International Journal of Multi Discipline Science
Vol. 6 No. 2 (August 2023)
e-ISSN: 2615-1707. Page: 142-155

Chemical, Physical, and Hedonic Quality Characteristics of Fish Cereal from Toman Fish Albumin Extract (*Channa micropeltes*) as Functional Food

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Keywords:
Toman Fish Albumin Extract; Hedonic; Chemical; Physical; Quality Characteristics; Fish Cereals

ABSTRACT
The nutritional value of fish cereal was determined by adding toman fish extract. Fish cereal is expected to be a useful food source rich in nutrients such as carbohydrates, vitamins, and minerals but rich in protein and albumin. Toman fish cereal is expected to be popular with people of all ages as a breakfast menu and can be a source of nutrition and increase endurance. The research aimed to obtain the formulation of toman fish albumin extract (Channa micropeltes) in fish cereal products as a functional food. This research was carried out in four stages: (1) preparation of fish albumin extract, (2) preparation of fish cereal; (3) Physical characteristics (hedonic test), fracture strength, and chemical characteristics (moisture content, ash content, protein content, fat content, and carbohydrate content), crude fibre content, albumin content, (4) determination of the best treatment using the Bayes method. The treatment with the addition of toman fish albumin consisted of 5 treatments with two replications. The treatment was carried out namely A1 0%, A2 30%, A3 35%, A4 40%, and A5 45%. The results showed that the highest protein content was around 4.57–13.33% and the albumin content of fish cereal was around 4.86–6.61%. This showed that fish cereal can be a functional food in increasing the immune system. Based on the Bayes test, the selected toman fish cereal formula was formula A2, namely 30% albumin extract.

INTRODUCTION

During the current COVID-19 pandemic, fishery products are one of the prima donnas because of the benefits of fish's nutritional content, which can increase the body's immunity. One fish that has the benefit of high nutritional content is the Toman fish. According to DKP (2012), the potential for toman fish in West Kalimantan is around 11,248,290/year compared to snakehead, parrot, and tilapia

fish. The results of this cultivation support the availability of fresh and processed toman fish. So far, the use of toman fish is still limited to consumption fish, so efforts are needed to diversify or diversify processed fishery products, including fish cereal products.

Cereal products are one type of processed food made from grain flour processed into flakes, strips (shredded), extruded (extruded), and ready to eat for breakfast (Iriyani & Fitriyani, 2011). Cereal products currently circulating are rich in carbohydrates but low in fibre and protein, with a total carbohydrate content of 20 g, 5 g protein, and 4 g dietary fibre. Therefore, to increase the nutritional value of cereals, it is necessary to add toman fish extract to manufacture cereals because it contains high amounts of protein, especially albumin. Research results by Fitriyani, Nuraenah, and Deviarni (2020) stated that fresh toman fish has a high protein content of around 24.75%, a total of amino acids of around 18.17%, and an albumin level of around 3.6 gr/dl. The benefits of toman fish albumin include increasing albumin levels and endurance and accelerating the healing process of internal or external wounds (Ulandari, Kurniawan, & Putri, 2011). Albumin extract contains other components such as fat, water, and ash. The higher the concentration of albumin extract added, the higher the albumin protein content in cereals.

The research results of Mentari (2014) showed that cereal products with the addition of 35% snakehead fish crude albumin resulted in an albumin content of around 2.57%, protein content of 7.49%, water content of around 4.77%, carbohydrate content of 77.43%, protein content of 6.73% fat, 3.56% ash content, 3.86% taste organoleptic value, 3.91% aroma, 3.83% texture, and 4.18% colour. This fish cereal is expected to be a useful food source rich in nutrients, not just carbohydrates, vitamins, and minerals. But also rich in protein and albumin. It is hoped that people of all ages can love this toman fish cereal as a breakfast menu, and can be a complete source of healthy nutrition and increase endurance during the Covid-19 pandemic. The utilization of functional food is a lifestyle of today's modern society. In addition to the food nutrition obtained, it also contains active compounds that are indirectly consumed. As technology advances, people prefer and consume healthy and hygienic foods. Functional food is food that is beneficial to health beyond the nutrients and nutrients available (De Roos, 2014). This study aimed to obtain the formulation of toman fish albumin extract (*Channa micropeltes*) in fish cereal products as a functional food.

METHOD

Material

The materials used in this study were fresh toman fish (*Channa micropeltes*) purchased at the Pontianak traditional market, wheat flour, whole wheat, cornstarch, vanilla, powdered sugar, salt, and water.

