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Instant Noodles from Pumpkin (*Cucurbita Moschata* D.) and Anchovy Flour (*Stolephorus Commersini*) as an Alternative Emergency Food

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ABSTRACT

This study evaluated the sensory, physical, and chemical characteristics of instant noodles from pumpkin and anchovy flour as an alternative emergency food. In this research, instant noodles were made with wheat and pumpkin flour ratios of 100:0, 90:10, 80:20, 70:30, 60:40, and anchovy flour of 0, 15, 20, 25, 30%. The analyses of the sensory (acceptance test), physical (water absorption, cooking loss, swelling volume, hardness, tensile strength), and chemical properties (moisture, ash, protein, lipid, carbohydrate content) of the instant noodles were performed. The data obtained were analyzed statistically. The results showed that the preferred instant noodles were those with a ratio of 80:20, and anchovy flour to 30%. The higher the anchovy flour content, the higher the water absorption, cooking loss, and swelling volume are. On the contrary, the tensile strength and hardness of the noodles were lower. The addition of 30% anchovy flour increased the protein content of instant noodles up to 3.17 times compared to the control, with 24.32% db protein. The addition of anchovy flour has followed the Indonesian National Standard (SNI). Lipid and carbohydrate content fulfill the emergency food standards. Based on sensory, physical, and chemical properties, the best ratio of wheat: pumpkin flour for the instant noodle was 80:20, with the addition of anchovies by 30%.

Keywords: anchovy flour, emergency food, instant noodle, protein, pumpkin flour

INTRODUCTION

Indonesia is a country prone to disasters such as earthquakes, volcanic eruptions, floods, landslides, and potential tsunamis due to the country's geographic condition. Indonesia is located in the Pacific Ring of Fire, where Eurasian, Indonesian, and Pacific tectonic plates meet and there are dozens of active faults. According to the National Disaster Management Authority (BNPB) (2019), the disasters that hit Indonesia in 2019 amounted to 3,814 events and increased by 48.29% in 2018 with 2,572 incidents. In disaster conditions, assistance is needed by victims, especially food. Emergency food needed should be safe and easy to consume, contains sufficient nutritional value, and has a shelf life of 2 years (Ainehvand *et al.* 2019). Dry food used as an emergency food should have a moisture content of 2–20% and water activity of 0.20–0.60 (Rao *et al.* 2016). Emergency food should provide a daily intake of 2,100 kcal. The macronutrients for emergency food should contain 10–15% protein content, 35–45% fat, and 40–50% carbohydrate (Hasan *et al.* 2020). One of the emergency foods is instant noodles (Gulia *et al.* 2014). However, the protein content of instant noodles on the market is generally low. According to Sikander *et al.* (2017), the protein content of instant noodles on the market is 6.7–11%. Therefore, it is necessary to develop instant noodle products from other ingredients that fulfill emergency food macronutrients, namely pumpkin and anchovy flour.

Yellow pumpkin (*Cucurbita moschata* D.) is a source of carbohydrate because it has a high carbohydrate content of 77.27% wb (Tamba *et al.* 2014).Its protein content is low at 3.59% db (Yanuwardana *et al.* 2013). In Indonesia, pumpkin production is high, shown by the total production in 2014 reaching 523,063 tons (Fauzi *et al.* 2017). However, the pumpkin consumption level is low, which is less than 466,400 tons (Ministry of Agriculture 2018). Pumpkin can be processed into flour, which has carbohydrates of 83.18% and protein of 4.28% (Gumolung 2019). However, the substitution of wheat with pumpkin flour reduces instant noodles' protein content. So, it is necessary to add other ingredients as a protein source in instant noodles.

