OSJ | OPEN SCIENCE JOURNAL

RESEARCH ARTICLE

Proximate Composition, Mineral Content, Cooking Quality, and Sensory Properties of Kalinga Mix and Moringa Noodles

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OPEN ACCESS

Citation: Lanorio C.L, Lalap B.R., Felix A., Gonzales P., Maneja C.P., Abuyog A.T., Castaneda A. (2022) Proximate Composition, Mineral Content, Cooking Quality, and Sensory Properties of Kalinga Mix and Moringa Noodles. Open Science Journal 7(2)

Received: 31st March 2022

Accepted: 27th May 2022

Published: 24th June 2022

Funding: The author(s) received no specific funding for this work

Competing Interests: The authors have declared that no competing interests exists.

Abstract:

The main objective of this study is to develop an acceptable and nutrient-dense noodles from KALINGA mix and moringa. Materials for making the noodles such as KALINGA mix (rice, sesame seeds, mung bean), bread flour, and moringa powder were purchased at the local market of Los Baños, Laguna. Malnutrition in the Philippines remains to be a serious health problem, especially to low-income areas. Its challenges and enormity in the country require new research and innovations that are accessible and will make use of native resources to achieve better health and nutrition for the community. Hence an attempt to develop an acceptable and nutrient-dense noodles incorporating KALINGA mix and moringa. The noodles were prepared with different ratios of KALINGA mix (30g, 20g, 10g) and flour (70g, 80g, 90g, 100g). All samples were then added with 5g of moringa. The results of the study showed that all the cooking losses of the samples were below the technologically acceptable limit (≤8%). In the overall acceptability, the sample with 30g KALINGA has the highest mean score of 7.125 (like moderately). The proximate composition showed that the highest moisture content (7.64%), and crude protein (10.86%) were found in 10g KALINGA, whereas crude fat (15.57%), and ash (1.0%) were the highest in 30g KALINGA, crude fiber (0.73%) and NFE (69.77%) were highest in the control sample. For the mineral content, the control sample was highest in calcium (125 mg/100g), and iron (7.4 mg/100g) while the 30g KALINGA had the lowest in both. Zinc is the same in all samples (1.2 mg/100g). In conclusion, the sample with 30g KALINGA was good in terms of its cooking quality, overall acceptability, and proximate composition. The control however was better in its calcium, and iron content.

Keywords: Kalinga Mix, Moringa Noodles, Mineral, Cooking quality

Introduction

The 2018 Expanded National Nutrition Survey (NNS) reported that the prevalence of underweight among school-age children (>5 to 10 years old) decreased from 31.2 percent (2015) to 25.0 percent (2018). Despite this decrease, its magnitude of severity is still considered high and a public health problem. Households in the poorest wealth quintiles had the highest prevalence of underweight with 38.4 percent. The prevalence of stunting significantly declined from 31.1 percent (2015) to 24.5 percent (2018), and households in the poorest quintiles recorded the highest prevalence with 39.9 percent. Wasting prevalence slightly decreased from 8.4 percent (2015) to 7.6 percent (2018). Households in the poorest quintiles also recorded the highest wasting prevalence with 8.2 percent (1). Malnutrition is still considered a public health concern in the country. Addressing the problem of malnutrition is a daunting task, both technical and financial, for the barangay local government units (LGUs). It requires collaborative partnership, new research, and innovations. The Philippine government issued various laws intended to address hunger and malnutrition. One of which is the “Masustansyang Pagkain para sa Batang Pilipino Act” (RA No. 11037).It recognizes the vital role of the youth and shall promote and protect their physical, moral, spiritual, intellectual, and social well-being (2). In support of this, the Participative Nutrition Enhancement Approach (PNEA) strategy of Barangay Integrated Development Approach for Nutrition Improvement (BIDANI) aims to be part of this activity by innovating healthy foods using the KALINGA mix of the Department of Science and Technology-Food and Nutrition Research Institute (DOST- FNRI).