Research Design

This research was experimental research using a Completely Randomized Design (C.R.D.). The stages of this research consisted of 3 stages, namely (1) making toman fish albumin extract, (2) making fish cereal; (3) Hedonic testing (S.N.I. 01 2346-2011), fracturability using texture profile analysis (T.P.A.), colour analysis (EZ Hunterlab colour flex method), moisture content testing (A.O.A.C. 2019 930.15 methods), ash content testing (A.O.A.C. 2019 942.05 methods), protein content (method A.O.A.C. 2019 2001.11), fat content (method A.O.A.C. 2019 2003.06) and carbohydrate content (by difference), crude fiber content (method A.O.A.C. 2019 962.09), albumin level test (SNI 2973-2011). The treatment of the addition of toman fish albumin consisted of 5 treatments with two replications. The treatments were A1 0%, A2 30%, A3 35%, A4 40% and A5 45%.

Preparation of Toman Fish Albumin Extract

The preparation of fish albumin extract referred to the results of previous studies (Fitriyani & Deviarni, 2018; Nugroho, 2012; Irwanda, Andrie, & Luliana, 2012) using a streaming system. First of all, the toman fish was cleaned of scales and entrails, and then the weight of the toman fish was

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weighed again after washing and cleaning. Sliced vertically along the back and all over the body, steamed the fish until the oil came out, then tamped the oil that came out and measured according to size. Steamed the sample using a water bath and added water to the place limit at 70°C for 25 minutes. Toman fish meat steamed was then pressed to obtain albumin extract filtrate. The toman fish extract filtrate results obtained from pressing were then centrifuged for 60 minutes at 4000 rpm.

Furthermore, the centrifugation process was followed by separating the extract from the impurities in the lower layer by carefully pouring it into a separatory funnel. Two solution phases were formed in the separation process with a separatory funnel: the upper layer was the oil phase, and the lower phase was the water. The water phase at the bottom of the separating funnel was then taken, stored in a dark container, and wrapped in aluminium foil. Storage of the extract was carried out at a temperature of ≤4°C.

Production of Cereal Fish

The manufacture of cereals referred to the research results of Mentari (2014). For the manufacture of cereals, the ingredients for making cereals were weighed first except for the water, mixed thoroughly, and put into a basin, then crude albumin fish toman was added, according to treatment. Stir until smooth, and add water until the mixture thickens. Prepared a baking sheet, printed the cereal dough on it, and flattened it as thinly as possible. Then dried in the oven at 150°C for 20 minutes. Once dry, remove the cereal from the can and crush it into flakes. The formulation for making toman fish cereal can be seen in Table 1.

Table 1
Formulation for Making Toman Fish Cereal

Ingredients	Total (gram)	Total (%)
Flour	15	25
Wheat flour	8	13.3
Cornstarch	8	13.3
Whole wheat	4	6.66
Powdered sugar	3	5
Salt	1	1.6
Water	20	33.3
Vanilla	1	1.6
Total	**60**	**100**

RESULTS AND DISCUSSION

Characteristics of Chemical Quality of Toman Fish Cereal Products

Characteristics of the chemical quality of toman cereals carried out in this study were comparative tests (moisture, ash, protein, fat, and carbohydrates), crude fibre content, and albumin content. The results of proximate analysis and crude fibre of toman fish cereal products can be seen in Table 2.

Table 2
Proximate and Crude Fiber Analysis Results of Toman Fish Cereal Products

	Proximate Analysis and Crude Fiber Analysis					
Treatment	Water (%)	Ash (%)	Protein (%)	Fat (%)	Carbohydrate (%)	Crude Fiber (%)
A1	6.46±1.01^{a}	4.59±0.13^{a}	4.57±0.19^{a}	0.67±0.21^{a}	79.02±1.35^{a}	1.28±1.18^{a}
A2	7.06±0.00^{a}	5.34±0.98^{b}	12.81±1.04^{b}	1.34±0.98^{b}	73.45±1.24^{b}	1.79±0.17^{a}
A3	8.24±1.19^{a}	5.32±0.56^{c}	12.42±0.26^{b}	1.97±0.42^{c}	72.06±0.94^{b}	1.91±0.15^{a}
A4	7.11±0.54^{a}	5.04±0.14^{d}	12.82±0.40^{b}	2.18±0.07^{d}	72.20±0.92^{b}	2.09±0.06^{a}
A5	7.22±0.49^{a}	5.09±0.12^{e}	13.33±0.33^{b}	1.92±0.56^{ce}	72.45±0.35^{b}	0.96±0.36^{a}

