JPPIPA 8(6) (2022)

Jurnal Penelitian Pendidikan IPA

Journal of Research in Science Education

http://jppipa.unram.ac.id/index.php/jppipa/index

The Pindang Fish Quality is Based on Physical, Chemical, and Biological Parameters

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Received: November 9, 2022
Revised: December 21, 2022
Accepted: December 24, 2022
Published: December 31, 2022

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DOI: 10.29303/jppipa.v8i6.2416

Abstract: Processing of fish products is mostly done by refining. However, spinning also has drawbacks, namely low durability and ease to rot. The purpose of the research was to test the quality of pindang fish physically, chemically, and biologically in the city of Tulungagung. The research method used is descriptive qualitative by testing the quality of pindang fish physically, chemically, and biologically. The results showed that physically pindang fish samples A and B were suitable for consumption with a value of more than 7. Chemical tests showed that samples A and B were safe for consumption when viewed from the content of salt, formalin, lead (Pb), tin (Sn), chromium (Cr), and mercury (Hg) which are all below the SNI standard. However, it should be noted that the content of water, cadmium (Cd), and arsenic (As) exceeds SNI. Biological tests showed the content of Escherichia coli, Salmonella spp. Staphylococcus aureus and Vibrio cholerae are all under the SNI, but there is one indicator, namely the Total Plate Number (ALT) which exceeds the SNI standard. Pindang fish found in the city of Tulungagung is suitable for consumption based on the results of physical, chemical, and biological tests.

Keywords: Quality; Pindang; Physical; Chemical; Biological

Introduction

Fish is one of the proteins so a source for people in Indonesia (Hidayat et al., 2020). In 2019, there was a 54.49% enhancement in fish consumption at all levels of society. Bear in mind the high protein content found in fish, many people choose fish as a food ingredient for consumption. Fish is also beneficial for health, the meat is soft, easy to process, and the price is cheap (Sitiopan, 2012). Some of the processing fish for consumption include drying, roasting, and other preparations. Most of the processing is done by making pindang. The fish that are processed into pindang are varied, both freshwater fish and sea fish. In 2017, the number of fishing businesses reached 11.561 units, the second rank only from the salted fish (Kementerian Kelautan dan Perikanan, 2018; Widria, 2019). The market demand for pindang fish is increasing day by day (Sipahutar et al., 2020).

Pindang fish is fish that is processed by boiling fresh fish with salt (Setiani et al., 2019). The making pindang process includes this traditional processing (Adrian, 2013). Making pindang is a very popular fish preservation process because it is simple with the need for expensive tools, the results can also be consumed directly, it has a taste that is in accord yes with the local community, and the protein content inside is also high (Hamzah et al., 2015). However, the making *pindang* process has also some drawbacks, namely low durability, so the time from transfer to consumption takes a short time, not too long. Pindang fish that has good quality is the process is done in a good, correct way (Sipahutar, 2021). Lubis et al. (2019) states that one of the important points of fishing ports, besides providing wet fish for consumption needs, should also provide wet fish for the needs of the processing industry around the port.

Indonesia is a maritime country, which a has 95,181 km coastline. One of the coastlines included in the Tulungagung area is 61.470 km within the Fisheries Management Area of the Republic of Indonesia (WPP-RI) 573. Tulungagung has a total fish resource potential (SDI) of 491,700 tons/year (Department of Marine Affairs and Fisheries of Tulungagung Regency—Dinas Kelautan dan Perikanan Kabupaten Tulungagung,

How to Cite:
Setyowati, E., & Agustin, H.Y. (2022). The Pindang Fish Quality is Based on Physical, Chemical, and Biological Parameters. *Jurnal Penelitian Pendidikan IPA*, *8*(6), 2764–2771. https://doi.org/10.29303/jppipa.v8i6.2416

2020). Some types of fish that are often caught in Tulungagung are *teropong* fish, mackarel tuna, salmon, mackerelmackerelnd mackerel. Many types of fish are caught in three fishing ports (PPI) in Tulungagung and its surroundings, namely PPI Popoh, PPI Sine, and PPI Prigi. The results of observations from the processing industry confirm that the type of pindang fish that is preferred by the community is the teropong fish because its size is not too big and it tastes delicious. Pindang fish processing activities in Tulungagung are centered in Pakel, Bandung, Campurdarat, and Boyolangu districts, which are then distributed to markets in the whole Tulungagung region.