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Anchovy is one of marine resources that is easily obtained. As the data of Statistics Indonesia (BPS) (2018) indicate, anchovy production in Indonesia in 2018 reached 29,097.93 tons. However, anchovy processing is not optimal and anchovy is only used as a side dish such as crisp, *pepes*, *bebothok*, and fried anchovy. Anchovy flour contains high protein at 48.8% wb (Ministry of Health Republic of Indonesia 2018). Anchovy contains total essential amino acids of 38.77–40.17%. Besides, anchovy also has DHA of 9.91–22.41% and EPA of 2.87–4.97% (Sankar *et al.* 2013). This study evaluated the sensory, physical, and chemical characteristics of instant noodles made from pumpkin and anchovy flour as alternative emergency food.

METHODS

Design, location, and time

This study consisted of 2 stages of instant noodle formulation. The first and second stages used a Completely Randomized Design (CRD) with one factor. In stage 1, the treatment was the ratio of wheat flour and pumpkin flour, consisting of 5 treatments, i.e., 100:0, 90:10, 80:20, 70:30, and 60:40, while stage 2 consisted of 5 concentrations of anchovy flour, i.e., 0, 15, 20, 25, and 30%. The study was carried out two times. In each treatment, three replicates were performed. This research was conducted at the Food Processing Laboratory, Faculty of Biotechnology, the Atma Jaya Catholic University of Indonesia, from September 2018 to August 2019.

Materials and tools

The materials used in this study were pumpkin and anchovies obtained from Bekasi Family Mart; Cakra Kembar flour from PT Bogasari with high protein specifications of 11–13%, and cooking oil. The chemicals used included sodium metabisulfite ($Na_2S_2O_5$), alkaline salts (Na_2CO_3 and K_2CO_3), and analytical chemicals with the quality of P.A. (Pro Analysis). The tools used in this study included a 60-mesh sieve, sieve shaker, food processor, noodle maker, deep frying, texture analyzer, analytical balance, oven, furnace, Kjeldahl flask, and Soxhlet extractor.

Procedures

Pumpkin flour preparation. Pumpkin (*Cucurbita moschata* D.) was peeled and cleaned from unwanted parts such as the skin and seeds. Then, the pumpkin was washed with clean water. The pumpkin was cut to a thickness of 2 mm and soaked in 0.25% sodium sulfite ($Na_2S_2O_5$) for 20 minutes. Soaking the pumpkin with sodium metabisulfite ($Na_2S_2O_5$) aims to prevent browning of the pumpkin so that the resulting flour has bright colors. The sulfite content of $Na_2S_2O_5$ can inhibit the browning reaction catalyzed by the phenolase enzyme and inhibit the formation of furfural metal hydroxyl compounds from D-glucose or mixtures that cause brown color. Pumpkin was dried in the oven at 60°C for 42 hours. After dried, the pumpkin was mashed with a food processor and sieved with a 60-mesh sieve to obtain fine yellow pumpkin flour (Prabasini *et al.* 2013).

Anchovy flour preparation. A total of 1 kg of wet anchovy (*Stolephorus commersini*) was soaked for 30 minutes in water. Then, it was washed thoroughly. The anchovy was dried using an oven at 60°C for 10 hours. Furthermore, the anchovy was then mashed using a food processor until smooth. Then, it was sieved with a 60-mesh sieve. After that, anchovy fish flour was ready for use and stored in a -2°C freezer (Rahmi *et al.* 2018).

Instant Noodles Making. Two formulas were used in the making of the instant noodles. The first formula was a mixture of two flour, namely wheat and pumpkin flour, with Wheat (WF) to Pumpkin Flour (PF) ratio of 100:0; 90:10; 80:20; 70:30; 60:40. Then instant noodles were analyzed in terms of their sensory properties. The sensory analysis aimed to determine the ratio of WF: PF used in the second noodle formulation. The second formula of instant noodles was a mixture of three flour, wheat, pumpkin, and anchovy flour. Anchovies flour was added 0, 15, 20, 25, and 30%. The processing of instant noodles began with the preparation of all the ingredients needed, including a mixture of flour formulations, alkaline salts (Na_2CO_3: K_2CO_3) with a ratio of 3: 2, water, and cooking oil. The addition of alkaline salt (Na_2CO_3: K_2CO_3) was used for improving the texture. Na_2CO_3 improved the noodles' smoothness and texture, while K_2CO_3 increased the thickness of the noodles. All the ingredients were mixed until homogeneous for 7–8 minutes until the dough was smooth. Then, it was pressed and thinned until 1–2 mm. Pressing and thinning were done to transform the dough into sheets,