Operationalizing the BIDANI as a strategy has three innovative components: 1) Barangay Integrated Development Approach (BIDA), 2) Barangay Management Information System (BMIS), and 3) Participative Nutrition Enhancement Approach (PNEA). BIDA component creates awareness and empowers actors to actively participate in development efforts in their communities and enhance the capacity of the local leaders in planning, implementation, monitoring, and evaluation of development programs/projects/activities. BMIS serves as the barangay’s data and information system/center for situational analysis using accurate, reliable, and easily retrievable data for program planning and implementation. PNEA utilized a participative strategy in preventing malnutrition among 24-month-old children via the life cycle approach as well as promoting food production and market-driven activities at the household level (3).

As part of PNEA’s promotion of food production and market-driven activities, the BIDANI program developed and promoted KALINGA-based products. It will help against malnutrition and increase the consumption of nutrient-rich foods. The KALINGA mix is composed of ground rice, mung bean, and sesame seeds. This mixture can be added to other food and can be as good as or even better than commercially produced baby food. It contains carbohydrates, fats, and proteins which are essential for the growth of infants (3). Moringa has many uses, the leaves, roots, and immature pods are used as vegetables. All parts of the tree (bark, pods, leaves, nuts, seeds, tubers, roots, and flowers) are edible. The leaves can be used fresh or dried and ground into powder form. Economically, it is the most valuable species that is native to South Asia (4). The leaves are particularly rich source of minerals, vitamins, and some phytochemicals. It is rare for a plant to have many essential nutrients in high quantities, however, moringa contains high content of various nutrients compared to those individually found in several diverse types of food or vegetables (5). Our goal is to develop a new KALINGA mix product by using raw materials like moringa that are easily found in the Philippines and can help against malnutrition.

To make the product familiar to consumers, noodles were chosen as the sample. Noodles are highly popular in many countries including the Philippines. In 2017, some 100.1 billion servings of instant noodles were eaten globally. The Philippines was also ranked 7th in the list of top 15 with the highest demand for instant noodles (6). The Philippine Bureau of Agricultural Statistics in 2013 reported that around 63.82 percent of households consumed instant noodles and the consumption of other noodles ranged from 2.92 percent to 14.44 percent (7).

Materials and methods

Noodle preparation

The bread flour, moringa powder, and raw materials used to make KALINGA mix (rice, sesame seeds, mung bean) were purchased at the local market of Los Baños, Laguna. In making the KALINGA mix, the rice, sesame seeds, and mung bean were thoroughly cleaned with a sieve and course impurities were handpicked. Ingredients were then toasted for about 5 minutes, then pulverized.

Blended flour for the noodles production was prepared as follows: bread flour of 100g, 90g, 80g, and 70g were combined with KALINGA mix to constitute 0g, 10g, 20g, and 30g ratio as shown in Table 1. The moringa powder was constant at 5 grams for all samples.

Table 1. Ratio of bread flour, KALINGA mix, and moringa powder

Samples	Bread Flour (g)	KALINGA mix (g)	Moringa powder (g)
Control	100	0	5
10g KALINGA	90	10	5
20g KALINGA	80	20	5
30g KALINGA	70	30	5

In each sample, the required amount of water (40ml), oil (1Tbsp), and salt (1/8tsp) were mixed well for 10 minutes to distribute uniformly through the flour and create a dough. The dough was left to stand for 30 minutes and then fed to the extruder. After extrusion, the noodle samples were air-dried (Fig. 1).

Figure 1. KALINGA-moringa uncooked noodle samples

Figure 1 shows the KALINGA-moringa uncooked noodle samples. The samples were cooked and subjected to various sensory and chemical analyses. The preparation of the noodles was adapted from the study of Ganga M.U and colleagues (8).