According to the observations, two markets were chosen, namely, the Ngemplak market represents *pindang* fish from PPI Prigi, and the Ngentrong market represents *pindang* fish from PPI Popoh. Keep in mind that pindang fish findings to decompose, and while the process of making *pindang* and then distributing it to the market takes a long time, it is possible for producers to producers canaddingg fish. One material that is often used to preserve is formalin. Many manufacturers or sellers abuse this formaldehyde as a food preservative. According to Setyowati et al. (2020), each PPI has a different formalin content, because in general fishermen have never or still few who have attended education from BPOM related to food processing and arrangement.

In Semarang, there are 13.64 is there are 13.64% of samples of pindang fish from traditional markets and 18.18% of samples of pindang fish from modern markets contain formalin (Sitiopan, 2012). In general, the provision of formalin is because *pindang* fish are not sold out immediately and the public are lack knowledge about formalin. Besides formalin content, the next quality of processed fish to notice is its chemical content, heavy metal, and microbiological content. Bear in mind that *pindang* fish are sourced from the sea, so heavy metal content may still be present inside pindang fish.

Based on Indonesian National Standard (SNI) (2017) regarding pindang fish findings is a maximum limit for chemical content, heavy metal contamination, and microbial contamination that are still tolerable in pindang fish. If the content inside pindang fish exceeds the limits set by SNI 2717: 2017, it needs to be aware and take some action for the process of making pindang. The entry of heavy metals into the waters will reduce the quality of the water. Chemicals that are deposited in sediment-water will cause the transfer of toxic chemicals from sediments into an organism (Permanawati et al., 2013). Further effects of metal contamination will not only harm marine biota or organisms, but if marine organisms are consumed by humans or other animals, it will also harm humans and other animals. Pollutants are accumulative, so they can cause chronic disease.

High microbial contamination can also interfere with human health, namely lowering the immune system and disrupting digestion. It is very important to test this microbial contamination before the product is consumed by the public (Sulistiani and Hafiludin, 2022). Several previous research results also found pindang fish containing microbial contamination exceeding the limits set by SNI (Putra et al., 2019; Masrifah et al., 2015; Junianingsih, 2015; Setyowati et al., 2020). Kusumaningsih & Diaris (2021) also confirmed that there were seven samples of pindang fish that still contained the bacteria *Bacillus cereus*, *Vibrio alginolyticus*, *Serratia nematodiphila*, *Enterobacter cloacae*, *Shewanella seohaensis*, and *Staphylococcus sciuri*. These bacteria have the potential to be pathogenic for humans. Based on the explanation above, it is necessary to test the quality of pindang fish in Tulungagung, both from physical, chemical, and biological parameters.

Method

This study a implements qualitative approach with a descriptive type of research, to test the quality of pindang fish in the Tulungagung area, according to physical, chemical, and biological parameter tests. The research material was pindang fish by the type of teropong fish taken from the Ngemplak market (sample A, fish from PPI Prigi) and Ngentrong market (sample B, fish from PPI Popoh). The selected beaches were based on the consideration that the two beaches are beaches where fish are mostly traded in Tulungagung markets. The two beaches are major fishing centers (PPI) in Tulungagung and Trenggalek. The market that was sampled was taken by purposive sampling (deliberately) with the consideration of a large-scale market. The weight of pindang fish is approximately 1000 grams (according to the needs of the test). The tools used in this study were aluminum foil paper and a refrigerator.

In testing the quality of pindang fish, there are three parameters tested, namely physical, chemical, and biological parameters. The quality test of pindang fish with physical parameters includes sensory/organoleptic tests, seen by appearance, texture, smell, color, and mucus. Chemical parameters include water content, salt content, formaldehyde content, cadmium (Cd), lead (Pb), tin (Sn), arsenic (As), chromium (Cr), and mercury (Hg). Biological parameters (microbial contamination) include Total Plate Number (ALT), *Escherichia coli, Salmonella spp, Vibrio cholerae,* and *Staphylococcus aureus*. This test was carried out at the Angler Biochemlab Surabaya Laboratory. The test results are then checked against the quality standard criteria from SNI and BPOM.

