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# STUDY OF CONTAMINATION AND NUMBERS OF S. *AUREUS* IN KBP SAUSAGES PRODUCED BY BUMDES BAHARI SEJAHTERA

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**Abstract**

Fish sausage is a processed food product that is widely consumed because of its high nutritional value and delicious taste. However, potential microbial contamination such as *Staphylococcus aureus* (S. aureus) in fish sausages can pose a health risk. This study aims to identify the level of contamination and numbers *of S. aureus* in fish sausages produced by Bumdes Bahari Sejahtera. This research uses experimental research by conducting a Standardization Study on the storage of fish sausage products looking at the number of S. *Aureus contamination* in fish sausages. The parameters used are to see Pb, As, Cd, Hg and Sn contamination. Testing is carried out using the working principle of a spectrophotometer. To determine the number of *S. aureus*, colonies were counted using the Most Probable Number (MPN) method. The analysis results showed that all fish sausage samples were not contaminated by *S. aureus*. With a colony yield of <10 colonies/g . Even though no contamination was found above normal limits, there is still a need to improve quality control and implement stricter sanitation standards in the production process to reduce the risk of contamination and ensure food safety. Recommendations for further research include evaluating processing and handling practices to identify sources of contamination and develop effective prevention strategy.

**Keywords**: Contamination, KBP Sausage, S. Aureus Numbers, S. Aureus

## INTRODUCTION

The high demand for food is caused by population growth, even though domestic food production tends to stagnate. The main problem in achieving food security in Indonesia is that food demand increases much faster than food growth and supply. The increasing demand for food is caused by population growth, economic growth, increasing people's purchasing power, and changes in eating habits. In addition, food policy interventions for rice (rice self-sufficiency) are generally Food is one of the basic human needs, and without food humans cannot survive. Healthy and intelligent human development cannot be separated from the food consumed, so that healthy nutrition with complete

and safe nutritional content is an absolute need that must be met by food. Food ingredients are said to be safe if they do not contain dangerous physical, chemical or microbiological components. In previous research by Sanjeev and Surendran (1993), they examined the effect of storage on the presence of S. aureus, bacteria that produce toxins in processed fish. As a result, S. aureus was found in processed fish which was processed under unhygienic conditions. This research shows that these bacteria survive in processed fish for less than 13 days with the number of these bacteria being 2.7 x 105 CFU/gram. Fish is one of the most popular foods among Indonesian people. Around 70% of Indonesia's territory consists of marine waters and fresh waters (Directorate General of Fisheries Processing and Marketing).

Under conditions like these, the potential for fishing in Indonesia is very high and can make a very significant contribution to efforts to understand the diet of local communities. Currently, various kinds of fast food preparations are made from fish, such as fish chips, fish pempek, fish sausages, and many more. This has become a lifestyle because apart from being affordable, it is also easy to prepare, practical, long-lasting and delicious. One of the favorite fast foods is sausages. Sausage is an item of various food products of animal origin, consisting of a mixture of quality meat (minimum 75%) with flour, spices and other approved food additives, filled in a sausage container and meeting the requirements. Sausage quality, Indonesian National Standard 01-3020 (BSN 1995).

Sausage is a processed meat product and is easily damaged because the microbial nutrients it contains are available throughout life. Undesirable microbial growth in food can occur in the form of food spoilage and disease (food poisoning) due to consumption of food contaminated with pathogenic microorganisms. Around 2 million people, including children, die every year due to food poisoning and diarrhea caused by water pollution (Indonesian Ministry of Health 2015). Storage and preservation are important factors to consider, and the sausage market chain from producer to consumer is long and varied. Improper methods of storing and preserving sausages affect the microbiology of sausages. The results of research regarding the shelf life of analog sausages show that this product has the potential to last well for quite a long period of time if stored in the right conditions. Research reveals that sausage analogues, which are made from non-meat ingredients such as vegetable proteins and other binders, are able to maintain their sensory quality and microbiological safety during storage.