ready to cut into noodles. After that, the dough sheets were cut using a noodle maker. Next, the mixture was steamed for 10 minutes. Then, the noodles were fried in a deep-frying method at 140–150^{o}C for 10 seconds. This process aimed to cook the noodles so that they can be eaten without cooking or consumed as snacks. Instant noodles were drained to speed up the noodles' oil release and stored for further analysis (Liandani & Zubaidah 2015).

Instant Noodle Analysis. The instant noodles were analyzed in terms of the sensory-, physical-, and chemical- properties. Sensory analysis was performed using an acceptance test with a hedonic scale (Meilgaard *et al.* 2016). The physical analysis performed included water absorption (Ko *et al.* 2015), cooking loss (Ko *et al.* 2015), swelling volume (Bhise *et al.* 2014), and texture profile (hardness and tensile strength) using a texture analyzer. The chemical analysis included moisture content using the thermogravimetry method (AOAC 2012), ash content using the gravimetry method (AOAC 2012), protein content using the Kjeldahl method (AOAC 2012), lipid content using the Soxhlet method (AOAC 2012), and carbohydrate content using by-difference method (AOAC 2012).

Data analysis

The experiments were carried out in two repetitions. The resulting data are shown as a mean with standard deviation. The data were analyzed with analysis of variance (ANOVA) SPSS 24 if there are significant differences, followed by Duncan's Multiple Range Test (DMRT) with a significant level of $p<0.05$.

RESULTS AND DISCUSSION

The sensory analysis results of cooked instant noodle made from pumpkin flour

The first hedonic test showed that instant noodles with wheat and pumpkin flour ratio of 80:20 could be accepted by the panelists because the preference attributes, i.e., aroma, taste, aftertaste, and overall preference, were not significantly different from the control instant noodle 100:0 ($p>0.05$). Also, the color and texture attributes were not significantly different from instant noodles 90:10 ($p>0.05$) (Table 1.). The instant noodles with 80:20 ratio have a dark yellow color, they are rather flavorful and have a pumpkin flavor, the texture is slightly chewy, and have bitter aftertaste. The cooked instant noodles with a ratio of 80:20 were significantly different from cooked instant noodles 70:30 and 60:40 ($p<0.05$). The panelists do not favor instant noodles with ratio of 70:30 and 60:40 because they have an intense yellow color, flavorful, pumpkin taste, a slightly springy texture, and bitter aftertaste. Increasing the addition of pumpkin flour would produce darker noodles because pumpkin contains carotenoids, causing the resulting flour to be dark and yellowish (Khan *et al.* 2019). The higher the pumpkin flour, the less chewy and easily broken the noodles are, because pumpkin flour has a low gluten matrix, reducing the strong bond between starch and starch granules (Ahmed *et al.* 2015). Based on the sensory test results, the ratio of wheat and pumpkin flour used in the second formulation of instant noodles was 80:20.

The sensory analysis of cooked instant noodles made from pumpkin and anchovy flour