The method of testing the quality of pindang fish is as follows, Physical content test is conducted by

organoleptic/sensory which includes appearance, smell, taste, texture, and mucus. The salt content test used the 5.4/IK/2/2.20.12.1 (Titrimetry) method. The water content test used the SNI 01-2891-1992 point 5.1 method. The formalin content test used the 5.4/IK/2/2.9.1.1 method (Spectrophotometry). The content of cadmium (Cd), lead (Pb), tin (Sn), arsenic (As), chromium (Cr), and mercury (Hg) using the BAM chapter 4, 2020 method. The *Escherichia coli* content test used the 5.4/IK/2/3/2 (Real Time qPCR) method. The *Salmonella spp.* The content test used the 5.4/IK/2/3/2 (Real Time qPCR) method. The *Staphylococcus aureus* content test used the ISO 6888-1:1999/Amd.2:2018 method. The Total Plate Count test used the BAM chapter 3, 2001 method. The *Vibrio cholerae* content test used the 5.4/IK/2/3/8.2 (Real Time qPCR) method.

Result and Discussion

The Pindang Fish Quality Based on Physical Parameter

Pindang fish that will be tested physically or organoleptically are sample A and Sample B. Physical parameter testing includes appearance, smell, taste, texture, and mucus. Physical parameter test is done by organoleptic or sensory. Sensory is a method for measuring, interpreting, and analyzing what is felt through the human senses, both objectively and subjectively (Tarwedah, 2017). In this study, subjective sensory testing was used by the panelists. There was 10 panelists/respon10 panelists/respondents perimeter test. The results of the physical parameter test of pindang fish are listed in Table 1.

Based on Table 1, shows that physically, both sample A and sample B are appropriate for consumption with values in all specifications of more than 7. By then, according to all physical parameters, pindang fish A and B are suitable for consumption. The first parameter test is appearance. The appearance of a product is important to see because consumers will consider what it looks like on the product. Consumers usually assume that a good appearance tends to have better taste and high, and good quality (Hidayat et al., 2020). Based on the results of the study, the average appearance score for Pindang fish sample A was 8.4, and for Pindang fish sample B was 8.6. When compared with SNI which states that if the appearance has a value of more than 7, it is said that the appearance of the fish is suitable for consumptisuitableysical parameter is the smell. The smell is a person's response to a product as a result of the smell or aroma that enters the nasal cavity when breathing and inhaling it (Tarwedah, 2017). Aroma has a very important role in food because it can increase attractiveness (Anatra and Wartini, 2014). Based on the results of the study, it showed that the average score in sample A of pindang fish was 8.4 and that of sample B of pindang fish was 8.6. The results of the sensory smell test showed that the pindang fish in Tulungagung was in accordance with SNI and was fit for consumption.

Table 1. The Pindang fish quality based on the physical parameter

Specification	Score	Average (10 respondents)	
		A	B
Appearance			
Intact, clean, type-specific bright color	9		
Intact, clean, less bright color	7	8.4	8.6
Intact, clean / not clean, dim	5		
Smell			
Very fresh, type-specific fragrance	9	8.4	8.6
Fresh, less fragrant	7		
Starting to smell sour	5		
Taste			
Very tasty, savory, type-specific	9		
	7		
Delicious, not type-specifics on the tip of the tongue	5	8.4	8.4
Texture			
Very compact, unified	9		
Dense, less compact	7	7.9	8.2
Less dense, mushy	5		
Mucus			
Not slimy	9	9	9
Slimy	3		

The third physical parameter is taste. Taste is something that the mouth senses respond to. Taste is a chemical compound that affects the senses of the body, namely the tongue which senses taste. The tongue can only taste four tastes, namely salty, sweet, sour, and bitter. This taste can evoke a taste through the aroma or smell that is spread (Hidayat et al., 2020). This taste is a biological perception of the product after it enters the mouth (Midayanto & Yuwono, 2014). Based on the results of the study, the average taste score in sample A of pindang fish was 8.4 and in sample B of pindang fish was 8.4. When compared with SNI which states that if the taste has a value of more than 7, it is said that the taste of fish is good and fit for consumption. The fourth physical parameter is texture. The texture is a feature of a product that includes the shape, size, and amount that can be felt by the senses of touch and taste, as well as the sense of sight. (Midayanto & Yuwono, 2014). The texture of a product is a response from the sense of touch to physical stimuli during direct contact. The texture of food can be in the form of density, viscosity, and elasticity of the product (Meilgrad et al., 2006). The results showed that the average texture score in sample A of pindang fish was 7.9 and that of sample B of pindang fish was 8.2. When compared with SNI which

states that if the texture has a value of more than 7, it is said that the texture of the fish is good and appropriate for consumption.