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Water Content

The average fish cereal water content value ranges from 6.46–8.24%. The analysis of water content ANOVA showed that P > 0.05, H0 was accepted, so there was no significant difference in the water content value of fish cereal products. This is because the higher the addition of toman crude albumin, the water content will decrease. Based on (SNI, 1996) regarding cereals' quality requirements, the moisture content of cereal products is a maximum of 3%. The water content of this fish cereal product still exceeds the quality requirements for cereal products and does not meet the requirements based on the Indonesian National Standard. The results of this study were almost the same as those of research (Arsyadana, 2015) which stated that the water content of snakehead fish cereal flakes ranged from 6.75–6.98%. It can be seen that high water content is related to the texture or crispness of a product. This was also revealed by Astuti, Suharyono, and Anayuka (2019) who stated that the lower the water content of the flakes, the crunchier the product would be; conversely, if the water content is higher, the texture of the flakes was not crunchy. According to Richana et al. (2010), the higher the concentration of starch used, the higher the product's water content, so the material particles are denser and the drying ability is lower.

Ash Content

The average value of the ash content of fish cereal ranged from 4.59–5.34%. The results of ANOVA analysis of ash content showed that P < 0.05, H0 was rejected, so there was a significant difference in the value of ash content of fish cereal products. Duncan's other test results show that the value of ash content of fish cereal products was significantly different (P < 0.05) with all treatments. This is due to the addition of crude albumin to toman fish. The ash content in cereal products will increase. According to (SNI, 1996), regarding cereals' quality requirements, the flakes' maximum ash content is 4%, so the Toman fish cereal product does not meet the quality requirements of SNI for SNI cereal milk. According to Fitriyani, Nuraenah, and Deviarni (2020), the ash content in toman fish is quite high, around 1.65%. In addition, the increase in the ash content of the flake product is also influenced by the supporting materials used (Mustaqim, 2012). According to Fakhrudin (2009), adding wheat flour to a product can increase inorganic substances so that the ash content becomes high.

Protein Content

The average fish cereal protein content value ranged from 4.57–13.33%. The results of ANOVA analysis of ash content showed that P < 0.05, H0 was rejected, so there was a significant difference in the value of protein content of fish cereal products. The results of Duncan's further test showed that the protein content of fish cereal products without albumin addition (A1) was significantly different (P < 0.05) with treatments A2, A3, A4, and A5. This is because cereal products treated without the addition of fish albumin have lower protein content compared to cereal products treated with the addition of fish albumin. This study's results are higher than those of the Mentari (2014) study which contained around 6.14–7.98% of snakehead fish cereal protein. According to SNI (1996) regarding the quality requirements for protein content in cereal milk, namely a minimum of 5%, this toman fish cereal product has fulfilled the quality requirements of SNI for cereal milk. So, it can be concluded that adding toman crude albumin in fish cereal products will increase the protein content. According to Fitriyani, Nuraenah, and Deviarni (2020), the protein content in toman fish is quite high, around 24.75%, while the protein content in toman fish from Central Kalimantan is around 19.69% (Firlianty et al., 2013).

Fat Content

The average fish cereal fat content value ranged from 0.67–2.18%. The results of the ANOVA analysis for fat content showed that P < 0.05, H0 was rejected, so there was a significant difference in the value of fat content. The results of Duncan's further test showed that the value of the fat content of fish cereal products with all treatments had a significant difference. The fat content of fish cereal without adding albumin had a lower fat content than the fish cereal with albumin treatment. This is influenced by the composition of the ingredients used in each fish cereal treatment. The fat content

results do not meet the SNI requirements for flakes milk, namely a minimum of 7%. According to Fitriyani, Nuraenah, and Deviarni (2020), the fat content in toman fish is quite low, around 0.89%, while the fat content of wheat flour is around 1-3% (Riganakos & Kontominas, 1995).

Carbohydrate Content

The average fish cereal carbohydrate content value ranged from 72.06–79.02%. The analysis of carbohydrate content ANOVA showed that P < 0.05, H0 was rejected, so there was a significant difference in the value of carbohydrate content in fish cereal products. The results of Duncan's further test showed that the value of the carbohydrate content of fish cereal products without the addition of albumin had a significant difference compared to the other treatments. Fish cereal products treated without adding fish albumin had a higher carbohydrate content than those treated with fish albumin. This shows that the higher the addition of fish crude albumin, the lower the carbohydrate content in the toman fish cereal. The results of this study are also almost the same as the results of Mentari's (2014) research, that the results of the carbohydrate content test in snakehead fish cereal ranged from 74.69–82.90%. The proximate analysis results of the carbohydrate content of SNI flakes milk is at least 60%. The analysis results of the toman fish cereal quality have met the SNI requirements for the quality of cereal milk. The results of this study were almost the same as those of research Amalia and Kusharto (2013) which stated that the carbohydrate content of arrowroot starch flakes and African catfish flour was around 69.06–83.86%. The decrease in carbohydrate content is suspected due to the addition of the concentration of toman fish crude albumin, which is quite large, around 30–45%, affecting the decrease in cereal carbohydrate content. According to Fitriyani, Nuraenah, and Deviarni (2020), toman fish has a carbohydrate content of around 0.55%. In addition, high heating temperatures will reduce the amylose content and clarity of the starch paste but increase the solubility and swelling power (Haryanti, Setyawati, & Wicaksono, 2014).

