

# Evaluation of the Quality of Canned Mackerel “Arsik” during Storage

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**Keywords:** Canning, Fish Shade Soup, Mackerel.

**Abstract:** Arsik is a traditional Batak dish in North Sumatera which is made from fish with a mixture of traditional spices and has a low shelf life. In this research, an innovation was carried out to produce mackerel arsik with a long shelf life by packaging it in cans. This research aims to study the effect of spices addition in different percentage (10, 20, and 30%) on the quality of mackerel fish arsik in cans during storage (1, 2, 3, and 4 weeks). The results showed that during storage the amount of spices added had a significant effect ( $p < 0.05$ ) on moisture content, fat content, protein content, color hedonic value, and color index of canned mackerel fish, however, there was no significant effect ( $p > 0.05$ ) on pH, hedonic value of aroma, taste, and texture. The amount of spices as much as 20% produces mackerel arsik with acceptable quality for 4 weeks of storage. There was no mold growth, gas formation, and can inflation for 4 weeks of storage, which indicates that the mackerel arsik product in tin packaging is still acceptable and safe. Canned mackerel fish arsik have become food creations with a longer shelf life.

## 1 INTRODUCTION

Arsik is one of the traditional Batak foods especially from the Batak Toba community in Toba Samosir and North Tapanuli area, North Sumatra. Generally, arsik dishes are made from goldfish. In arsik making, goldfish usually are not discarded scales, but only by cleaning some of the fish guts. Goldfish are freshwater fish that contain nutrients such as protein which are lower than sea water fish. Goldfish also has a low content of omega 3 fatty acids. Therefore, in this study, mackerel fish was used to replace goldfish in making arsik soup. The advantage of mackerel compared to goldfish is that it is easily available in the market, rich in long-chain polyunsaturated fatty acids such as omega 3 fatty acids, a source of selenium and minerals, high protein, and a source of vitamins B12.

In its processing, arsik soup uses traditional spices consisting of various types of spices such as andaliman, red onion, garlic, red chilies, cayenne pepper, lemongrass, galannut, ginger, turmeric, chives, hazelnut, salt, lime leaves, water, and cikala acid. On the other hand, the process of making mackerel fish arsik takes a long time and requires a lot of energy. The shelf life of goldfish arsik soup is

also short, and it must be consumed immediately after cooking. Changes in lifestyle that want food products that are completely instantaneous, require the need for innovation of arsik soup that is packaged in cans, so that it has a long shelf life, and can be used as a ready to eat product.

Food canning is a type of food preservation procedures using airtight closed packaging and heating it to kill pathogenic microorganisms that cause decay and spores, and deactivate enzymes that can damage quality (Sholihah, 2011). Canning technology can maintain product shelf life of more than six months (Hariyadi et al., 2006). Canning is usually carried out at a sterilization temperature of 121°C for 15 minutes or for a certain time, where the heat given is enough to destroy pathogenic bacteria but does not reduce the nutritional and organoleptic quality of canned food (Nurhikmat, et al., 2016).

The purpose of this study was to evaluate the effect of the amount of seasoning added on the microbiological, physical, chemical, and sensory characteristics of mackerel arsik soup during storage and to obtain the best quality and acceptable formulation of mackerel arsik soup by consumers.

Table 1: Arsik seasoning formulation.

Material *	Treatment (%)		
	10%	20%	30%
Andaliman	4	8	12
Onion	20	40	60
Garlic	15	30	45
Red Chili Peppers	10	20	30
Cayenne Pepper	8	16	24
Lemongrass	4	8	12
Galangal	4	8	12
Ginger	4	8	12
Turmeric	4	8	12
Lokio	6	12	18
Pecan	14	28	42
Cikala Acid	2	4	6
Orange Leaves	5	10	15

\*) The amount of material expressed in g

## 2 MATERIALS AND METHOD

### 2.1 Research Materials

The main ingredient used in this study was mackerel fish (*Rastrelliger*) obtained from “Tempat Pelelangan Ikan (TPI) Percut District, Deli Serdang Regency, North Sumatera Province. The seasoning ingredient used in making arsik soup consists of andaliman, onion, garlic, red chili, cayenne pepper, lemongrass, galancque, ginger, turmeric, lokio (Batak onion), pecans, salt, orange leaves, water, and *cikala* acid. All of these seasonings were obtained from the traditional market in Medan.