The fifth physical parameter is mucus. A mucus is a secretion that is in the form of a sticky and slippery liquid. The results showed that the average score of mucus in sample A of pindang fish was 9 and that of sample B of pindang fish was 9. From the sensory test, the mucus of the pindang fish was not slimy. When compared with SNI which states that if the mucus specification has a value of more than 7, it is said that the fish is good and fit for consumption. The test results in Table 1, show that all the results of the parameter test indicate that the pindang fish in Tulungagung is in good condition and fit for consumption. However, to determine the suitability of pindang fish to be consumed, it is not enough only physical parameters, but also chemical and biological parameters must be tested. Usually, if the parameter test results show unfavorable conditions, then the pindang fish does not look fresh, smells bad (like a bad smell), has a soft texture, breaks easily, and is slimy. If the bad condition of pindang fish is consumed by humans, it will cause health problems to humans. Usually what often happens is diarrhea or stomach pain, or also causes itching on the skin. Damage to pindang fish from physical parameters is also affected because the water content is too high, so the fish becomes mushy and easy to rot because it contains many microorganisms.

The results of the physical parameter test are in line with research Masrifah et al. (2015), namely the organoleptic test results of the Cindy Group pindang milkfish are quite good, and are ready to be registered with the National Standards Agency, and include the SNI label on the packaging. The success of the processing process is strongly influenced by the level of freshness of fish as raw materials, the quality of salt, and environmental conditions (Pandit, 2016). As it is known that pindang fish contains high protein, vitamin A, minerals, and omega 3. If consumed properly and appropriately, it is very good for health. Pindang fish have several what are benefits, among others: as a source of animal protein, can launch the digestive system, because it contains fiber, helps diet programs, stabilizes high blood pressure, and can reduce strokes.

The Pindang Fish Quality Based on Chemical Parameter

Chemical parameter tests are tests to determine the water content, salt content, formaldehyde content, and heavy metal content of cadmium (Cd), lead (Pb), tin (Sn), arsenic (As), chromium (Cr), and mercury (Cr). The results of the chemical parameter test are shown in Table 2.

Table 2. The *Pindang* Fish Quality based on Chemical Parameter

Parameter Test	Unit	SNI	Result A	Result B
Salt content	%	Max 10	2.43	1.70
Water content	%	Max 60	67.4	68.9
Formalin	mg/kg	Max 35	Not Detected	Not Detected
Cadmium (Cd)	mg/kg	Max 0.1	0.094	0.122
Plumbum (Pb)	mg/kg	Max 0.5	Not Detected	Not Detected
Tin (Sn)	mg/kg	Max 0,2	Not Detected	Not Detected
Arsenic (As)	mg/kg	Max 1	1.54	1.19
Chromium (Cr)	mg/kg	Max 0.1	Not Detected	Not Detected
Mercury (Hg)	mg/kg	Max 0.5	Not Detected	Not Detected

The results in Table 2, show that between samples A and B, based on chemical parameter tests, the conditions were almost the same. Samples A and B are safe for consumption, however, the water content and arsenic content still exceed the limits set by SNI, so it is necessary to pay attention to the water content and arsenic content in the two samples. In addition, the cadmium content in sample B also exceeds the SNI standard.

In the chemical parameter test, the salt content, water content, formaldehyde content, and, heavy metal content tests were done. Salt content or often referred to as salinity is the level of salt dissolved in water. The factor that affects the salt content in food products is the rate of evaporation. WHO recommends we limit salt consumption. We recommend that in a day humans consume about 1 teaspoon of salt. We need to monitor the salt content in food products to maintain their quality of these food products. Salt (NaCl) is useful as a preservative, flavoring, improving taste, and color as a stabilizer, as well as a binder of food produced. In SNI 2717:2017 regarding pindang fish, the salt content of *pindang* should not be more than 10%. The results showed that the salt content in sample A of pindang fish was 2.43% and that of sample B was 1.70%, which indicates a salt content of less than 10% so that it can be said that pindang fish in Tulungagung is safe and suitable for consumption.