The sensory result of instant noodles made from pumpkin flour 80:20 and anchovy flour 0% (control) to 30% are presented in Table 2. The panelists' preferences on the attributes of color, aroma, taste, texture, and overall instant noodles with anchovy flour of 25 and 30% were not significantly different from the control noodles (without the addition of anchovy flour) ($p>0.05$). In comparison, the aftertaste attributes of instant noodles with 30% anchovy flour was significantly different from that of the control ($p<0.05$), but not significantly different from instant noodles with 25% ($p>0.05$) anchovy flour. The panelists still accepted instant noodles with 25 and 30% anchovy flour having a dark yellow color, the taste of anchovy, and the chewy texture. Instant noodles with anchovy flour of 15 and 20% on all sensory attributes except texture were significantly different from the control ($p<0.05$). The resulting instant noodles with anchovy flour of 15 and 20% have dark yellow, rather flavorful and taste anchovies, a slightly chewy texture, and somewhat tasted for the aftertaste. Based on these sensory results, the addition of anchovy flour to instant noodles made up 30%. The instant noodles have been an acceptable color, aroma, taste, texture, and aftertaste to meet emergency food development's critical criteria.

Table 1. The sensory test results of cooked instant noodle made from pumpkin flour

Instant noodles formulation (WF:PF)	Color	Aroma	Taste	Texture	Aftertaste	Overall
100:0	5.24±1.66^{a}	5.04±1.46^{a}	5.16±1.41^{a}	5.48±1.09^{a}	4.80±1.83^{a}	5.52±1.12^{a}
90:10	4.40±1.53^{ab}	5.00±1.26^{a}	5.00±1.38^{a}	4.64±1.52^{b}	4.60±1.53^{a}	5.00±1.35^{a}
80:20	4.30±1.47^{bc}	4.60±1.26^{ab}	4.48±1.47^{a}	4.64±1.38^{b}	4.32±1.65^{a}	4.80±1.29^{a}
70:30	3.40±1.39^{cd}	3.96±1.31^{b}	3.64±1.49^{b}	4.40±1.08^{b}	3.40±1.41^{b}	3.76±1.27^{b}
60:40	2.96±1.58^{e}	3.84±1.34^{b}	3.36±1.49^{b}	4.24±1.27^{b}	3.00±1.50^{b}	3.76±1.36^{b}

The above values were mean±SD; Mean value with different superscript letters in the same column are significantly different ($p<0.05$) according to ANOVA with Duncan's Multiple Range Test; Hedonic scale: 1: Dislike very much; 2: Dislike; 3: Dislike slightly; 4: Neither like nor dislike; 5: Like slightly; 6: Like; 7: Like very much: WF:Wheat Flour; PF:Pumpkin Flour

The physical analysis of cooked instant noodles made from pumpkin and anchovy flour

The physical analysis of instant noodles showed that anchovy flour would increase water absorption, cooking loss, and swelling volume. In contrast, the hardness and tensile strength value of instant noodles decreased (Table 3.). Water absorption is the ability of noodles to trap water maximally during the cooking process. The water absorption capacity of instant noodles plays an essential role in the development of cooked instant noodles. The water absorption analysis results of instant noodles were significantly different from all treatments ($p<0.05$). The high water absorption causes starch granules to break easily, and the noodles become very soft (Asthami *et al.* 2016).

The cooking loss was shown by the percentage of dry matter lost during cooking to dry noodles weight. The cooking loss was acted as a quality parameter for the noodles' quality after cooking. The cooking loss analysis results of instant noodles were significantly different from all treatments ($p<0.05$). Increased cooking loss from instant noodles because pumpkin and anchovies flour has low gluten content. The low gluten content weakens the ability to form three-dimensional networks so that starch granules can escape during cooking. This study obtained a high value of the cooking loss, which causes instant noodles' texture to be not chewy and easily broken (Ahmed *et al.* 2015). Based on the hedonic test, the panelists still accepted the texture of instant noodles.

The swelling power of control instant noodles was not significantly different from instant noodles with 15 and 20% of anchovy flour ($p>0.05$), but significantly different from instant noodles with 25 and 30% of anchovy flour ($p<0.05$). The higher the addition of anchovy flour, the swelling volume of instant noodles cooked would be higher. The increased swelling volume of instant noodles is influenced by the high Water Holding Capacity (WHC) of anchovy flour so that the volume of prepared noodles increases (Ahmed *et al.* 2015; Ahmed *et al.* 2016). The swelling volume was also influenced by the hydrated starch's content, resulting in swelling of the granular core.

