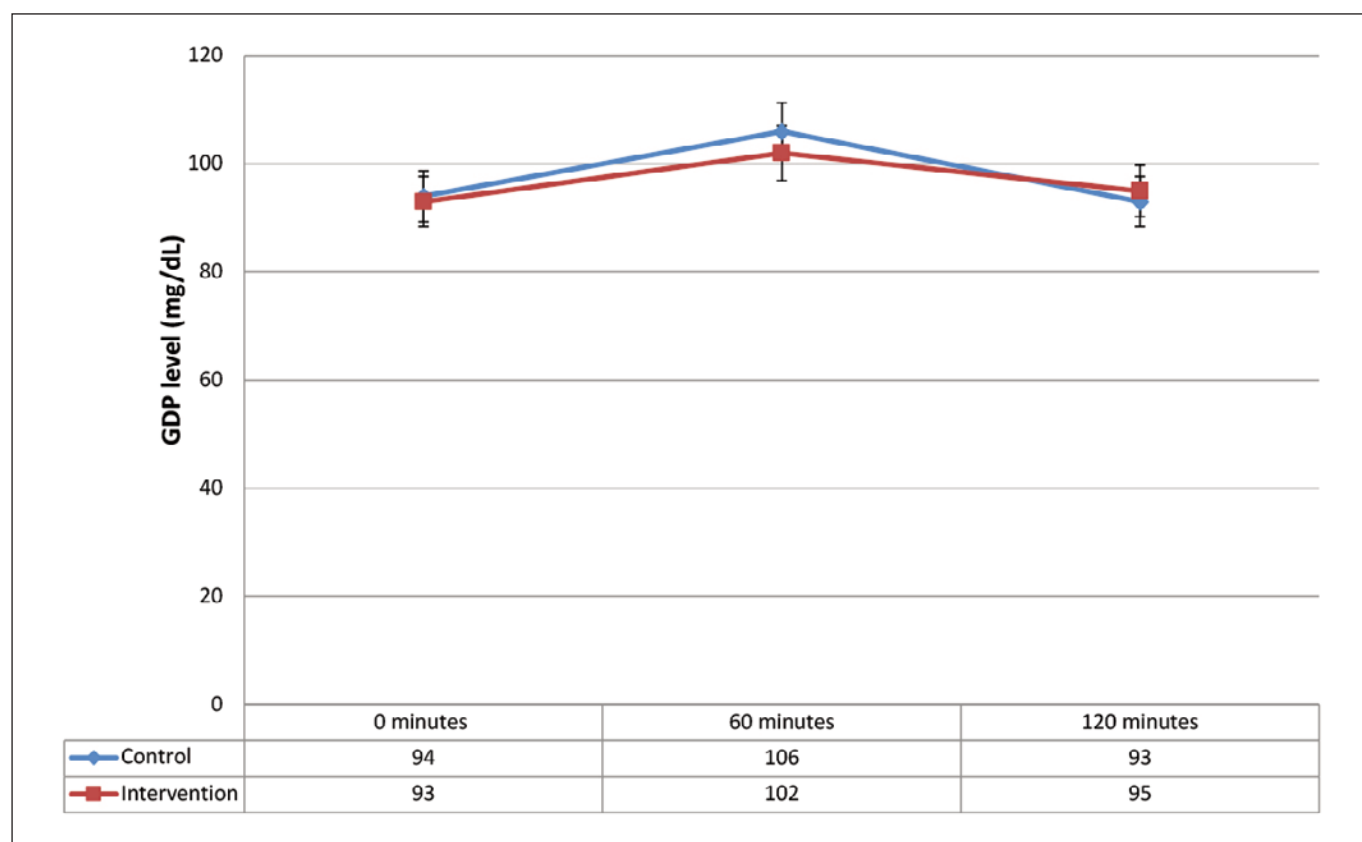


Figure 2. Graph of average blood glucose levels after consumption of instant noodles based on moringa flour, soybean flour, and macerel flour in both the control group and the intervention group

below standard, so the formula needed to be adjusted to be more balanced. In terms of storage, F1 instant noodles have a shelf life of 15 days at 25°C, 14 days at 35°C, and 13 days at 45°C, after which the quality begins to decline, although they are still safe for consumption until the 15th day. The intervention test results showed that consumption of this product increased satiety more than the control group at 30 minutes ($p = 0.001$) and 60 minutes ($p = 0.023$), which was influenced by the high protein content. Additionally, blood glucose levels in both groups remained stable up to 120 minutes without spikes, indicating that this product is safe to consume and does not trigger hyperglycaemia.