### 2.2 Arsik Seasoning Formulation

The formulation of arsik seasoning used based on the 1 kg weight of mackerel fish can be seen in Table 1. The marinade was made by mshing all the ingredients except *cikala* acid and orange leaves using a blender until the smooth spice was obtained.

### 2.3 Arsik Soup Making

Each fish from 1 kg mackerel fish was cut into 4 pieces, while the head and tail parts were removed, then washed cleanly up to 3 times washing. The arsik seasoning was added as much as 10%, 20%, 30% based on the weight of mackerel fish. The fish and seasoning mixture were cooked using a pan that has contained 1 L of water for 45 minutes on medium heat. The addition of salt is done as much as 14,5 g to 1 kg of fish which aims to improve the taste.

### 2.4 The Canning Process of Arsik Soup

#### 2.4.1 Washing and Sterilization of Cans

Cans material used for fish arsik soup packaging is a tinplate type with a size of 205 x 301 mm and completed with a hand-opened tinplate (pop up model). The inside of the can is coated with a special layer of food grade lacquer that is resistant to bases and corrosion. Before use, all cans and lids are washed using running water and then sterilized at 121°C for 15 minutes.

#### 2.4.2 Filling Arsik into Cans

The fish is arranged in such a way that it is not too dense, then the broth of arsik soup is added. The can is filled up to 1-2 cm from the surface of the can, to provide head space.

#### 2.4.3 Timing of Optimum Sterilization with the Improved General Formula

To prevent overprocess and underprocess, optimum sterilization time calculation is performed for canning mackerel arsik soup. The sterilization time is calculated from the area below the curve on the semilogarithmic paper. The shape of the area below the curve is considered trapezoidal. To calculate the area of the trapezoid, the area below the curve is divided into a number of parallelograms at a specific time interval ( $\Delta t$ ). Then each is calculated by the trapezoidal area formula so that it gets the lethal rate (LR) and partial sterility (partial  $F_0$ ) on the  $\Delta t$ . Each partial  $F_0$  is summed up. The result shows the total

sterility value (minutes) of the process that has been performed.

#### **2.4.4 Canning Arsik Soup in Canned Packaging at a Time of the Process**

Based on the results of the heat penetration test, the heat adequacy ( $F_0$ ) value for each spice formulation used can be calculated, namely 10%, 20%, and 30%. The sterilization process is carried out based on the  $F_0$  value of each spice formulation. Before being sterilized, the product is exhausted for 20 minutes at a temperature of 90°C, which aims to remove water vapor that is still in the headspace area so that the state of the can when sterilized becomes a vacuum. The can containing product is then closed using a double seamer. It works by packing the cans twice so that the possibility of the tin leak is minimized. The sterilization process was carried out at a temperature of 121°C for 60 minutes using an autoclave.

#### **2.4.5 Cooling**

The can is removed from the autoclave and cooled immediately by draining the can with running water.

#### **2.4.6 Packing**

Packing is carried out for one week by placing the can in an inverted position at room temperature (25° – 30°C) to determine the leakage of the can (SNI 01-3548-1994). Then the can is arranged in an upright position.

### **2.5 Evaluation of the Physical, Chemical, and Sensory Quality of Canned Mackerel Arsik Soup**

The physical, chemical, and sensory quality of canned mackerel arsik soup were observed weekly for 4 weeks (1 month) against visual quality parameters, pH by using pH meter (AZ pH meter), moisture content, protein by micro kjeldahl method, fat by Soxhlet method. and antioxidant activity by.