Tensile strength is a material's ability to resist the tensile force applied to a certain

Table 2. The sensory test results of cooked instant noodle made from pumpkin and anchovy flour

Instant noodles formulation	Color	Aroma	Taste	Texture	Aftertaste	Overall
WF:PF=80:20; AF=0%	5.40±1.08^{a}	5.56±1.04^{a}	5.28±1.17^{a}	4.60±1.61^{a}	5.32±1.03^{a}	5.08±1.29^{a}
WF:PF=80:20; AF=15%	4.32±1.25^{b}	4.60±1.38^{bc}	3.44±1.47^{b}	3.92±1.35^{a}	3.96±1.17^{b}	3.72±1.06^{b}
WF:PF=80:20; AF=20%	3.80±0.90^{bc}	4.08±1.44^{c}	3.48±1.50^{b}	3.72±1.31^{a}	3.96±1.17^{b}	3.64±1.25^{b}
WF:PF=80:20; AF=25%	4.78±1.55^{ab}	5.16±0.94^{ab}	4.88±1.23^{a}	4.16±1.43^{a}	5.12±1.10^{ab}	4.60±1.12^{a}
WF:PF=80:20; AF=30%	4.62±1.46^{ab}	4.88±1.33^{ab}	4.64±1.60^{a}	4.48±1.45^{a}	4.48±1.42^{b}	4.96±1.21^{a}

The above values were mean±SD; Mean value with different superscript letters in the same column are significantly different ($p<0.05$) according to ANOVA with Duncan's Multiple Range Test; Hedonic scale: 1: Dislike very much; 2: Dislike; 3: Dislike slightly; 4: Neither like nor dislike; 5: Like slightly; 6: Like; 7: Like very much: WF:Wheat Flour; PF:Pumpkin Flour; AF:Anchovy Flour

Table 3. The physical analysis results of instant noodle made from pumpkin and anchovy flour

Instant noodles formulation	Water absorption (%)	Cooking loss (%)	Swelling volume (%)	Tensile strength (gf)	Hardness (gf)
WF:PF=80:20; AF=0%	125.78±2.69^{a}	9.55±0.38^{a}	11.11±0.00^{a}	82.00±7.38^{e}	7,642.83±97.43^{d}
WF:PF=80:20; AF=15%	135.60±2.75^{b}	11.54±0.26^{b}	12.49±0.73^{a}	66.67±5.13^{d}	7,529.00±101.80^{d}
WF:PF=80:20; AF=20%	140.69±2.56^{c}	12.56±0.40^{c}	13.06±2.44^{a}	54.00±3.35^{c}	7,127.17±97.57^{c}
WF:PF=80:20; AF=25%	156.48±1.82^{d}	13.56±0.14^{d}	15.69±3.08^{b}	43.67±3.98^{b}	6,829.83±92.85^{b}
WF:PF=80:20; AF=30%	166.17±2.09^{e}	15.72±0.51^{e}	18.41±0.94^{c}	36.67±2.07^{a}	6,601.50±98.97^{a}

The above values were mean±SD; Mean value with different superscript letters in the same column are significantly different ($p<0.05$) according to ANOVA with Duncan's Multiple Range Test; WF:Wheat Flour; PF:Pumpkin Flour; AF:Anchovy Flour

amount until it breaks (Sukri *et al.* 2016). Based on ANOVA test results, the tensile strength of instant noodles with anchovies showed a significant difference from the control ($p<0.05$). The addition of anchovy flour reduces the tensile strength value. The addition of anchovies causes the noodles' gluten content to decrease. The bond between the starch granules causes the resistance to traction to weaken, causing the noodles to break easily (Ahmed *et al.* 2016).