The second chemical parameter is water content. Moisture content is the amount of water contained in the product and is expressed in percent (%). In food, water content is an important characteristic, because water can affect the texture, appearance, and taste of the food product. Water also determines the freshness and durability of food products. The high-water content will make it easy for bacteria, fungi, and mold to breed which will cause changes in the food product (Sakti, 2016). As a result of changes that occur in food products, of course,

it will disrupt human health if the product is consumed by humans. According to SNI 2717, 2017 regarding pindang fish, the water content of pindang should not be more than 60%. In the results of the study, the water content in sample A of pindang fish was 67.4% and in sample B of pindang fish was 68.9%. This result shows the above condition recommended by SNI, which is 60%. So that this water content needs special attention, hence, pindang producers can reduce the water content in pindang fish.

The third chemical parameter is formalin content. The results showed that both sample A and sample B did not contain formalin. It can be said that *pindang* fish in Tulungagung is safe from formaldehyde content. The next parameter is the heavy metal content. The first heavy metal is cadmium (Cd). Cadmium (Cd) is a by-product of zinc production. Examples of objects that contain cadmium are soil, stone, and fertilizer. Cadmium also has many applications, for example in plastics and metal coatings. Cadmium also has the potential to cause cancer, chronic kidney failure, myocardial infarction, pneumoconiosis, absorbed through the digestive tract, circulated to the placenta during pregnancy, risk of stillbirth, membrane and DNA damage, accumulation in the liver and muscles (Luqueno et al, 2013). The results showed that the cadmium content in sample A was 0.094 mg/kg. Sample B was 0.122 mg/kg. Based on SNI, the cadmium content in pindang fish should not be more than 0 m1/mg.kg. These results indicate that the pindang fish sample A is safe for consumption, while the pindang fish sample B needs special attention to the levels of cadmium.

The fifth chemical parameter is Plumbum (Pb). Plumbum (Pb) is distributed in the least amount compared to other heavy metals, which is about 0.0002% of the earth's crust. Plumbum can be in the form of pure metal or inorganic and organic compounds of any form that will cause poison to live things. Plumbum is soft, dark brown in color, and is easily purified from mining. It has a low melting point, is easy to form, has active chemical properties, and can be used to coat metals from rust. The results showed that pindang fish samples A and B did not contain Plumbum.

The sixth chemical parameter is Tin (Sn). Tin is extracted from oxide ores with coal. Tin is a strong poison when it is in food and consumed by humans. The results showed that pindang fish samples A and B did not contain plumbum. The seventh chemical parameter is arsenic. Arsenic (As) is the most toxic element and is found in soil, water, and air. Naturally, a lot of arsenic is produced from volcanic eruptions, which can cause release about 3,000 tons every year. However, it is human activities that are thought to be responsible for the release of arsenic of more than 80.000 tons of per year due to the burning of fossil fuels and various industrial activities. Arsenic is found in two forms namely reduced and oxidized forms. Arsenic can cause lung, liver, bladder, and skin cancer, DNA damage, single-stranded DNA and double-stranded DNA damage, changes in gene expression, cerebrovascular disease, diabetes mellitus, and kidney disease (Luqueno et al, 2013). The results showed that sample A of pindang fish contained 1.54 mg/kg of arsenic and 1.19 mg/kg of sample B. According to SNI, the maximum arsenic content in pindang fish is 1 mg/kg. This means that special attention needs to be given to pindang fish in Tulungagung in terms of their arsenic content.