Sausages stored at refrigeration temperatures show minimal loss of quality over the specified storage period, which can be several weeks. The tested parameters, including aroma, texture and taste, remained within acceptable limits throughout the period. In addition, the results of microbiological testing show that the growth of pathogenic and spoilage microbes in analog sausages

can be controlled well. These findings confirm that with appropriate packaging and storage techniques, analogue sausages can be an effective and safe alternative to processed meat products, with competitive shelf life. This research supports the potential of analog sausages as a food choice that is not only nutritious but also practical for long-term consumption. This research aims to determine the study of contamination and S. aureus in fish sausages produced by Bumdes Bahari Sejahtera.

## MATERIALS AND METHODS

This research uses experimental research by conducting a Standardization Study on the storage of fish sausage products looking at the number of S. Aureus contamination in fish sausages. The parameters used are to see Pb, As, Cd, Hg and Sn contamination. The test is carried out using the working principle of a UV-Vis Spectrophotometer, namely that if monochromatic light passes through a medium (solution), then some of the light is absorbed (I), some is reflected (lr), and some is emitted (It). To determine the number of S. aureus, colonies were counted using the Most Probable Number (MPN) method.

## RESULTS AND DISCUSSION

### Results

*Table 1: Table of Fish Sausage Microbial Test Results*

| Tests carried out | Results | Condition |
|---|---|---|
| PK Pollution Pb | Not pregnant | Max.0.3 mg/kg |
| PK Pollution As | 0.04 mg/kg | Max. 2mg/kg |
| PK Pollution Cd | Not pregnant | Max. 0.3mg/kg |
| PK Pollution Hg | 0.165 mg/kg | Max. 0.5mg/kg |
| PK Pollution Sn | Not pregnant | Max. 40 mg/kg |
| *S. Aureus* numbers | < 10 colonies/g | $10^{2}$ Colonies/g |
| Fourth Row | 4 | 5 |

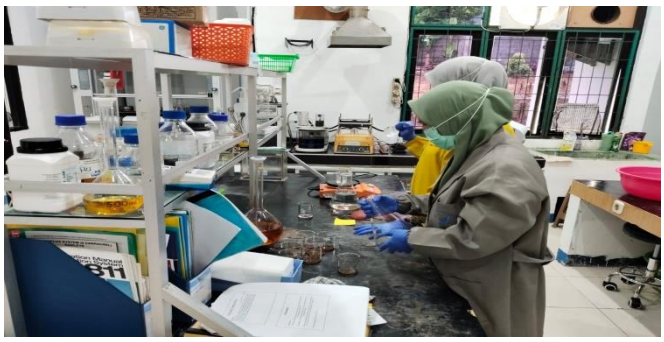

*Figure 1: Testing for S. Aureus contamination at BPOM*

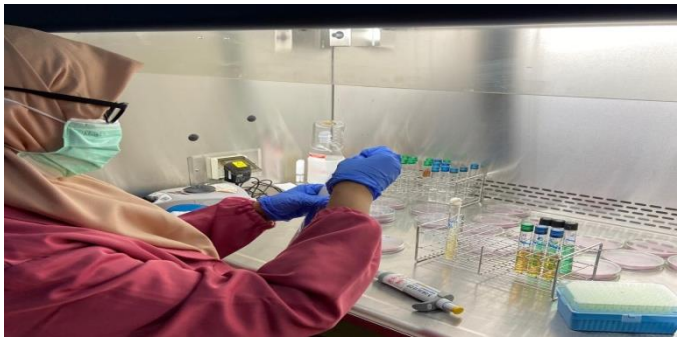

*Figure 2: Observing the results of the number of S. Aureus colonies*

**Discussion**

*Lead (Pb) Content in Fish Sausage*

Based on SNI recommendation no. 6989.8:2009, two wavelengths, 283.3 nm and 217 nm, are used to assess contamination, the normal requirement is max. 0.3 mg/kg test results showed that no Pb (Heavy Metal Lead) contamination was found in fish sausages. According to research results (Muhamad U. Caksana, 2021), the heavy metal Pb content in fish samples was <0.0204 µg/g. Lead (Pb) is a non-essential heavy metal which is very dangerous and can cause poisoning in living creatures. This poison is cumulative, which means that its toxic properties will appear if it accumulates in large enough quantities in the bodies of living creatures, which means that the lead content in all samples is below the detection limit of the equipment, this shows that the lead content in fish samples is very small. The heavy metal lead content in fish samples is still in accordance with quality standards based on SNI 7387:2009, that the maximum limit for lead heavy metal contamination in fish is 0.3 µg/g.

