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IDENTIFIKASI *SALMONELLA* sp. PADA IKAN ASAP DI KOTA JAYAPURA

Identification Of *Salmonella* sp. In Smoked Fish In Jayapura City

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ABSTRAK

Tujuan dari penelitian ini adalah untuk menilai kualitas mikrobiologis ikan asap di sentra pengolahan di Kota Jayapura, Papua. 100 kilogram ikan asap diuji, sampel diambil dari produsen, distributor, dan pengecer di tiga tingkat distribusi. Uji mikrobiologis termasuk identifikasi bakteri *Salmonella* sp. dan uji Angka Lempeng Total (ALT). Hasil penelitian dilakukan dengan menggunakan ANOVA dan uji lanjut DMRT pada taraf signifikansi 95%. Nilai ALT rata-rata pada semua tingkat distribusi berkisar antara 3,379 dan 3,509 log cfu/g, yang masih berada di batas aman untuk dikonsumsi ($p > 0,05$). Setiap sampel yang diuji tidak menunjukkan adanya kontaminasi *Salmonella* sp. Studi ini menunjukkan bahwa produk ikan asap di Kota Jayapura aman dari segi mikrobiologis, tetapi perawatan selama distribusi perlu diperbaiki, terutama dalam hal pengemasan dan kebersihan, agar produk tetap memberi kepuasan konsumen. Konsumen dapat lebih puas dan daya simpan dapat diperpanjang dengan higiene, pengemasan yang lebih baik, dan manajemen rantai distribusi yang lebih baik. Hasil penelitian ini memberikan wawasan penting bagi produsen, konsumen, dan pihak terkait tentang kualitas ikan asap Jayapura. Informasi ini dapat digunakan sebagai dasar untuk kebijakan perikanan dan perbaikan kualitas produk.

ABSTRACT

The purpose of this study was to assess the microbiological quality of smoked fish at the processing center in Jayapura City, Papua. 100 kilograms of smoked fish were tested, samples were taken from producers, distributors, and retailers at three distribution levels. Microbiological tests included identification of Salmonella sp. bacteria and Total Plate Count

(TPS) tests. The results of the study were conducted using ANOVA and DMRT further tests at a significance level of 95%. The average TPS value at all distribution levels ranged between 3.379 and 3.509 log cfu/g, which is still within the safe limit for consumption ($p>0.05$). Each sample tested did not show any Salmonella sp. contamination. This study shows that smoked fish products in Jayapura City are microbiologically safe, but care during distribution needs to be improved, especially in terms of packaging and cleanliness, so that the product continues to satisfy consumers. Consumers can be more satisfied and shelf life can be extended with better hygiene, packaging, and better distribution chain management. The results of this study provide important insights for producers, consumers, and related parties about the quality of Jayapura smoked fish. This information can be used as a basis for fisheries policy and product quality improvement.

Kata Kunci	*Ikan Asap, Salmonella sp., Mikrobiologi, Jayapura, Distributor*
Keywords	*Smoked Fish, Salmonella sp., Microbiology, Jayapura, Distributor*
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INTRODUCTION

The fish smoking center in Hamadi Village and Imbi Village produces around 100 smoked fish of various types and sizes every day to meet the smoked fish needs of Jayapura City and surrounding regencies. This fish smoking center uses simple and unhygienic fish smoking technology. The results of the study (Haryati and Nurlita, 2021) show that the nutritional quality of smoked yellowtail fish sold at Youtefa Market, Jayapura City, does not meet the standards. Where, the water content is more than 60% and the ash content is less than 12.9% even though the fat content is less than 20%. Another study conducted by (Sirait et al., 2022) showed that the results of the application of temperature in the smoking process were still not appropriate, which could cause the growth of microorganisms and a decrease in the quality of raw materials (Sipahutar et al., 2021).

The results of observations conducted at the location of smoked fish sales in the market or at the sales stalls showed that smoked fish sellers usually sell their goods in an unpackaged condition. This increases the possibility of contamination by pathogenic bacteria from the environment. The distribution of smoked fish for a long time can also increase the possibility of contamination of pathogenic bacteria in smoked fish (Swastawati, 2018). Consumers will be greatly disadvantaged if this is allowed because the products received already have quality defects. In addition, there is insufficient data on the microbiological quality of smoked fish, especially in Jayapura City. So, research must be conducted to identify the microbiology of smoked fish in smoked fish processing places in Jayapura City. The test parameters to be carried out include identification of Salmonella

bacteria and Total Plate Count (ALT) to measure the quality of smoked fish products. Based on the description above, it is important to conduct microbiological research to evaluate the hedonic quality and smoked fish in smoked fish processing centers in Jayapura City.