A sensory evaluation was also conducted to evaluate color, aroma, taste, and texture of mackerel arsik soup. Panelists evaluated samples on 5 point of hedonic scale quality analysis with 5=liked very much, 4 = liked, 3=neither liked nor disliked, 2 =disliked, 1=disliked very much

### **2.6 Selection of the Best Mackerel Arsik Soup**

Selection of the addition of spices treatment that produces mackerel arsik soup with the best quality is based on all observed quality parameters. The best quality mackerel arsik soup is then analyzed for its omega-3 fatty acid levels using method.

### **2.7 Data Analysis**

The research was conducted by using a Complete Randomized Design (RAL) with two factors namely the addition of arsik seasoning (10%, 20%, and 30%) and storage time (weeks 1, 2, 3, and 4 weeks).

## **3 RESULTS AND DISCUSSIONS**

### **3.1 Visual Observation of Mackerel Fish Arsik Soup**

The shelf life of canned mackerel soup was seen based on the visual acceptance test for 4 weeks of storage (Table 1). Arini (2015) shows that there are several indicators that indicate that food products especially canned food are damaged, such as discoloration, inflated cans, and changes in odors. In the product of canned mackerel arsik soup, the damage of the product is referred to the growth of the fish, inflated of can lid, and the presence of gas bubble.

Table 1 shows that during 4 weeks of storage there has been no change of mackerel arsik soup at all levels of the addition of spices. This is because the heat treatment given during the sterilization process is sufficient to kill all types of microorganisms, including *Clostridium botulinum* (Hariyadi, 2019). In addition, the cans used as packaging materials are hermetic so that the oxygen demand for aerobic microbial growth is not available.

### **3.2 Degree of Acidity (pH)**

Based on figure 1, it is found that the more spices would make the pH tends to decrease, but if the store too long it could be make the pH of canned fish arsik soup is increase relatively. The low pH made soup of canned fish is durable because spoilage microbes can not grow. The high PH of canned fish would made different of smell, color and texture. This is appropriate with Suradi (2012) who stated that a higher pH will experience protein decomposition faster, which causes changes in color, aroma, and

Table 2: The effect of seasoning addition on the shelf life of mackerel arsik soup during 4 weeks storage.

Product Damage Indicator	Seasoning Addition (%)	Storage Time (week)			
		1	2	3	4
Growth Mold	10	-	-	-	-
	20	-	-	-	-
	30	-	-	-	-
Inflated Lid Can	10	-	-	-	-
	20	-	-	-	-
	30	-	-	-	-
Gas Bubble	10	-	-	-	-
	20	-	-	-	-
	30	-	-	-	-

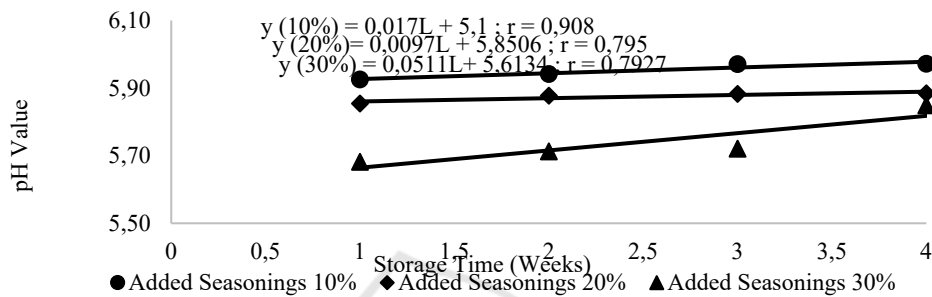


Figure 1: The effect of interaction effect in adding spices and storage time on the pH of canned fish arsik soup.