RECOMMENDATIONS

For further development, dietary fibre analysis is needed to determine its role in increasing the satiety produced by the product. In addition, microbial contamination tests such as TPC, coliform, *E. coli*, *Salmonella*, mould, and yeast are important to ensure product safety before consumption. Shelf life testing should also include organoleptic and microbiological parameters to make the results more comprehensive and able to describe overall quality changes during storage. In addition, reformulation of the addition of moringa leaf flour is necessary so that the taste and aroma are not too strong, making the product more balanced and acceptable to consumers.

REFERENCES

1. Lassa Ja, Teng P, Caballero-Anthony M, Shrestha M. Revisiting Emergency Food Reserve Policy And Practice Under Disaster And Extreme Climate Events. *Int J Disaster Risk Sci* [Internet]. 2019;10(1):1–13. Available From: <https://doi.org/10.1007/S13753-018-0200-Y>
2. Miyagawa N, Tsuboyama-Kasaoka N, Harada M, Nishi N. A Review Of Factors Associated With Nutritional Problems And Improvement Initiatives After Natural Disasters. 2020;
3. Fazilah Z, Sudirman S, Lestari A. Management of Malnutrition After Disasters at the Talise Community Health Centre in Palu City. *J Collaborative Science*. 2022;5(6):312–9.
4. Adeoya Aa, Egawa S, Adeoya As, Nagatomi R. Improving Child Nutrition in Disasters by Developing a Modeled Disaster Preparedness Nutrition Education Curriculum. *Frontiers in Public Health*. 2023;11(December).
5. Rahmad Ah Al. Nutrition and Disaster Management [Internet]. Researchgate.Net. 2024. Available From: https://www.researchgate.net/profile/Laeli-Hasanah/Publication/381193538_Nutrition_And_Nutrition_And_Disaster_Disaster_Management/Links/666151d5b769e769191ad267/Nutrition-And-Nutrition-And-Disaster-Management-Disaster.Pdf
6. Olson B, Marks DI, Grossberg Aj. Diverging Metabolic Programmes And Behaviours During States Of Starvation, Protein Malnutrition, And Cachexia. *J Cachexia Sarcopenia Muscle*. 2020; 11(6):1429–46.
7. Sumarto, Tajrifani As. Development of Food Products from Local Raw Materials for Emergency Disaster Buffer Stocks in Tasikmalaya Regency, West Java. *J Dialog Disaster Management*. 2020; 11(2):179–85.
8. Utami V, Prabandari, Suryo Y, Susetyowati. Determinants of Instant Noodles Consumption Among Students in Sriwijaya University. *Public Health Journal*. 2017;33(3):153–60.
9. Venn Bj. Macronutrients and Human Health for the 21st Century. *Nutrients*. 2020;12(8):1–3.
10. Adisty Y, Vanesa T, Wahyuni W, Khairani M. Utilisation of Moringa Oleifera Leaves as a Base Ingredient for Making Cendol Jelly as a Traditional Drink. *Sci-Tech J*. 2024;3(1):1–9.
11. Kkp. Marine Capture Fisheries Production [Internet]. 2023 [Cited 2025 Jun 3]. Available From: <https://portaldata.kkp.go.id/portals/Data-Statistik/Prod-Ikan/Summary>
12. Andira A, Sumartini, Hutapea J, Soleha Sp, Amalia Ar. Fortification of Mackerel (*Rastrelliger sp*) on the Characteristics and Nutrition of Wet Noodles. *National Seminar on Science and Technology and Humanities*. 2022;8(2):94–103.
13. Koswara S. Popular Food Technology Series: Noodle Processing Technology. Ebookpangan.Com. 2009;1–13.
14. Wahyuli Ms. The Effect of Substituting Jackfruit Flour (*Musa sp. L*) for Rice Flour on the Organoleptic Quality and Potassium Content of Sapik Cake. *Scientific Paper, Padang Health Polytechnic* [Internet]. 2017;11:11–20. Available From: <http://ojs.uho.ac.id/index.php/jpkime-mail>
15. Nugrahani R, Yuniartini Nlps. Organoleptic Test of Steamed Sponge Cake with Proportions of Mocaf Flour (Modified Cassava) and Kelor Flour (*Moringa Oleifera*). *Ganec Swara*. 2025;19(2): 674–80.
16. Aisyah Pn, Rahma A, Prayitno Sa. Analysis of Quercetin Content and Sensory Quality in a Beverage Formulation Made from Moringa Leaves and Star Fruit. *J Food Saf Process Technol*. 2025; 2(2):144.
17. Farameita M, Wati Da. Journal of Nutrition and Health. *J Nutrition and Health* [Internet]. 2022;14(2):207–2015. Available From: <http://jurnalgizi.unw.ac.id/index.php/jgk>
18. Rachmawati Y, Rumatupa Ri, Purnama Di. Acceptability of Purple Sweet Potato Flour Cookies with Soybeans as Emergency Food. *Jgk J Nutrition and Health*. 2022;2(1):82–90.
19. Martiyanti Maa, Vita Vv. Organoleptic Properties of Instant White Sweet Potato Flour Noodles with Added Moringa Leaf Flour. *Foodtech J Teknol Pangan*. 2019;1(1):1.
20. Mufarrohah S, Supriyadi T, Dinangsit D. Nutritional Intake and Its Impact on Physical Endurance and Stamina of Taekwondo Athletes at Bunisari Club, Bandung Regency. *Gladi Journal of Sports Science* [Internet]. 2025;16(01):89–100. Available From: <https://journal.unj.ac.id/unj/index.php/gjik/article/view/53617>
21. Arentson-Lantz E, Clairmont S, Paddon-Jones D, Tremblay A, Elango R. Protein: A Nutrient In Focus. *Appl Physiol Nutr Metab*. 2015;40(8):755–61.