METHOD

Tools and Materials

The tools and materials in this study were: Materials in the form of 100 kilograms of smoked fish samples, SSA media, LB media, BGLB media, NA media, distilled water, sodium chloride, fertilizer media, BPW, pure bacterial culture, spirits, and immersion oil were needed. The tools needed for this study included an autoclave, actor, petri dish, vortex, test tube, durham tube, measuring pipette, volume pipette, water bath, actor or, inoculation loop needle, marking pencil, object glass, object glass clamp, colony counter, and test tube rack. The experimental design used one actor randomized block design (RAK). The factors used were differences in distribution levels between three treatments: distributors, consumers, and producers. The significance test of the effect of treatment was carried out on the data obtained using analysis of variance (ANOVA). If it was found that there was a significant effect of treatment, the difference between treatments was tested at the 95 level%.

Sample analysis procedure

Total Plate Count (TPC)

The total plate count used in this study used BSN, 2013. To perform aseptic dilution, 25 grams of smoked fish samples were dissolved with 225 milliliters of Butterfield's Phosphate Buffered solution. Pipette one milliliter of solution and add 12-15 milliliters of PCA at 45oC. Cover and let stand until solidified. The media was incubated in an inverted position in an incubator for 48 hours ± 2 hours at 35oC ± 1 oC. A colony counter was used to count the total colonies. Repetition was carried out twice.

Identification of Salmonella sp.

Salmonella sp. bacteria were found (BSN, 2006). A total of 25 grams of smoked fish samples were dissolved with 225 milliliters of milk porridge solution then put into a sterile container and incubated for 60 minutes at room temperature in a closed condition. Incubated for 24 hours ± 2 hours at a temperature of 35oC ± 1oC. For initial estimation, the turbidity of the solution was observed. 1 milliliter of solution was mixed with 10 milliliters of tetrathianone Broth solution. Then incubated for 24 hours at a temperature of 43 oC ± 0.2 degreesoC with bath water. After that, the solution was scratched onto the SSA media that had been prepared the day before. Re-incubated for 24 hours ± 2 hours at a temperature of 35 oC ± 1oC and the characteristics of the colonies were observed.

Data processing and analysis

The ALT test result data were tested quantitatively using ANOVA, and further testing was carried out using DMRT if differences were found. Salmonella sp. identification data were tested qualitatively, and consumer perception questionnaire data were tested quantitatively using validity and reliability tests as data quality tests. To determine the influence of the variables used, multiple linear regression analysis was used.

RESULT AND DISCUSSION

Total Plate Count (TPC)

Table 1. The effect of differences in the distribution level of smoked fish sold on the first day (fresh) on the microbiological quality of Jayapura City

Distribution level	Average(log cfu/g)	*Homogenity of Variances*	Analysis of Varians
Produsen	3,3973		
Distributor	3,3973	*0.0368*	*0.1732*
Retailer	3,3971		

Description:
1. A significance value greater than 0.05 (p > 0.05) in Homogeneity of Variances indicates that the measured data group is homogeneous.
2. A significance value greater than 0.05 (p > 0.05) in Analysis of Variances indicates no significant difference.
3. The same superscript in the same column indicates no significant difference.

Total Plate Count (TPC), also known as Total Plate Count (TPC), is a microbiological tool that measures the total number of bacteria present in a food sample, including fishery products such as smoked fish. ALT is used as an indicator of microbiological quality and food safety. The food industry relies heavily on this test because it provides an overview of the number of bacteria present, which can be used to assess freshness, cleanliness of the production process, and potential risks to consumer health. Smoked fish is treated using the smoking method (diasar). Although the smoking technique can kill or stop the growth of bacteria, ALT testing is still important to ensure that the number of microbes in smoked fish is within safe limits for consumption. Table 1 and Table 2 show the results of the total plate count analysis of smoked fish from various distribution levels in Jayapura City.

Table 2. The effect of differences in the distribution level of smoked fish sold the next day (heated) on the microbiological quality of Jayapura City.

Distribution Level	Average(log cfu/g)	*Homogenity of Variances*	Analysis of Varians
Manufacturer	3,502		
Distributor	3,504	*0.0513*	*0.8473*
Retailer	3,509		

Description:
1. A significance value greater than 0.05 (p > 0.05) in Homogeneity of Variances indicates that the measured data group is homogeneous.
2. A significance value greater than 0.05 (p > 0.05) in Analysis of Variances indicates no significant difference.
3. The same superscript in the same column indicates no significant difference.

The microbiological quality of smoked fish sold in Jayapura City on the first day (fresh) or the next day (heated) was not affected by the microbiological quality of the distribution

level, as shown in Table 1 and Table 2. In addition to hygiene and material care factors, there are several additional factors that contribute to low levels of microbial contamination in smoked fish, one of which is the quality of the raw materials (Susanti, 2020). If the fish used for smoking is already contaminated by bacteria, smoking may not be sufficient to significantly reduce the microbial population (Rumakat, 2020). Other factors include inadequate smoking processes, such as low smoking temperatures or smoking times that are too long (Abror et al., 2022). Smoking at temperatures below 65°C may not be effective in killing pathogenic and non-pathogenic microbes (Rahmi et al., 2021). In addition, there are aspects of hygiene during the handling and storage process, as well as storage time. The number of bacteria can increase due to unclean processing environments, contaminated equipment, or storage of smoked fish at temperatures above 5°C (Hidayah, 2023). Aerobic bacteria tend to increase with the storage time of smoked fish, especially if it is not stored at cold temperatures (Ahmad et al., 2024).