Cooking quality

Cooking loss (%) and weight increase (%) were taken to determine the cooking quality. Approximately 10g of noodles were added into 300ml of boiling distilled water. KALINGA-moringa samples were cooked in three different time stamps (10, 15, and 20 minutes). The samples were then washed with distilled water and drained for two minutes. The following equations were used to calculate the cooking loss and weight increase of the noodle samples (9):

$$\text{Weight increase (\%)} = \frac{(\text{Weight increase of cooked noodle} - \text{Weight of uncooked noodle})}{\text{Weight of uncooked noodle}} \text{ X } 100$$

$$\text{Cooking loss (\%)} = \frac{\text{Weight of drained residue in cooking water}}{\text{Weight of uncooked noodle}} \text{ X } 100$$

Sensory evaluation

Sample size and sampling design

The sensory evaluation was conducted at the College of Human Ecology, Los Baños, Laguna. Due to Covid-19 restrictions, convenience sampling was used and only 40 participants were chosen. All participants are the employees allowed to physically report to their offices.

Participants

Participants with colds, cough or any illness during the activity were excluded from the study. Prior to the activity, a researcher called the offices of the participants to ask for their permission. For the participants, a written consent was discussed before the actual evaluation of the product. The background, objectives, procedure of the study along with the possible risks and benefits, participation criteria, privacy and confidentiality of the results were explained. They were also allowed to back out if they felt any discomfort during the sensory evaluation and assisted to the nearest clinic/hospital for any allergies.

Data gathering

The sensory evaluation was conducted between 9:00-10:00am and 3:00-4:00pm. Table 2 shows how the samples were evaluated using a 9-point hedonic scale for its overall acceptability and sensory attribute such as color, flavor, aroma, and mouthfeel.

Table 2. Nine-point hedonic scale

9	8	7	6	5	4	3	2	1
Like Extremely	Like Very Much	Like Moderately	Like Slightly	Neither Like nor Dislike	Dislike Slightly	Dislike Moderately	Dislike Very Much	Dislike Extremely

Chemical analyses

Proximate composition and mineral analysis

Proximate and mineral analysis were conducted according to the procedure of the Association of Official Analytical Chemist (AOAC) for moisture, ash, crude fiber, crude protein, calcium, iron, and zinc. The nitrogen free extract (NFE) was calculated through difference method by subtracting the sum (g/100g dry matter) of crude protein, crude fat, ash and fiber from 100g (10).

Statistical analysis

Data obtained were presented as mean (standard deviation). Using PHStat software, one-way ANOVA and post-hoc Tukey Kramer test were used to obtain any significant differences in all determinations at 95% confidence level.

Results and discussion

Cooking quality

There are various methods to determine the quality of the noodles. During cooking, it should absorb water, maintain its shape, and should not stick together. Noodles should be cooked to “al dente”. The firmness can be evaluated using either sensory panel or instrumental methods (11). Other characteristics that can be measured for the cooking quality are cooking loss and weight increase (9)(11). Figure 2 shows the cooked KALINGA-moringa noodle samples.

Figure 2. KALINGA-moringa cooked noodle samples

As shown in table 3, the control absorbed lower amount of water compared to the samples with KALINGA. After cooking, sample with 20g KALINGA increased 2.7 times its weight, while sample with 30g KALINGA and 10g KALINGA increased 2.6 and 2.3 times, respectively.

Table 3. Cooking quality parameters of KALINGA-moringa noodles

SAMPLES	Parameters	
	Weight Increase (%)	Cooking Loss (%)
Control	202.09	4.69
10g KALINGA	229.14	6.53
20g KALINGA	273.79	3.35
30g KALINGA	258.04	3.34

The addition of KALINGA may have caused the increase in weight of three noddle samples (10g, 20g, and 30g KALINGA). Cooking losses are one of the basic parameters used to predict the cooking quality (9). It indicates the amount of dry matter lost into the cooking water (12). The cooking losses of the control and noodles with KALINGA (10g, 20g, and 30g) were found to be 4.69, 6.53, 3.35, and 3.34 percent respectively. All the cooking losses of the noodle samples were below the technologically acceptable limit (≤8%) (9)(13).