Hardness is the durability of the sample for breaking due to the compressive force applied. Based on the ANOVA test results, the hardness value of instant noodles with anchovy flour of 20–30% showed a significant difference with the control ($p<0.05$). Instant noodles with anchovy flour of 15% was not significantly different from the control ($p>0.05$). The higher the addition of anchovy flour, the hardness of instant noodles decreases. It was caused by the higher value of the cooking loss, and the high Water Holding Capacity (WHC) of anchovy flour used is 276.15±10.04%. The high cooking loss value causes the loss of starch molecules so that the noodles become less dense, and the starch retrogradation process decreases so that the hardness also decreases (Yulianti 2018). Also, the high WHC of fish flour causes instant noodles' water content to be higher so that the hardness of instant noodles decreases (Sukri *et al.* 2016).

The chemical analysis of instant noodles made from pumpkin and anchovy flour

Based on the sensory test results of the noodles favored by the panelists, chemical analysis was carried out, which included instant noodles with wheat: pumpkin flour with a ratio of 80:20 and addition of 25–30% anchovy flour (Table 4.). The results show that the addition of anchovy flour increases moisture, ash, protein, and lipid content but decreases instant noodles' carbohydrate content. Instant noodles with 30% anchovy flour have significantly different chemical properties with the control, i.e., moisture, ash, protein, lipid, and carbohydrate content ($p<0.05$). The analysis of the moisture content of instant noodles with the addition of anchovies up to 30% follows the Indonesian National Standard (SNI 3351-2012), which is a maximum of 8% (SNI 2012). The addition of anchovy flour increases the moisture content of instant noodles. Due to the very high Water Holding Capacity (WHC) of anchovy flour by 276.15±10.04%, water was added to form more dough. The instant noodles'

Table 4. The chemical analysis results and total caloric calculation of instant noodle made from pumpkin and anchovies flour

Instant noodles formulation	Moisture content (% wb)	Ash content (% db)	Protein content (% db)	Lipid content (% db)	Carbohydrate content (% db)	Calculation of total energy (kcal)
WF:PF=80:20; AF=0%	7.01±0.28^{a}	0.63±0.28^{a}	7.67±0.70^{a}	15.78±0.04^{a}	75.91±0.79^{c}	476±1.20^{a}
WF:PF=80:20; AF=25%	7.79±0.12^{b}	0.80±0.20^{a}	22.43±0.62^{b}	18.17±0.02^{b}	58.60±0.54^{b}	488±0.80^{b}
WF:PF=80:20; AF=30%	7.95±0.09^{b}	1.79±0.13^{b}	24.32±0.47^{c}	19.49±0.05^{c}	54.40±0.44^{a}	490±0.69^{c}

The above values were mean±SD; Mean value with different superscript letters in the same column are significantly different ($p<0.05$) according to ANOVA with Duncan's Multiple Range Test; WF:Wheat Flour; PF:Pumpkin Flour; AF:Anchovy Flour

moisture content was less than 10% so that it met the criteria for dry products as emergency food.

The ash content of instant noodles with 30% anchovy flour was significantly different from the control ($p<0.05$). Still, the instant noodles' ash content with 25% anchovy was not significantly different from the control ($p>0.05$). The ash content of the instant noodles produced was higher with the addition of anchovy flour. It was because the anchovy flour has a high ash content of 4.82±0.19% db.

The protein content results in instant noodles with anchovy flour of 25 and 30% following SNI 3351-2012 quality standards, the minimum requirement of 8% (SNI 2012). The control noodles were not following SNI 3351-2012 because they were not added with anchovy flour. The ANOVA test results showed that protein content in instant noodles with anchovy flour is significantly different from the control ($p<0.05$). The increase in protein content of instant noodles caused by the protein of anchovies (85.55±0.68% db) is higher than the wheat flour (11.70±0.47% db) and pumpkin flour (3.96±0.26% db). The protein content of instant noodles with 25–30% anchovy flour was 22.43±0.62–24.32±0.47% db higher than the dry noodle products added with skipjack flour 20–50% of 10–11.93%; noodles made from sago starch added with mungbean and red kidney bean flour 10–30% of 4.06±0.23–10.47±0.59% db (Agustia *et al.* 2016; Yulianti 2018). Instant noodles with 30% anchovy flour contained protein of 24.32±0.47% (db), which increased 3.17 times compared to protein control instant noodles. The instant noodle protein level was 30%, equivalent to 20.88% of total calories, exceeding the standard calories of emergency food protein by 13.5–15% of total calories (Hasan *et al.* 2020). The addition of anchovy flour increased the protein content of instant noodles as alternative emergency food.