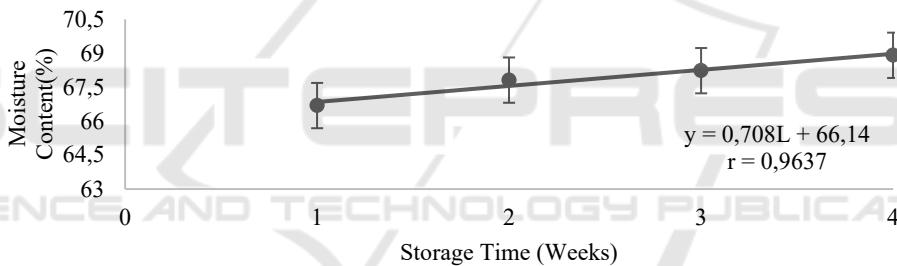


Figure 2: The main effect in storage time on the moisture content of canned fish arsik soup.

texture. In other words, interaction effect in adding spices and storage time on pH can be seen in Figure 1.

### 3.3 Moisture Content

The results showed that the addition of seasoning and the interaction of seasoning addition and storage length had an unreal different influence ( $P > 0.05$ ) on moisture content. Storage length exerts a very noticeable different influence ( $P < 0.01$ ) on moisture content. The main effect of storage time on the moisture content of canned fish arsik soup can be seen in Figure 2.

Figure 2 explained that the average score of water degree of fish of canned mackerel on storage of one week is 66.6964%. The average scores of water degree of canned mackerel is 67.8112%. On storage in 3 weeks is 68.2385% and the average score of water degree on storage in 4 weeks is 68.9173%. It

shows that the longer of storage time make the amount of air from the canned mackerel soup product is increase along with the storage time. It caused the decomposition of protein or fat in fish meat during storage which make the water of degree is increase. Based on figure 3 is found that in adding spices with percentage of 20% could be reduce of protein degrees on canned fish arsik soup. It Couused, the high of water degree of canned fish arsik soup could be reduce the protein degree. Reducing the water degree is caused the water that found on product that make interact of maillard during fastly.

Based on Figure 4, it is known that the longer of store make the degree of protein will be reduced. This is appropriate with the literature of Sinaga (2010) which states that protein changes in properties after experiencing certain treatments, although it is very little or light and has not caused the breakdown of covalent or peptide bonds.

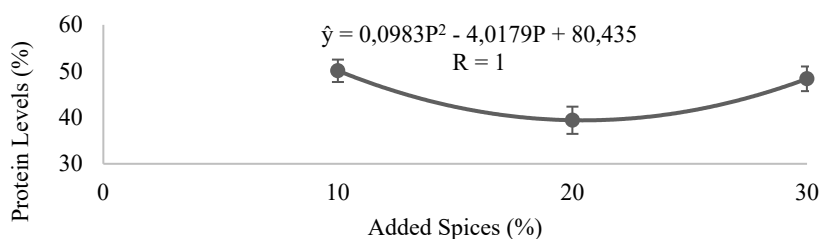


Figure 3: The main effect in adding spices on the protein levels of canned fish arsik soup.

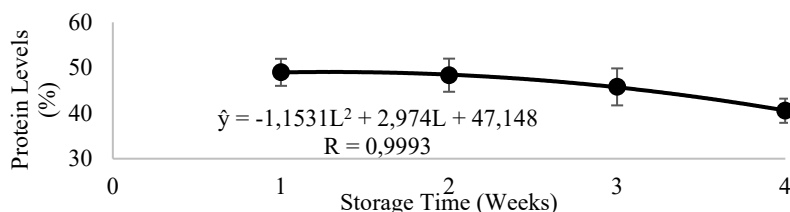


Figure 4: The main effect in storage time on the protein levels of canned fish arsik soup.

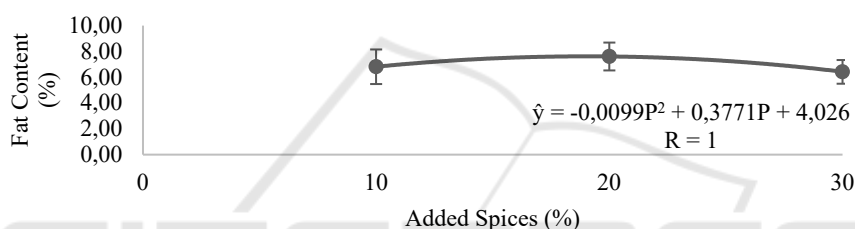


Figure 5: The main effect in added spices on the fat content of canned fish arsik soup.