Sensory attributes

The sensory attributes of the four samples were evaluated based on its color, aroma, mouthfeel, flavor, and overall acceptability. Table 4 shows the findings of the sensory evaluation of the different samples.

Table 4. Sensory evaluation of the KALINGA-moringa noodles

SAMPLES	SENSORY ATTRIBUTES				
	Color	Aroma	Mouthfeel	Flavor	Overall Acceptability
Control	$6.75{\pm}1.41^{a}$	$7.18{\pm}1.32^{a}$	$6.70{\pm}1.34^{a}$	$6.93{\pm}1.21^{ab}$	$6.80{\pm}1.29^{a}$
10g KALINGA	$7.30{\pm}1.34^{a}$	$7.00{\pm}1.40^{a}$	$6.73{\pm}1.60^{a}$	$6.45{\pm}1.28^{a}$	$6.65{\pm}1.42^{a}$
20g KALINGA	$7.08{\pm}1.49^{a}$	$6.78{\pm}1.39^{a}$	$6.75{\pm}1.63^{a}$	$6.65{\pm}1.55^{ab}$	$6.73{\pm}1.36^{a}$
30g KALINGA	$7.05{\pm}1.40^{a}$	$6.88{\pm}1.26^{a}$	$6.75{\pm}1.56^{a}$	$7.35{\pm}1.49^{b}$	$7.13{\pm}1.40^{a}$

Sensory scale: 9 -like extremely, 8 -like very much, 7 -like moderately, 6 -like slightly, 5 -neither like nor dislike, 4 -dislike slightly, 3 -dislike moderately, 2 -dislike very much, 1 -dislike extremely
a-bValues with the same letters on each column are not statistically different ($p<0.05$)

Colors can affect our perception of food, as it generates a certain product expectation. Seeing colors can be particularly important in the food industry especially when panelists(persons trained to describe products with their properties) usually assess its color as well (14). In the evaluation of the KALINGA-moringa noodles, the sample with 10g KALINGA (7.30) had the highest mean score in color while the control had the lowest with 6.75. However, all of the samples were not significantly different from each other.

The core of food flavor is formed not through the taste types (sweet, sour, bitter, salty, and umami) but instead through substances and sensations that are perceived through the olfactory nerve. Odor can influence our likes and dislikes. Positively stimulating odors and aromas also serve to quicken the appetite. On the other hand, off-aromas and odors make consumers recognize danger, for instance in spoiled foods (15). In KALINGA-moringa noodles, the control (0g KALINGA) has the highest mean score with 7.18 followed by the sample with 10g KALINGA . There were no significant differences between all samples.

The texture and mouthfeel are important properties in food and beverages (16). Mouthfeel is important in sensory impression of many food items, thus it is associated with consumer acceptability. Studies have shown that organs involved in the perception of mouthfeel (mouth, tongue, and lips) have the second most discriminative sense of touch in the body (17). In the KALINGA-moringa noodles, samples with 20g and 30g KALINGA have the highest mean score with 6.75 while the control had the lowest with 6.70. There were no significant differences between all the four samples.

As defined by the Michigan State University Center for Research on Ingredient Safety, flavors are the sensory impressions you experience when consuming foods and beverages. These impressions are formed by the chemical sensations of taste and smell (18). The perception of flavor can be divided into three stages. The odor assessment, flavor in the mouth assessment, and aftertaste assessment (19). In the KALING-moringa noodles, the sample with 30g KALINGA had the highest mean score with 7.35, while the sample with 10g KALINGA had the lowest with 6.45. The 30g KALINGA sample was also found to be significantly different from the 10g KALINGA.

Food acceptability is influenced by several factors that can be related to the individual, food, or environment. It is based on hedonics and subjective for each individual. It can be influenced by the sensory properties of the food, previous exposure and expectations, contextual factors, culture, physiological status, and other variables (20). For overall acceptability, the sample with 30g KALINGA had the highest mean score with 7.13 while the 10g KALINGA had the lowest with 6.65. No significant differences were found between all the samples.