The eighth chemical parameter is chromium. Chromium (Cr) is a heavy metal that is present in rocks, soil, animals, and plants. Usually, most are in water sediments. Chromium is highly toxic and carcinogenic. Chromium pollution comes from the chromium plating industry, textile factories, paint factories, leather tanning, ink factories, and oil refineries (Adhani and Husaini, 2017). The results showed that the pindang fish samples A and B did not contain chromium. The ninth chemical parameter is mercury. Mercury (Hg) is a naturally occurring metal, the only metal that is liquid at room temperature. Mercury is a pure silver/greyish-white metal, odorless, and shiny. When heated at a temperature of 357 degrees Celsius will evaporate. Mercury poisoning will cause pink disease or acrodynia. Mercury is released due to industrial activities such as pharmaceuticals, paper, industry, agriculture, and others. The results showed that pindang fish samples A and B did not contain mercury. Based on chemical parameter tests, it was shown that in general, pindang fish in Tulungagung was safe, but there was special attention to salt content, cadmium content, and arsenic. This is in line with research by Junianingsih (2015), which states that the quality of scad fish in the village of Jangkar, Situbondo is by SNI. The selection of raw materials for pindang layang fish is based on the abundant catch in the area. Salt additives use the type of crystal salt on the market.

The Pindang Fish Quality Based on Biological Parameter

Biological parameter tests are tests for *Escherichia coli*, *Salmonella* spp. *Staphylococcus aureus*, total plate count, and *Vibrio cholera*, as shown in Table 3.

Table 3. The *Pindang* fish quality based on biological parameter

Parameter Test	Unit	SNI	Result		Description
			A	B	
Escherichia coli					
Replicate 1	APM/g	< 3	< 3	< 3	Safe
Replicate 2	APM/g	< 3	< 3	< 3	Safe
Replicate 3	APM/g	< 3	< 3	< 3	Safe
Replicate 4	APM/g	< 3	< 3	< 3	Safe
Replicate 5	APM/g	< 3	< 3	< 3	Safe
Salmonella spp.					
Replicate 1	/25g	negative	negative	negative	Safe
Replicate 2	/25g	negative	negative	negative	Safe
Replicate 3	/25g	negative	negative	negative	Safe
Replicate 4	/25g	negative	negative	negative	Safe
Replicate 5	/25g	negative	negative	negative	Safe
Staphylococcus aureus					
Replicate 1	CFU/g	1×10^2	<10	<10	Safe
Replicate 2	CFU/g	1×10^2	<10	<10	Safe
Replicate 3	CFU/g	1×10^2	<10	<10	Safe
Replicate 4	CFU/g	1×10^2	<10	<10	Safe
Replicate 5	CFU/g	1×10^2	<10	<10	Safe
Total Plate Count					
Replicate 1	CFU/g	1×10^4	$>2.5 \times 10^5$	$>5.7 \times 10^3$	Need attention
Replicate 2	CFU/g	1×10^4	$>2.5 \times 10^5$	$>7.2 \times 10^3$	Need attention
Replicate 3	CFU/g	1×10^4	$>2.5 \times 10^5$	$>6.4 \times 10^3$	Need attention
Replicate 4	CFU/g	1×10^4	$>2.5 \times 10^5$	$>7.3 \times 10^3$	Need attention
Replicate 5	CFU/g	1×10^4	$>2.5 \times 10^5$	$>6.2 \times 10^3$	Need attention
Vibrio cholera					
Replicate 1	/25g	negative	negative	negative	Safe
Replicate 2	/25g	negative	negative	negative	Safe
Replicate 3	/25g	negative	negative	negative	Safe
Replicate 4	/25g	negative	negative	negative	Safe
Replicate 5	/25g	negative	negative	negative	Safe

The results of the biological parameter test showed that sample A and sample B (safe for consumption when viewed from the content of *Escherichia coli*, *Salmonella spp*, *Staphylococcus aureus*, and *Vibrio cholera* was all below the SNI standard, but the Total Plate Count indicator exceeded the SNI standard. The *Escherichia coli* content test showed that the pindang fish samples A and B contained *Escherichia coli* < 3 APM/g, which means it met the SNI criteria, namely < 3 APM/g. *Escherichia coli* is a gram-negative bacterium, that has a rod-like shape. 0- 1.5 µm x 2.0-6.0 µm. *E. coli* has a locomotion called flagella, and can move (motile) or non-motile *E. coli* has a volume size ranging from 0.6-0.7 m^3, and can live at a temperature of 20-40^{0}C, with an optimal temperature of 37^{0}C. *E. coli* can grow and reproduce aerobically (with oxygen) and anaerobically (without oxygen), which is called facultative anaerobic (Sutiknowati, 2016). The cause of contamination can be caused by both internal and external factors. The internal factor is in the fish itself. The body of fish contains substances needed for microbial growth. While external factors are caused by the inaccuracy of the handling process, transfer processing, to distribution (Irawati et al., 2019). The results of this study are in line with the research by Christanti & Azhar (2019) which stated that the *E. coli* test on frozen fishery products in Bali showed negative or did not contain *E. coli*. Sulistiani and Hafiludin (2022), also showed the *E. coli* content test in fishery products in Semarang showed a value of < 3 APM/g, this was by SNI.