A study by Tule et al. (2017) in Papua tested the microbiological quality of smoked fish traditionally produced by coastal communities. This study found that 35% of smoked fish samples had ALT values higher than 105 CFU/g. This study concluded that non-ideal smoking temperatures, poor post-production handling, and market environmental hygiene all contributed to increased ALT values. The test results showed that the ALT values of most smoked fish were below the threshold considered unsafe, which was 103-104 CFU/g. However, ALT values increased when smoked fish were stored at room temperature for more than three days.

Identification of Salmonella sp.

One of the most common pathogenic bacteria found in food, especially animal products such as fish, meat, and poultry, is Salmonella sp (Nahda et al., 2024). The presence of Salmonella in smoked fish, or smoked fish, is very important to study because Salmonella infection in humans can cause a disease known as salmonellosis, which is characterized by symptoms such as diarrhea, fever, and abdominal cramps (Ariyani et al., 2023). Smoked fish, a processed fishery product, is preserved through a smoking process. Although the smoking process functions as a natural preservative that kills or prevents the growth of bacteria, Salmonella contamination can occur because the fish are not treated cleanly, the smoking temperature is inadequate, or contamination after production (Istiqomah, 2023).

The color variation of Salmonella sp. colonies on SSA media is indicated by pink spots, orange with black spots, and without black spots in the center of the colony (Novianti et al., 2022). The results of the study showed that every smoked fish distributed in Jayapura City did not contain Salmonella sp. bacteria. The presence of bacteria in smoked fish is mainly caused by poor hygiene practices from producers and sellers. Table 3 shows the results of descriptive analysis of Salmonella sp. bacteria in smoked fish from various distribution levels in weeks 1, 2, and 3.

Table 3. Analysis of Salmonella sp. bacteria for smoked fish on the first day (fresh)

Repeat-	**Distribution Level**		
	Manufacturer	Distributor	Retailer
1	Negatif	Negatif	Negatif

2	Negatif	Negatif	Negatif
3	Negatif	Negatif	Negatif

Table 4. Analysis of Salmonella sp. bacteria for smoked fish in the following (heated)).

Repeat-	**Distribution Level**		
	Manufacturer	Distributor	Retailer
1	Negatif	Negatif	Negatif
2	Negatif	Negatif	Negatif
3	Negatif	Negatif	Negatif

Description: Analysis using LB and SSA media

A study by Rahman et al. (2018) investigated Salmonella contamination in various smoked fish products (including smoked fish) in several traditional markets in Indonesia. In the study, it was found that between ten and fifteen percent of samples tested positive for Salmonella sp., indicating that conventional processed fish products are highly susceptible to contamination by pathogenic bacteria. According to this study, the main cause of contamination is poor hygiene when handling and storing smoked fish, especially in traditional markets with inadequate hygiene facilities. In addition, this study shows that to reduce the possibility of contamination, improving hygiene during the processing and distribution of smoked fish is essential. In another study conducted by Cannizzaro et al. (2023) in Papua New Guinea, Salmonella sp. was found in smoked fish produced in coastal areas. More than 20% of smoked fish samples in this study contained Salmonella sp., especially in products stored without adequate refrigeration for more than two weeks. Inadequate smoking and storage at room temperature caused this contamination. Researchers suggest the use of refrigerators after smoking and improving hygiene procedures to reduce contamination levels (Aminah et al., 2022).

The results of a study conducted to identify Salmonella sp. bacteria in smoked fish in Jayapura City, together with the results of previous studies, can be concluded that smoked fish in Jayapura City are smoked at a minimum temperature of 65°C. To ensure the death of all pathogenic bacteria, including Salmonella, smoking must be carried out at an adequate temperature (65°C or higher). The smoking process is also carried out by implementing and improving hygiene standards. To avoid cross-contamination, post-production hygiene must be improved by using sterile equipment, personnel hygiene, and processing in a clean environment. Finally, after the smoked fish is cooked, it is immediately stored in a cold temperature to prevent the growth of remaining bacteria.

CONCLUSION

The results of the study showed that smoked fish sold in Jayapura City has a microbiological quality that is safe to eat. All samples from various distribution levels (producers, distributors, and retailers) are still within safe limits, and there is no significant difference in bacteria between distribution levels. This is indicated by the results of the Total

Plate Count (TPL) test. Salmonella sp. bacterial contamination was also not found. This shows that smoking at a fairly high temperature (more than 65°C) successfully prevents the development of these pathogenic bacteria.

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