According to research (Audi Ichsani Aribowo, 2022), the results of a literature review of the analysis of lead (Pb) metal contamination in food and beverages in the form of sample preparation generally use wet and dry digestion methods. Then to analyze metal contamination using atomic absorption spectrometry (SSA) with wavelengths of 283.3 nm and 217 nm. The factors that influence Pb metal contamination in food are soil, water, air and storage places (such as cans). The standard maximum limit for lead content in food is 0.005 – 1 ppm so you need to be careful with food and drinks that exceed this figure. Because the large amount of lead in the human body will cause things that are dangerous for humans.

*Cadmium (Cd) Content in Fish Sausages*

Cadmium is a toxic heavy metal that can contaminate food, including sausages, and poses health risks if it accumulates in the human body. Cadmium can enter food products through several routes, including contamination from soil, water, or raw materials used in the sausage-making process. Research shows that cadmium often accumulates in foods grown in contaminated soil or processed with contaminated equipment. In the context of sausages, cadmium can come from additives or preservatives containing this metal, as well as from environmental contamination during the production process. Several studies have identified cadmium levels in sausages that can exceed limits set by regulatory agencies if strict quality controls are not carried out.

Considering the accumulative nature of cadmium in the body and its toxic effects which damage organs such as the kidneys and bones, it is important to monitor and control cadmium contamination in sausages. Regular testing and implementation of good processing practices are crucial steps to ensure food safety and protect consumer health. In the Cd test, no Cd was found in fish sausages, according to research (Karina Legiarsi, 2022) which states that the human body basically does not need cadmium. Cadmium in even small amounts can be dangerous to health. Humans do not have mechanisms in their bodies that function to block the absorption of cadmium, so that if exposed, cadmium will easily be absorbed by the body. The effect of cadmium toxicity is most likely due to the interaction between cadmium and the protein, resulting in disruption of enzyme activity in the body. Signs of cadmium poisoning in humans, whether acute or chronic, include disturbances in the respiratory system, damage to the function of the liver and kidneys, bleeding, and disturbances in bone growth.

*Arsenic (As) Content in Fish Sausages*

In the test, As contamination was found to be 0.04 mg/kg, while the maximum requirement was 2 mg/kg, it can be concluded that this test was still below the normal requirement threshold. According to research (Anselmus Helmi Fernandez, 2022) the BPOM SNI standardization value is 0.2 mg/kg, in the trials carried out in this study As was found but it was still within the low threshold. This feasibility refers to the maximum limit for heavy metal contamination in food that has been determined by the Food and Drug Supervisory Agency (BPOM) and provisions from the National Standardization Agency (BSN). Arsenic contamination is important for examining processed products because arsenic is a toxic heavy metal that can have serious impacts on human health. Arsenic is often not seen or smelled, but its presence in food products can cause various long-term health problems, such as cancer, impaired liver function, and nervous system damage.

Food products, especially those from polluted soil or water, can contain arsenic from environmental contamination, use of pesticides, or additives containing arsenic. Apart from that, inadequate food processing can also worsen arsenic contamination. Therefore, screening for arsenic in processed

products is essential to ensure food safety and prevent health risks for consumers. Detection and control of arsenic contamination helps maintain food quality and protects public health from the harmful effects it can cause.

*Mercury (Hg) Content in Fish Sausages*

Based on the Food and Drug Monitoring Agency (BPOM) No. 5 of 2018 concerning the Maximum Limit for Heavy Metal Contamination in Processed Food, namely 0.3 mg/kg. No fish sausage CD contamination was found from the test results. In the Hg contamination test it was found to be 0.165 mg/kg with the Max requirement. 0.5 mg/kg based on standards from BPOM SNI. It can be concluded that the Hg contamination study is still below the threshold of the maximum requirements. (SNI, 2009) mercury detected in fish sausages most likely comes from fish raw materials used in making sausages. Fish can be contaminated with mercury through the environment, especially from water pollution caused by industrial waste and the use of pesticides containing mercury. Previous studies have shown that mercury in the form of methylmercury can accumulate in aquatic food chains, and fish that are high in the food chain tend to have higher mercury concentrations.