Test on *Salmonella spp*. the pindang fish samples A and B were negative, which means that samples A and B did not contain *Salmonella*. This is by the SNI criteria which are < 3 APM/g. This result is also in line with Sipahutar's research, which shows that fish processing in Banyuwangi does not contain *salmonella* contamination and is by SNI (Sipahutar et al., 2020). *Salmonella* is one of the gram-negative bacteria and includes enteric pathogens as the cause of the foodborne disease (foodborne disease). The growth is facultative anaerobes such as *E. coli*. *Salmonella* does not form spores. The results of the *Staphylococcus aureus* test on pindang fish A and B < 10 CPU/g. This result is by SNI, namely the quality of pindang fish which is safe if the content of *Staphylococcus aureus* is not more than 1×10^2 CPU/g. *Staphylococcus aureus* is a non-pathogenic bacterium that usually comes from environmental contamination, sellers of pindang fish, and workers who process the transfer process when they are sick (Oh et al., 2019). The results of the Total Lampeng Count test

showed that pindang fish A > 2.5 x 10^5 and pindang fish B < 1 x 10^4. This means that sample A of pindang fish exceeds the SNI limit of 1 x 10^4. Total Lampeng Count is a number that indicates the number of colonies of mesophilic aerobic bacteria contained per gram or milliliter of the sample tested. Total Lampeng Count test results can be used as quality parameters in fish. From the results of this test, it can be seen how many bacteria or microorganisms in the product may be harmful pathogenic bacteria.

The results of the *Vibrio cholerae* test on pindang fish samples A and B showed negative values, meaning that they did not contain *Vibrio cholerae*. This result is by SNI, namely the quality of pindang fish which is safe if it does not contain *Vibrio cholerae*. *Vibrio cholerae* is a gram-negative, comma-shaped, motile (movable) bacterium, having an antigenic structure of H flagellar antigen and O somatic antigen, gamma-proteobacteria, mesophilic, and chemoorganotrophs. *Vibrio cholerae* causes cholera infection. The lethal effects of this disease are the result of the toxins that bacteria produce in the small intestine. The toxin causes the body to excrete large amounts of water, causes diarrhea, and a rapid loss of fluids and salts (electrolytes). In general it can be concluded that the pindang fish in Tulungagung seen from the biological parameters in the form of contamination of *Escherichia coli*, *Salmonella spp*, *Staphylococcus aureus*, and *Vibrio cholerae* were declared safe, but theirs was special attention to the total plate count in sample A and sample B of pindang fish. Especially sample A whose total plate count result was very high exceeding the SNI threshold.

Conclusion

According to the analysis and discussion, the following conclusions can be drawn that the results of the physical parameters test show that physically, sample A pindang fish and sample B pindang fish are fit for consumption with the value of each specification which includes appearance, smell, taste, texture, and mucus is more than 7. This means that physically, the quality of pindang fish in Tulungagung is in a good category and suitable for consumption. Results of the chemical parameters test show that sample A pindang fish and sample B pindang fish are safe for consumption when viewed from the content of salt, formalin, plumbum (Pb), tin (Sn), chromium (Cr), mercury (Hg) which are all below the SNI standard. However, it is necessary to pay attention to the water, cadmium (Cd), and arsenic (As) content which exceeds the SNI standard. Results of the biological parameters test show that sample A pindang fish and sample B pindang fish are safe for consumption when viewed from the content of Escherichia coli, Salmonella spp, Staphylococcus aureus, and Vibrio cholera are all below the SNI standard, but the Total Plate Count indicator exceeds the SNI standard.

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