### 3.4 Fat Content

The results showed that the interaction of seasoning addition and storage length had an unreal different influence ( $P > 0.05$ ) on fat levels. The addition of seasoning and length of storage gives a very noticeable different influence ( $P < 0.01$ ) on fat content. The main effect in adding spices of fat content on canned fish arsik soup can be seen in Figure 5.

Based on Figure 5 shows that in adding of spices with a higher amount can reduce the fat degree of canned mackerel soup. This is due in adding of spices which causes the protein degree of canned mackerel soup is increase. Soeparno (2009) explains that protein degree has an inverse relationship with fat degree. That the smaller protein degree has a greater fat degree and vice versa.

Based on Figure 5, it is found that the longer of store, the fat degree of canned mackerel soup will be decrease. This is due to the hydrolysis of fat.

The higher the hydrolysis rate, the lower or lower the omega-3 fatty acid levels in canned mackerel soup that were stored for a longer period of time. Raharja, et al (2011) stated that the hydrolysis rate that occurs is related to the omega 3 fatty acids produced.

### 3.5 Organoleptic Value

#### 3.5.1 Color Hedonic Value

The results of the variety fingerprint show that the interaction of seasoning addition and storage length exerts an unreal different influence ( $P > 0.05$ ) on the hedonic value of a color. The addition of seasoning and storage length gives a very noticeable different influence ( $P < 0.01$ ) on the hedonic value of the color. The main effect in adding spices of color hedonic value on canned fish arsik soup can be seen in Figure 7.

From Figure 7, it is found that the color hedonic value will be increase due to the amount of spices or acids added that make the resulting color is brighter. Based on Figure 8, it is found that if the longer of store, the hedonic value of canned fish soup will be decrease.

This is because while during storage, there was a change in the components of canned fish arsik soup due to a faster maillard reaction triggered by high water degree.

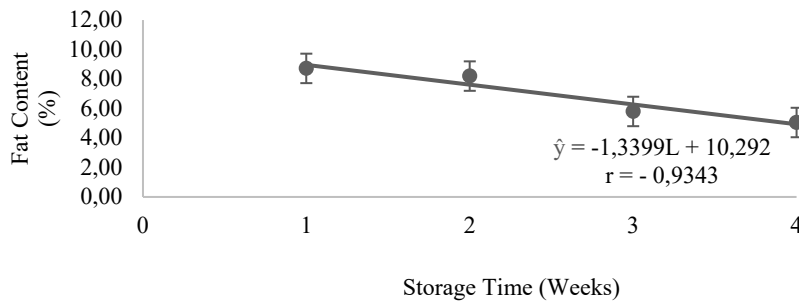


Figure 6: The main effect in storage time on the fat content of canned fish arsik soup.

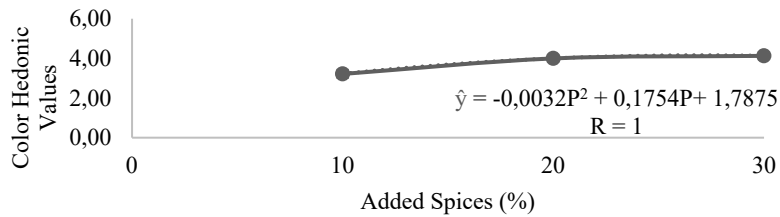


Figure 7: The main effect in added spices on the color hedonic value of canned fish arsik soup.

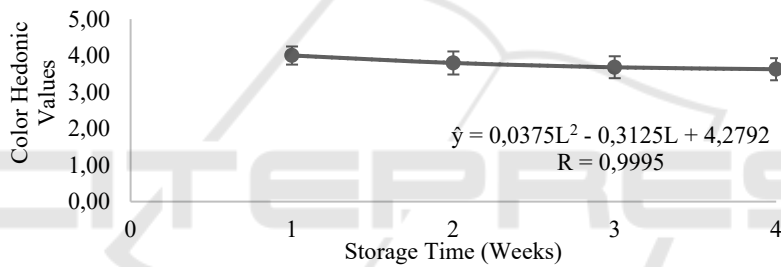


Figure 8: The main effect in storage time on the color hedonic value of canned fish arsik soup.