Crude Fiber Content

The average value of crude fibre content of fish cereal ranged from 0.96–2.09%. The results of ANOVA analysis of crude fibre content showed that P>0.05, H0 was accepted, so there was no significant difference in the value of crude fibre content of fish cereal products. The crude fibre content in toman fish cereal is higher than the quality requirements for cereal milk (SNI, 1996), where cereal milk has a maximum crude fibre content of 0.7%, so toman fish cereal does not meet the quality requirements for cereal milk. This is caused by adding wheat flour and wheat flour, which have a lot of fibre, increasing the fibre content of fish cereal products. According to Haryani, Andini, and Hartini (2017), the crude fibre content of wheat flour is around 11.76% (w/w dry), and the crude fibre content of whole wheat flour is around 14.46% (w/w dry).

Albumin Content

The results of content for albumin in toman fish cereal products can be seen in Table 3.

Table 3
Results of Testing Content of Toman Fish Cereal Albumin

Treatment	Albumin Content (%)
A1	4.86
A2	5.25
A3	5.40
A4	6.05
A5	6.61

The average value of toman cereal albumin ranged from 4.86–6.61%. The highest albumin content of fish cereal products was in treatment A5, and the lowest albumin content of toman fish cereal products was in treatment A4. This is caused by the greater the concentration of the addition of crude albumin in toman fish, the higher the albumin level in toman fish cereal products. The results of research on toman fish cereal products had a higher albumin value than the results of Mentari's (2014)

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study which stated that the albumin content of snakehead fish cereal was around 2.26–2.6%. This is also reinforced by a study by Firlianty et al. (2013) which stated that fresh toman fish has a high albumin content of around 5.35%.

Characteristics of Physical Quality of Toman Fish Cereal Products

Colour Analysis

Colour measurement was carried out using a Lovibond tintometer. The parameters used are the value of L which indicates brightness; the value of a represents the chromatic colour of the red-green mixture with a value of +a (positive) for red and -a (negative) for green, and the value of b represents the chromatic colour of the mixture. Blue-yellow with a +b (positive) value for yellow and -b (negative) value for blue. L, a, and b values. The results of measuring the colour of fish cereal can be seen in Table 4.

Table 4
Colour Analysis of Toman Fish Cereal Products

	Color Intensity			
Treatment	**L***	**a***	**b***	**^{0}Hue**
A1	64.14±0.81^b	5.36±0.50^a	22.32±1.18^b	76.51±0.17^a
A2	53.89±0.57 ^{a}	8.92± 0.14^a	28.73±1.06^a	72.74±0.07^a
A3	47.58±6.08^a	11.57± 4.32^a	27.62±0.75^a	68.58±0.88^a
A4	50.67±1.78^a	9.05± 1.23^a	28.68±0.29^a	72.64±0.47^a
A5	50.35±0.27^a	8.71± 0.75^a	29.05±0.21^a	73.37±0.13^a

The results of colour analysis on the L* value of fish cereal products ranged from 47.58–64.14, the (a*) value ranged from 5.36–11.57, and the b (*) value ranged from 22.32–29.05. This shows that the resulting Toman fish cereal product has less brightness in red and yellow areas. The results of the L* colour ANOVA analysis showed that P < 0.05, H0 was rejected, so there was a significant difference in the L* colour of the fish cereal. The results of Duncan's further test showed that the L* colour of fish cereal products and fish cereal without albumin addition (A1) was significantly different (P < 0.05) with treatments A2, A3, A4, and A5. The test results for treatment A1 (without adding fish albumin) had a slightly whiter brightness level of around 64.14 compared to the other treatments. The brightness level is closer to 100, the brighter it is, whereas if it is closer to 0, it gets darker (Nugraha et al., 2021). The results of testing the colour of fish cereal on the L value showed that the higher the L value, the higher the brightness of the fish serum produced. This is due to the drying temperature above 100oC, causing the resulting colour to have low brightness. According to Apriyani, Widiastuti, and Syafutri (2015), the more protein is added to a product, the less the lightness value (L). A high protein content in a product will have a higher fat content, so when frying, the oil absorption process can cause the colour to become less bright (Octavianus, Supriadi, & Hanggita, 2014).