Proximate composition

The moisture, crude fat, crude protein, crude fiber, ash, and NFE of the samples are presented in Table 5

Table 5. Proximate composition of the cooked noodle samples

Cooked Samples	Proximate Composition (%)					
	Moisture	Crude Fat	Crude Protein	Crude Fiber	Ash	NFE
Control	5.38±0.01^{a}	12.74±0.09^{a}	10.74±0.40^{a}	0.73±0.08^{a}	0.64±0.04^{a}	69.77^{a}
10g KALINGA	7.64±0.07^{b}	13.63±0.24^{ab}	10.86±0.84^{a}	0.54±0.10^{a}	0.79±0.07^{b}	66.61^{b}
20g KALINGA	6.55±0.04^{c}	15.34±0.50^{bc}	10.74±0.40^{a}	0.64±0.08^{a}	0.80±0.01^{b}	65.93^{b}
30g KALINGA	7.32±0.14^{d}	15.57±0.04^{c}	10.15±0.80^{a}	0.30±0.08^{b}	1.0±0.05^{c}	65.66^{b}

a-dValues with the same letter on each column are not significantly different ($p<0.05$)

In table 5, the highest moisture content (7.64%), and crude protein (10.86%) were found in sample with 10g KALINGA. Crude fat (15.57%) and ash (1.0%) were highest in sample with 30g KALINGA. Crude fiber (0.73%), and NFE (69.77%) were highest in the control.

The moisture content is one of the most measured properties in food, it is important due to several reasons. One of which is because the food quality, texture, taste, appearance, and stability of foods depend on the amount of water they contain (21). It is also not an independent value. In different conditions like storage with definite air humidity, the moisture content changes depending on the difference between water activity in the material and parameter because the value predetermines the rate of many biological and biochemical processes (22)(23). The KALINGA-moringa noodle sample with 10g KALINGA had the highest moisture content followed by 30g KALINGA, 20g KALINGA, and then the control. All the samples were significantly different.

Fats allow humans and animals to consume fat-soluble vitamins and provide them with essential fatty acids, that bodies are unable to produce. The efficiency of fat as foodstuff is remarkably high, because the fat in food is almost completely reabsorbed by the body. Fats also enhance the mouthfeel by providing a smooth, creamy consistency to many dishes (24). In the KALINGA-moringa noodles, there was an increasing trend in crude fat content from control to the sample with 30g KALINGA. This may be because of the fat content in KALINGA mix. The sample with 30g KALINGA (15.57%) was not significantly different from the sample with 20g KALINGA (15.34%), but it is significantly different from the other samples.

Protein is a key factor in achieving good health as it is involved in immune function, oxygen transport, and maintenance of strong muscle tissue. Crude protein is a measure of how much protein is in food, based on laboratory tests (25). There was a decline in the protein content when the amount of KALINGA increased.

This may be due to the fact that during the extrusion process, protein structures are disrupted and altered. The process of extrusion may bring denaturation of protein (26). The sample with 10g KALINGA had the highest crude protein content, followed by samples with 20g KALINGA and control. While the sample with 30g KALINGA was the least in crude protein. All samples were not significantly different.

Crude fiber refers to one type of dietary fiber, the type that remains as residue after the sample undergoes a laboratory treatment with dilute acid and alkali. The treatment dissolves all the soluble fiber and some insoluble fiber in food (27). The results showed that there was a decrease in the crude fiber content from control to sample with 30g KALINGA. Sample with 30g KALINGA had the least crude fiber (0.30%). It was also significantly different from the rest of the samples. This decrease may be attributed to the extrusion process during the KALINGA mix and noodle sample development. In a study conducted by Arribas in 2018, there was a 30 percent reduction in total dietary fiber due to extrusion (28). Another study by Sobota in 2010 showed there was a decrease in the crude fiber content from extrusion (29).