### 3.5.2 Aroma Hedonic Values

The results showed that the interaction of seasoning addition and storage length exerted an unreal different influence ( $P > 0.05$ ) on the hedonic value of the aroma. The addition of seasoning and length of storage gives a very noticeable different influence ( $P < 0.01$ ) on the hedonic value of the aroma. The main effect in adding spices of aroma hedonic value on canned fish arsik soup can be seen in Figure 9.

From Figure 9, it is found that the hedonic aroma will be increase due to the number of spices added that make the aroma result is stronger.

From Figure 10, the longer of store make the aroma value is decrease. Canned mackerel soup with a storage of four weeks obtained the lowest value compared to canned mackerel soup with a storage of one to 3 weeks. Changes or smell irregularities occurred to protein decomposition by proteolytic enzymes.

### 3.5.3 Taste Hedonic Values

The results showed that the interaction of seasoning addition and storage length exerted an unreal different influence ( $P > 0.05$ ) on the hedonic value of the taste. The addition of seasoning and storage length gives a very noticeable different influence ( $P < 0.01$ ) on the hedonic value of the taste. The main effect in adding spices of taste hedonic value on canned fish arsik soup can be seen in Figure 11.

From Figure 11, it is found that the highest hedonic taste value is found in the spice percentage 20% because the higher the concentration of seasoning added the taste will become acidic so that the panelists do not like because of the panelists.

Based on Figure 12, it is found that the longer the storage, the more likely the panelist's favorite value will decrease. This is influenced by the loss of organic acid components in the canned fish arsik soup so that the panelists' fondness goes down. The loss of these organic acids is compounded by the decomposition of proteins by proteolytic enzymes so that  $H^+$  ions or





Figure 9: The main effect in added spices on the aroma hedonic value of canned fish arsik soup.

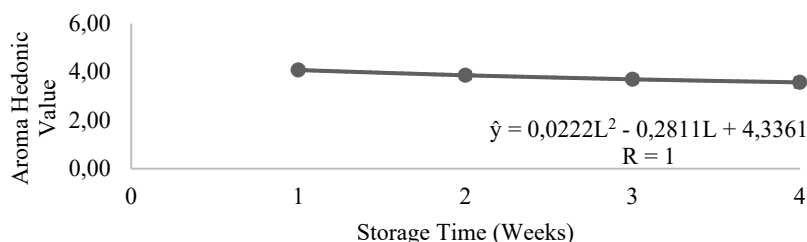


Figure 10: The main effect in storage time on the aroma hedonic value of canned fish arsik soup.

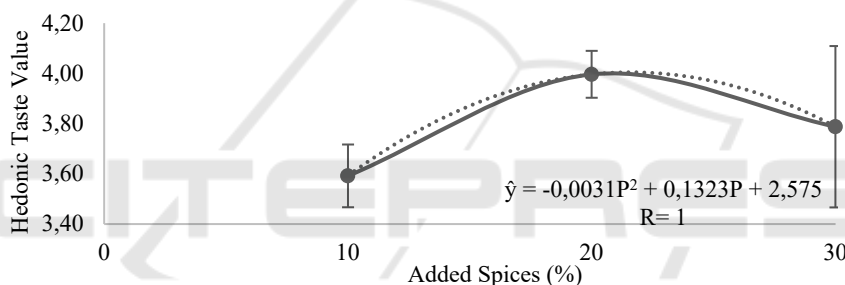


Figure 11: The main effect in added spices on the taste hedonic value of canned fish arsik soup.

acid components are lost or reduced replaced by alkaline compounds such as ammonia (NH<sub>3</sub>). This is by Hadiwiyoto (1993) which says that the decrease in the taste of foodstuff is caused by the decomposition of proteins, fats, and carbohydrates due to enzymatic reactions.