The results of a* colour ANOVA analysis showed that P > 0.05, H0 was accepted, so there was no significant difference in the colour of fish cereal. The fish cereal colour test results at a value showed that all fish cereal treatments had the same colour, which was close to red. This is also reinforced by Winarti, Sarofa, and Anggrahini (2008) that the higher the heating temperature, the lower the absorbance or colour stability, so the red colour will decrease. In addition, the Maillard reaction in the heating process will also occur where the reaction between the amino group of a free amino acid peptide chain residue or protein with the carbonyl group of a carbohydrate when both are heated or stored for a long time (Lakshmi, 2014). The b* colour ANOVA analysis showed that P < 0.05, H0 was rejected, so there was a significant difference in the b* colour of the fish cereal. Duncan's other test results showed that the colour b of fish cereal products and fish cereal without albumin addition (A1) was significantly different (P < 0.05) with treatments A2, A3, A4, and A5. This is because the colour of the fish cereal treatment shows that the higher the b value, the more yellow the colour intensity of the fish cereal tends to be. This is also influenced by the temperature and heating time in the manufacture of fish cereal, which determines the intensity of the yellow colour of the toman fish cereal.

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The hue value of the Toman cereal product shows the colour characteristics of the Toman cereal colour as a whole, where the hue value ranges from 68.58–76.51, which means that the hue value of the Toman cereal in all treatments produces a reddish yellow colour (yellow red -Y. R) with a hue range of 54°–90°. The results of the ANOVA analysis of hue values showed that P > 0.05, H0 was accepted, so there was no significant difference in hue colour in fish cereals. The heating process with temperatures above 100°C produces a slightly reddish colour on the toman fish cereal. This is also reinforced by Octavianus, Supriadi, and Hanggita (2014) that one of the factors that affect the processing of crackers is temperature. According to Lidiasari, Syafutri, and Syaiful (2006), drying time affects a product so that it can cause the pigments in the material to undergo oxidation and the product to turn brown.

Fracturability Analysis

Fracturability is the main measurement parameter in determining food products' quality and consumer acceptance (Widhi, 2008). Fracturability was measured using Texture Profile Analysis (TPA) with fracturability and hardness parameters. Fracturability indicates the resistance properties of food to the pressure exerted on a product which is related to the degree of crispness and brittleness of a product. This means an increased fracture strength value indicates a food product with a hardness level (Rakhmawati, Amanto, & Praseptiangga, 2014). Besides that, fracture strength can also be described as the more difficult it is for the food to be crushed, the higher the pressure force needed to press the product (Sabilla & Murtini, 2020) or in other words, the smaller the fracture strength, the higher the hardness. Decreases and increases the crispiness of a product (Rakhmawati, Amanto, & Praseptiangga, 2014). The maximum force required to press the product until the product breaks the first time is closely related to the hardness of a product. This means that the higher the hardness value, the product will have a relatively hard and less crunchy texture than products with a low hardness value (Apriani, 2009). The results of measuring the colour of fish cereal can be seen in Table 5.

Table 5
Fracturability Analysis results for Toman Fish Cereal Products

Treatment	Fracturability (gf)	Hardness (gf)
A1	2495.5±3342.2[b]	1962.2±494.2[a]
A2	1740.9±166.4[a]	1420.5±419.6[a]
A3	2549.9±427.9[a]	4642.5±6146.1[a]
A4	1937.1±366.5[a]	1919.2±1051.2[a]
A5	2731.8±1161.1[a]	2093.6±793.6[a]

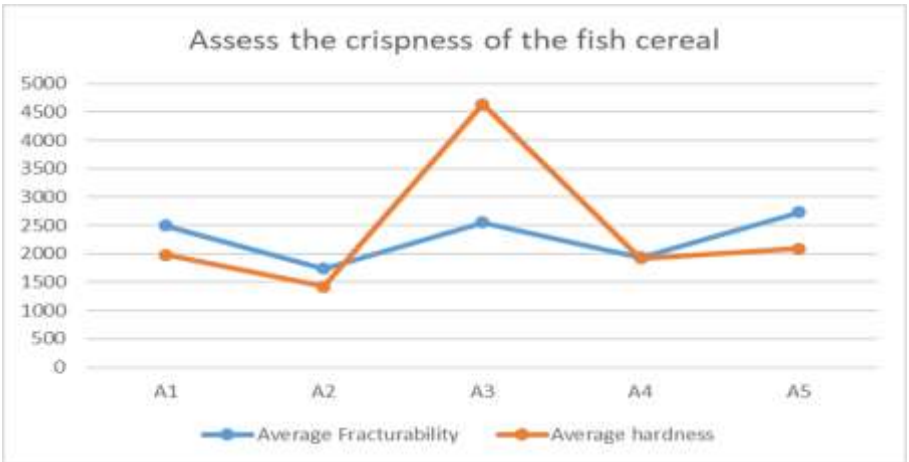

Fig. 1 *Graph of the results of the fracturability and hardness tests of toman fish cereal*