The lipid content of instant noodles with anchovy flour would increase along with the higher concentration of anchovy flour. Based on the ANOVA test results, the lipid content of instant noodles with anchovy flour is significantly different from the treatments and control ($p<0.05$). It was because the lipid content of anchovy flour (4.75±0.26% db) is higher than that of wheat (1.38±0.20% db) and pumpkin flour (3.71±0.18% db). Instant noodles' lipid content with 25–30% anchovy flour was equivalent to 35.09–37.64% of total calories. Thus, it met the emergency food standard's lipid calories at 35–45% of total calories (Hasan *et al.* 2020).

Based on the analysis, the carbohydrate content of instant noodles with anchovy flour 30% was significantly different from instant noodles with anchovy flour of 25% and control ($p<0.05$). The higher the addition of anchovy flour, the lower the carbohydrate content of instant noodles is. It was because the carbohydrate content of anchovies (4.88±3.22% db) is lower than that of wheat (86.32±0.54% db) and pumpkin flour (84.66±0.57% db) used in instant noodles making. The addition of 25–30% anchovy flour to instant noodles has a carbohydrate level equivalent to 46.7–50.3%, fulfilling the calories of emergency food carbohydrates by 40–50% of total calories (Hasan *et al.* 2020).

The calculation of the total caloric content in food products was done by multiplying the macronutrient amount of the ingredients used with the respective calorific value. The energy value of protein is 4 kcal / g, lipid 9 kcal / g, and carbohydrate is 4 kcal / g (Anandito *et al.* 2016). Calculation of the total energy of instant noodles with 25–30% of anchovies flour was 488–490 kcal (Table 4.). The calorie content of instant noodles has fulfilled the nutritional adequacy rate for emergency food, which is at least 466 kcal per 100 g of material (Hasan *et al.* 2020). The instant noodles that need to be consumed for one serving are 150 g to meet 731 kcal needs. Therefore, to meet humans' daily energy needs of 2,100 kcal, the assumption is that instant noodles should be consumed three times a day, so that one serving meets the energy of at least 700 kcal. Instant noodles with 30% anchovy flour are suitable for emergencies because they meet emergency food nutrients such as lipids, carbohydrates, and energy. These instant noodles had a moisture content of less than 10%, so they had a long shelf life of at least six months. Consuming instant noodles is practical and the noodles can even be consumed directly and easily distributed in emergencies.

CONCLUSION

The instant noodle formulation favored by the panelists was instant noodles with wheat and pumpkin flour ratio of 80:20, with the addition of anchovy flour up to 30%. The physical analysis

results of instant noodles showed that the higher the addition of anchovy flour, the higher the water absorption, cooking loss, and swelling volume are, but the hardness and tensile strength are lower. The chemical analysis of instant noodles with 25 and 30% anchovy flour follows the Indonesian National Standard (SNI 3551-2012). Instant noodles with the addition of 30% anchovy flour contained a high protein content of 24.32±0.47% db. The protein increase was 3.17-fold compared to the control instant noodles. The moisture, lipid, carbohydrates content, and total calorie intake of instant noodles with anchovy flour by 25–30% met the criteria for emergency food standards. The best treatment of instant noodle formulation based on sensory, physical, and chemical properties was WF ratio: PF: AF = 80: 20: 30% which can be used as an alternative to emergency food.

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AUTHOR DISCLOSURES

The authors have no conflict of interest.

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