### 3.5.4 Texture Hedonic Values

The results showed that the interaction of seasoning addition and storage length exerted an unreal different influence ( $P > 0.05$ ) on the hedonic value of the texture. The addition of seasoning and storage length gives a very noticeable different influence ( $P < 0.01$ ) on the hedonic value of the texture. The main effect in adding spices of texture hedonic value on canned fish arsik soup can be seen in Figure 13.

From Figure 13, it is found that the hedonic value of the texture will be increase due to the increasing number of spices added that make the spices soak into the fish meat which causes the texture of the fish is harder. This is because the protein in the fish soup is

coagulated and the evaporation of water in the product is getting bigger due to the high temperature and cooking time of the canned fish soup. This is in accordance to Sundari, et al. (2015) who said that heating proteins at high temperatures can cause denaturation, loss of enzyme activity, color change, cross-linking, and breaking of peptide bonds.

From Figure 14, the longer of texture is stored in the first week until the fourth that make the value is decrease. This is caused by the high activity of water for food that make the texture becomes soft due to the liquid in the product evaporating a lot (dehydration). According to Rachmat et al (2015), it is shown that the longer it is stored, the texture value will decrease due to the activity of water in foodstuffs.

### 3.6 Antioxidant Activity (IC<sub>50</sub>)

The interaction effect in adding spices and storage time on the antioxidant activity of canned fish arsik soup can be seen in Figure 15.

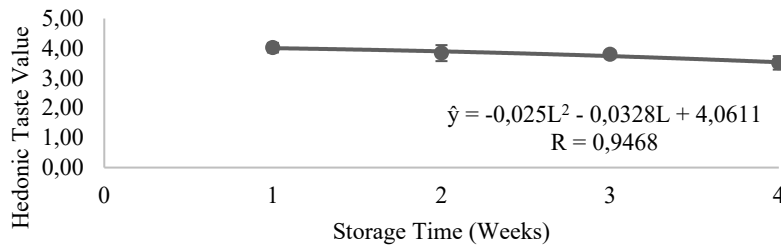


Figure 12: The main effect in storage time on the taste hedonic value of canned fish arsik soup.

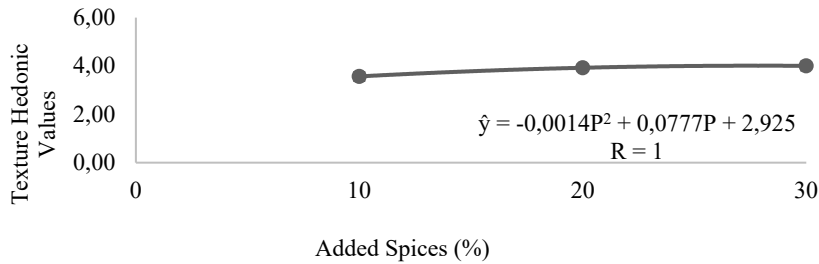


Figure 13: The main effect in added spices on the taste hedonic value of canned fish arsik soup.

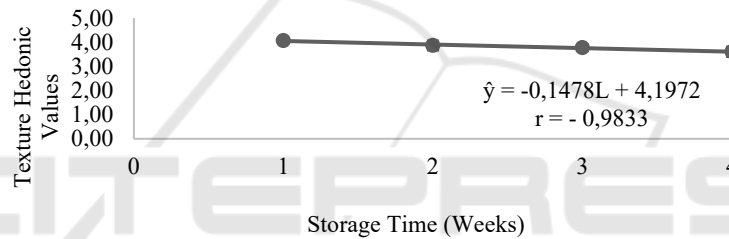


Figure 14: The main effect in storage time on the texture hedonic value of canned fish arsik soup.