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The results of the fracturabilily test on toman fish cereal products ranged from 1740.9 gf to 2731.8 gf. The results of the ANOVA fracturability analysis showed that P < 0.05, H0 was rejected, so there was a significant difference in the fracturability value of fish cereal products. Duncan's other test results showed that the fracturability value of fish cereal products without the addition of albumin (A1) was significantly different (P < 0.05) with treatments A2, A3, A4, and A5. The results in Fig. 1 show that the higher addition of fish albumin to cereal products causes the value of fracture strength (*fracturability*) to increase. So, it was concluded that the fracture strength value (f*racturability*) increased, indicating that the fish cereal produced was getting harder. The results of this study are from Gionte, Limonu, and Liputo (2022) that the average value of flakes fracturability ranges from 1682.3–3153.6 g/f.

The hardness test results for toman fish cereal products ranged from 1420.5 gf to 4642.5 gf. The results of the ANOVA fracturability analysis showed that P > 0.05, H0 was accepted, so there was no significant difference in the hardness value of the toman fish cereal product. This shows that the higher the addition of fish albumin to cereal products, the hardness the value increases. The research results on fish cereal products had a higher hardness value than the hardness test results on brown rice flour cereals, which ranged from 1.7821-2.5735 kgf. The results in Fig. 1 show that the more concentration of fish albumin is added to cereal products, the more the hardness value increases. According to Putra, Nopianti, and Herpandi (2015), the lower the hardness value, the more crunchy the product. The hardness of extruded products is affected by material moisture, screw speed, and temperature. In addition, moisture has the most significant effect on hardness values. The higher the addition of water to the treatment, the higher the hardness value of the cereal product (Brncic et al., 2006).

Hedonic Testing of Toman Fish Cereal

Assessment of the level of consumer preference for toman fish cereal products using the hedonic test method (liking). Hedonic testing uses 15 panellists. Panelists were asked to rate cereal products using a score sheet. Parameters assessed from the product consisted of the appearance, colour, aroma, texture, and taste of the fish cereal product. The hedonic scale used ranges from 1-9 where 1=dislike very much, 2=dislike very much, 3=dislike, 4=somewhat dislike, 5=neutral, 6=rather like, 7=like, 8=very much likes and 9 = likes very much. The hedonic test results for toman fish cereal products can be seen in Table 6.

Table 6.
Results of Product Hedonic Testing

Parameter	**Mean Value of Fish Cereal Hedonic Test**				
	A1	**A2**	**A3**	**A4**	**A5**
Appearance	6,33±1,632^{a}	5,40±1,404^{abcd}	5,26±1,222^{bcd}	4,73±1,162^{cd}	4,86±1,060^{d}
Colour	6,06±2,218^{a}	5,20±1,373^{a}	4,93±1,099^{a}	5,20±0,676^{a}	5,20±1,373^{a}
Aroma	6,40±1,549^{a}	5,73±1,387^{a}	5,60±1,055^{a}	5,73±1,334^{a}	5,46±1,457^{a}
Taste	5,73±2,120^{a}	5,00±1,603^{a}	5,60±1,454^{a}	5,66±1,290^{a}	5,13±1,407^{a}
Texture	6,33±1,112^{a}	5,46±1,245^{a}	5,40±1,212^{a}	5,73±1,162^{a}	4,93±1,579^{a}

Note: Different superscripts in the same column show a significant difference (P)

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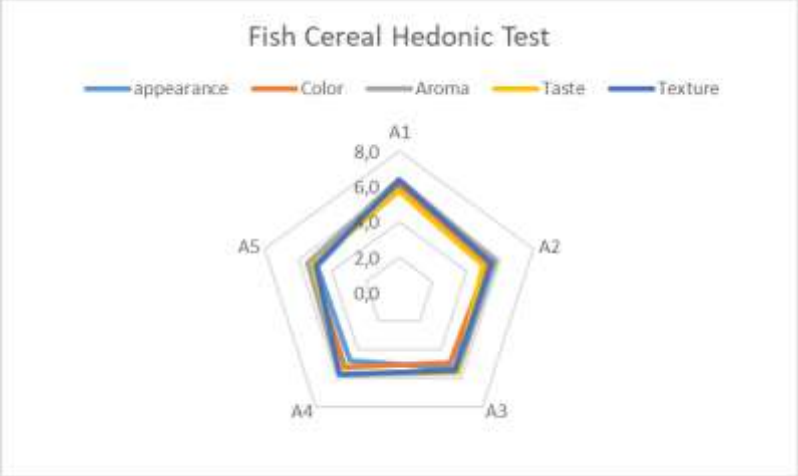