Ash is an inorganic material, like minerals, present in food. It is the residue that remains after heating removes water and organic material such as fat and protein. Ash can include compounds with essential minerals, such as calcium and potassium, and toxic minerals, such as mercury (30). There was an increasing ash content from the control to the sample with 30g KALINGA. This increase may be due to the ash content from KALINGA mix. The sample with 30g KALINGA that has 1.0 percent ash was also significantly different from the other samples. In the samples NFE, control was highest with 69.77 percent. It was also significantly different from the other samples.

Mineral content

A decreasing trend was observed in the mineral content of the KALINGA-moringa noodles. Calcium and iron decreased from the control down to the 30g KALINGA sample, while zinc remained the same across all samples (Fig. 3).

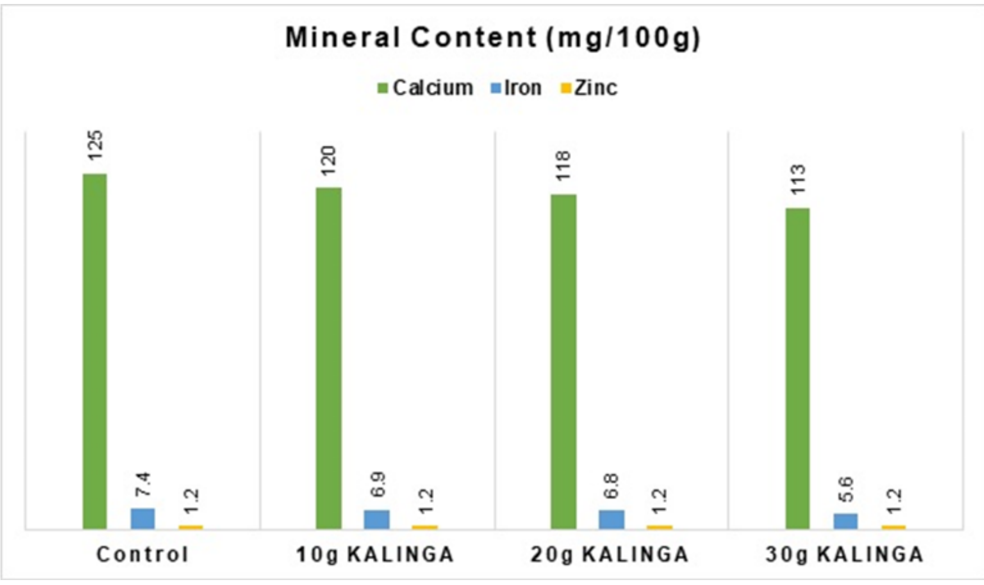

Figure 3. Mineral content of KALINGA-moringa noodles

The amount of bread flour was reduced as the amount of KALINGA mix was increased, this may be the reason for the decreasing trend in calcium and iron. It was observed that bread flour has a substantial amount of calcium ranging from 83 to 134 mg/100g, while iron range from 0 to 3.39 mg/100g (31)(32)(33).Aside from the calcium and iron content in the bread flour, Philippines also mandated the fortification of flour with vitamin A and iron under Republic Act no. 8976 (DOH) (34).

Conclusions

The obtained results from the cooking quality, sensory evaluation, and chemical analyses proved that:

1) all the samples were acceptable based on the cooking quality parameters that were taken;
2) in sensory evaluation, samples with KALINGA mix have higher mean score in three attributes (color, mouthfeel, flavor) and overall acceptability;
3) in the proximate composition, the sample with 10g KALINGA had the highest moisture (7.64%) and crude protein (10.86%) content. Crude fat (15.57%) and ash (1.0%) were highest in the sample with 30g KALINGA. Crude fiber (0.73%) and NFE (69.77%) were highest in the control; and,
4) the control had the highest calcium and iron content, while zinc remains the same in all samples.

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