*Tin (Sn) Content in Fish Sausage*

Lead in the processing of food products often comes from several interrelated processes and sources. First, lead can enter food products through a polluted environment, such as soil or water that contains this heavy metal. Plants growing in contaminated soil can absorb lead, which then transfers to food. Additionally, during the processing process, lead can become contaminated from equipment or packaging that does not meet safety standards. For example, using cooking utensils or packaging materials that contain lead can cause this metal to be transferred to food. The use of pesticides containing lead can also contribute to contamination of food products. Lead in food product processing usually enters through several main processes. First, lead can be contaminated from the environment, such as polluted soil and water, which then has an impact on plants or food raw materials. During the processing process, the use of equipment or packaging containing lead can also cause contamination. Additionally, additives or chemicals contaminated with lead can increase the risk of contamination. In other words, lead can enter food products through environmental contamination, equipment and packaging, and chemicals, so it is important to implement strict quality controls to prevent this contamination.

Overall, the main sources of lead in food usually involve environmental contamination, contaminated raw materials, and unsafe equipment and packaging. Efforts to control and minimize this contamination are critical to maintaining food safety. In the test, Lead (Sn) was not found in fish sausages according to research This found that the fish sausages tested contained lead with

concentrations ranging from 0.01 to 0.15 ppm (parts per million). This concentration varied between samples and exceeded the maximum limit recommended by food safety standards, as set by the Food and Drug Supervisory Agency (BPOM), namely 0.01 ppm for processed food products. These findings indicate that fish sausages on the market have the potential to pose health risks to consumers. According to standardization (SNI, 2009) the maximum limit requirement is 40 mg/kg

*Content of S.aureus On Fish Sausage*

Staphylococcus aureus, often abbreviated as S. aureus, is a bacteria that has multiple roles in human life. Under normal circumstances, S. aureus can become part of the body's microflora, living on the skin and nose without causing problems. However, if the balance of the microbiome is disturbed or the immune system is weakened, S. aureus can become a pathogen that causes infection. These bacteria can produce various damaging toxins, such as enterotoxins which cause food poisoning and exfoliative toxins which cause scalded skin syndrome. Additionally, S. aureus is renowned for its ability to develop resistance to antibiotics, including methicillin, which makes this infection difficult to treat, especially in hospital settings. (Khalifa, 2014)

In the world of research, S. aureus is also an important model for studying the mechanisms of infection and antibiotic resistance, helping the development of new therapies. In other words, S. aureus has a complex role as part of the normal microflora, a potential pathogen, and a vital research subject. According to National Standards Indonesia (2009) tolerance limits for colony contamination Microbes from processed meat products in the form of sausages are not allowed more than 1 x 105 colonies/gram, Salmonella sp negative/25 gram, E.coli <3/gram and *S.aureus* 1 x 102 colonies/gram . According to research (M. Yusuf, 2016) S. aureus, Salmonella and E. coli are pathogenic bacteria that are commonly used as indicators of unhygienic food processing. This research showed that several fish sausage samples tested contained Staphylococcus aureus with concentrations varying between 10^3 to 10^6 CFU/g (colony-forming units per gram). These findings indicate that contaminated fish sausages could potentially pose a health risk to consumers if the bacteria reproduce and produce toxins.

## CONCLUSION

Contaminants containing Lead (Pb), Cadium (Cd) and Tin (Sn) were not found. Arsenic (As) contamination was 0.04 mg/kg, Mercury (Hg) contamination was 0.165 mg/kg, and S. *Aureus numbers* were <10 colonies/g. The number of S. *Aureus* in fish sausages can be concluded as a threshold category that is below the normal contamination limit. So it can be concluded that fish-based sausages are suitable for consumption.

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## Declaration of Interest Statement

During the period from making fish sausage until the study of S. *Aureus contamination*, no conflict problems occurred. Fish sausage is suitable for consumption.

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