Fig. 2 *Radar Fish Cereal Hedonic Test Results*

The resulting toman fish cereal product has a neat, intact, yellowish, and white appearance. Fish cereal products for each treatment can be seen in Fig. 3.

A5 A4 A3 A2 A1

Fig. 3 *Toman Fish Cereal Products for Each Treatment*

Appearance

The average hedonic value of Toman cereal ranged from 4.73–6.33. The highest average appearance value was in fish cereal without the addition of toman fish albumin extract, and the lowest average value was in fish cereal with 40% toman fish albumin extract (A4). Based on the Kruskal Walis test results, the appearance parameter $P < 0.05$, H0 was rejected so that there were significant differences in the treatment (A1, A2, A3, A4, and A5) on the appearance of fish cereal with the addition of albumin. The results of the Wann-Whitney test showed that the level of preference for the appearance of fish cereal products without the addition of albumin was significantly different ($P < 0.05$) in A1 and A3, A1 and A4, and A1 and A5. This is because the appearance of fish cereal without the addition of albumin is rather preferred because it has a neat, whole, and white appearance compared to the appearance of fish cereal with the addition of albumin, which has an uneven appearance, is rather thin and has a brownish yellow colour (Fig. 2). This is to the statement of Chandra, Marsono, and Sutedja (2014) that the appearance of flakes is flat, and the edges are uneven. Generally, brownish yellow has a crunchy texture and low water content. Cereal products are consumed for breakfast (*breakfast cereals*) with the addition of milk.

Colour

The average hedonic value of toman cereal colour ranged from 4.93–6.06. The highest average colour value was in fish cereal without adding toman fish albumin extract, and the lowest average value was in fish cereal with adding 35% toman fish albumin extract (A3). Based on the Kruskal Walis test

results, the colour parameter P > 0.05, H0 was accepted so that there was no significant difference in the colour of fish cereal with the addition of toman fish albumin. The results of the hedonic test showed that the average panellists were neutral to somewhat like the colour of the fish cereal without the addition of albumin or with the addition of fish albumin (Fig. 2). The colour of the fish cereal, on average, produces a brownish-yellow colour. The results of research by Mentari (2014) stated that the higher the carbohydrate content of a product, the resulting colour tends to be brownish and burns easily. In addition, during the roasting process, Maillard reactions or non-enzymatic browning occur due to reactions between carbohydrates and reducing sugars with the amino groups of proteins at high temperatures (Salsabiela, Afgani, & Dzulfikri, 2021).

Aroma

The average hedonic value of toman fish cereal aroma ranged from 5.46–6.40. The highest average aroma score was found in fish cereal without adding toman fish albumin extract. The lowest average score was in fish cereal with the addition of 45% toman fish albumin extract (A5). Based on the Kruskal walis test results, the taste parameter P > 0.05, H0 was accepted so that there was no significant difference in the aroma of fish cereal with the addition of toman fish albumin. The results of the hedonic test showed that the average panellist was neutral to somewhat fond of the aroma of fish cereal without the addition of albumin or fish albumin (Fig. 2). The strong fish aroma influences the aroma of Toman fish's cereal products. This is the opinion of Mentari (2014) that the higher the concentration of albumin added will give a fishy aroma to the fish cereal.

Flavor

The average hedonic value of toman fish cereal ranged from 5.00–5.73. The highest average taste score was in fish cereal without adding toman fish albumin extract, and the lowest was in fish cereal with 30% toman fish albumin extract (A2). Based on the Kruskal Walis test results, the taste parameter P > 0.05, H0 was accepted so that there was no significant difference in the taste of fish cereal with the addition of toman fish albumin. The results of the hedonic test showed that the average panellist was neutral to somewhat liked the taste of fish cereal without the addition of albumin or fish albumin (Fig. 2). This is because the taste produced in fish cereal products still has a fish taste from the albumin used to manufacture fish cereal. According to Witono et al. (2017), fish have the amino acid L-glutamic acid, indicating a potential source of savoury taste (umami).