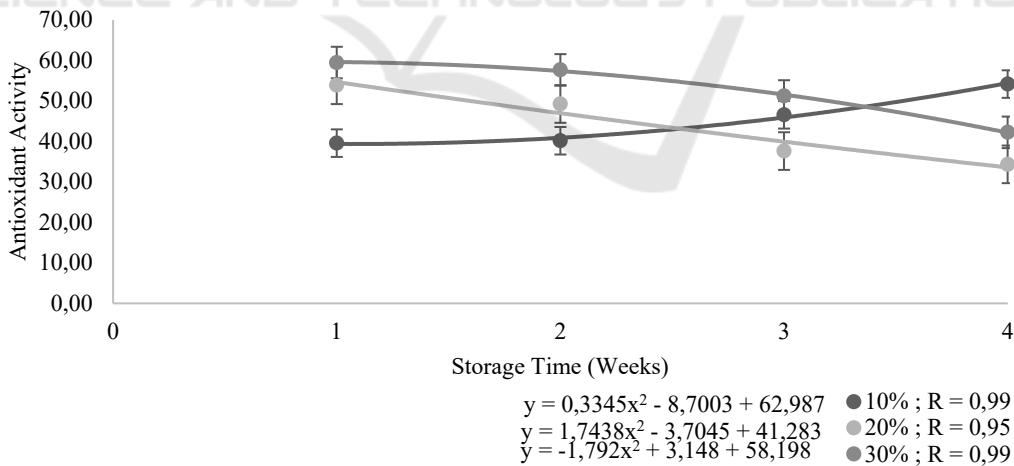


Figure 15: The interaction effect in added spices and storage time on the antioxidant activity of canned fish arsik soup.

In Figure 15, the addition of 20% and 30% spices reduces IC50 or in other words, the antioxidant activity is increase. This is because arsik spices are a source of antioxidants that contain phenolic compounds (andaliman and cikala acid), beta-carotene (turmeric), etc. However, the addition of 10% spices

is increased IC50 or in other words, the antioxidant activity decreased along with the length of storage. This is because the antioxidant activity is easily damaged by high temperatures because antioxidant compounds such as phenolic the compounds are oxidized during heating at high temperatures. This



condition is because antioxidants are compounds that susceptible to damage due to several factors such as light and oxygen that make the percentage value of antioxidant activity is decrease with storage time (Winarsi, 2007). The results of this study indicated that although there was a decrease in the antioxidant activity of canned fish arsic soup, the antioxidant activity was still active and included in the moderate category. Muharni, et al., (2013) stated that based on the standard level of antioxidant activity, compounds that are in the active / moderate category if they have an IC50 value of 10-100 µg / ml.

### 3.7 Omega 3 Fatty Acid

Based on the results of the analysis concluded that the omega-3 value of canned mackerel arsic soup was 4.52 g / 100 g fish. When the value of omega-3 from the original product by 0.48 g from 5 g / 100 g of mackerel is decreased. This is due to the destruction of omega-3s due to heating at high temperatures used such as cooking and sterilization. Sumartini, et al (2014) said that omega-3 fatty acids are very easily damaged due to high temperatures.

## 4 CONCLUSIONS

Fish arsic soup is become a food creation that has a longer duration about 1 month. Completely randomized design (CRD) in this study are used two factors, namely the addition of arsic spices (10%, 20% and 30%) and storage time (weeks 1, 2, 3 and 4 weeks). The addition of different spices is giving the preparation of mackerel parsley soup very significant effect ( $P < 0.01$ ) on pH, protein degree, and organoleptics (color, aroma, taste, and texture) of canned fish soup. Storage time is giving a very significant effect ( $P < 0.01$ ) on pH, moisture degree, protein degree, fat degree, and organoleptics (color, aroma, taste, and texture) of mackerel soup. The interaction between the addition of spices and storage time are only a very significant effect ( $P < 0.01$ ) on pH but did not have a significant effect ( $p > 0.05$ ) on the quality parameters of other mackerel soup. The final result showed that the addition of 30% spices can maintain the quality of mackerel arsic soup for 4 weeks of storage.

## ACKNOWLEDGEMENTS

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