22. Unaisatul Akmaliah. Protein: An Essential Molecule for Metabolism and Immunity. *Biol J Ilm Biol* [Internet]. 2023;Vol. 1(1):27–33. Available From: <https://Media.Noran.Co.Id/Index.Php/Jurnalmedia-teknologi/Index>
23. Mutammima F. Optimising Breakfast: A Guide to Healthy Choices and Balanced Nutrition. *Maliki Interdiscip J Eissn* [Internet]. 2024;2(11):1152–9. Available From: <http://Urj.Uin-Malang.Ac.Id/Index.Php/Mij/Index>
24. Putri Lar, Afadil Ah, Nurulfuadi N, Randani Ai, Khatimah H, Rahmawati R, et al. Acceptability, Nutrients, and Antioxidant Capacity of Snack Bars Made from Red Bean Flour and Plantain as Emergency Food for Disasters. *Ghidza J Nutrition and Health*. 2024;8(2):242–9.
25. Nasria N, Tanra Tellu A, Nurdin M. Proximate Analysis of Noko Rattan Shoots (*Daemonorops Robusta*). *J Inov Glob*. 2024;2(3):445–52.
26. Seftiono H, Asmaradika I. Development of Purple Sweet Potato Porridge (*Ipomea Batatas*) as an Alternative Emergency Food Product. 2020;2(1):1–9.
27. Rosenheim NP, Watson M, Casellas Connors J, Safayet M, Peacock WG. Food Access After Disasters: A Multidimensional View of Restoration After Hurricane Harvey. *Journal of the American Planning Association* [Internet]. 2024;90(3):452–70. Available From: <https://doi.org/10.1080/01944363.2023.2284160>
28. Gong Y, Meng A, Zhang Y, Zhang B, Ying D, Guo B. Effect of Water Migration Rate on the Deformation Characteristics of Wheat Starch/Gluten Extruded Noodles. *Lwt* [Internet]. 2022;163(August 2021):113546. Available From: <https://doi.org/10.1016/j.lwt.2022.113546>
29. Wisesa S, Soraya Ai, Wahyudin W. Whey Protein Isolate Increases Satiety and Reduces Calorie Intake Through Induction of Anorexi-genic Signals. *Mandala Heal*. 2024;17(1):11.
30. Anak Agung Gede B. Education and Screening in Preventive Efforts for Pre-Diabetes in Adolescents at SMPN 9 Denpasar. *Warmadewa Minesterium Med J*. 2024;3(3):242–6.
31. Soelistijo Sa, Suastika K. Guidelines for the Management and Prevention of Type 2 Diabetes Mellitus in Indonesia 2024 Indone-sian Endocrinology Association. 2024;1–126.