Texture

The average hedonic value of toman fish cereal texture ranged from 4.93–6.33. The highest average texture value was in fish cereal without adding toman fish albumin extract, and the lowest average value was in fish cereal with adding 45% toman fish albumin extract (A5). Based on the Kruskal Walis test results, the texture parameter P > 0.05, H0 was accepted so that there was no significant difference in the texture of fish cereal with the addition of toman fish albumin. The results of the hedonic test showed that the average panellist was neutral to somewhat liked the taste of fish cereal without the addition of albumin or fish albumin (Fig. 2). This is because the texture produced in fish cereal products, on average, has a rather hard texture. This is to the results of the fracture strength test on fish cereal products, resulting in increased fracture strength and a hard texture. According to Fellow (2000), the texture of flake products that are considered is crisp, where the product is easily broken and consistent in the first bite. According to Kusumadewi (2010), the texture of a dry product is influenced by the water content bound in the carbohydrate matrix.

Determination of Selected Products from Fish Cereals

Determination of the selected formulation was carried out using the Bayes method, as can be seen in Table 7. The first step taken was to determine the weight of each objective parameter (albumin, protein, fracturability, hardness, water content, colour, fat content, ash content, carbohydrate content, crude fibre), as well as subjective parameters (appearance, colour, aroma, texture, and taste). The weighting is based on the importance value of each cereal parameter. The importance value ranges from 1–3, with specifications of 1 representing expected value, 2 representing important value, and 3

International Journal of Multi Discipline Science
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e-ISSN: 2615-1707. Page: 142-155

representing very important value. The results of determining the selected formulations of toman cereal products using the Bayes method were A2 treatment with 30% albumin extract added to toman fish cereal products. The selected formulations from the Bayes method analysis have organoleptic, physical, and chemical product characteristics, as seen in Table 8.

Table 7
Best Treatment Calculation Results with the Bayes Method

Parameter		Parameter Weight	Ranking of Each Treatment					The Weight of Each Treatment				
			A1	A2	A3	A4	A5	A1	A2	A3	A4	A5
Objective	Albumin Content	0.09	2	3	4	1	5	0.182	0.273	0,.364	0.091	0.455
	Protein Content	0.09	1	3	2	4	5	0.091	0.273	0.182	0.364	0.455
	Fracturability	0.09	3	5	2	4	1	0.273	0.455	0.182	0.364	0.091
	Hardness	0.09	1	5	2	4	3	0.091	0.455	0.182	0.364	0.273
	Water Content	0.06	5	4	1	3	2	0.303	0.242	0.061	0.182	0.121
	Colour Analysis	0.06	5	3	1	2	4	0.303	0.182	0.061	0.121	0.242
	Fat Content	0.06	1	2	4	5	3	0.061	0.121	0.242	0.303	0.182
	Ash Content	0.03	5	1	2	4	3	0.147	0.029	0.059	0.118	0.088
	Carbohydrate Content	0.03	1	2	5	4	3	0.030	0.061	0.152	0.121	0.091
	Crude Fiber Content	0.03	4	3	2	1	5	0.121	0.091	0.061	0.030	0.152
subjective	appearance	0.06	5	4	3	1	2	0.303	0.242	0.182	0.061	0.121
	Colour	0.09	5	4	2	3	3	0.455	0.364	0.182	0.273	0.273
	aroma	0.06	5	4	3	4	2	0.303	0.242	0.182	0.242	0.121
	Taste	0.09	5	3	4	5	2	0.455	0.273	0.364	0.455	0.182
	Texture	0.09	5	3	2	4	1	0.455	0.273	0.182	0.364	0.091
	Total Value Rating							**3.5712**	**3.5751**	**2.6355**	**3.4513**	**2.9374**

Table 8
Test Results for Selected Formulations Treatment A2

Test Criteria	SNI-01-4270-1996 Cereal Milk	Selected Formulations
Albumin content	-	5.25
Protein content	At a minimum of 5%	12.81
Fat Content	At a minimum of 7.0%	1.34
Water Content	Maximum 3.0%	7.06
Ash Content	Maximum 4.0%	5.34
Carbohydrate Content	Maximum 60.0%	73.45
Crude Fiber Content	Maximum 0.7%	1.79
Fracturability	-	1740.9
Hardness	-	1420.5
Hue value	-	72.74
appearance	-	5.40
color	-	5.20
Aroma	-	5.73
Taste	-	5.00
Texture	-	5.46

CONCLUSIONS

The research results concluded that the best toman fish cereal formula with the A2 formulation can be used as a functional food based on organoleptic characteristics, chemical characteristics and physical properties.

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