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Identification of *Salmonella* sp. Bacterial Contamination on Pempek Products Circulating in Urban Village of Ciracas, RW 08, East Jakarta

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ABSTRACT

Pempek is a traditional Palembang food widely popular among the public, but it is vulnerable to contamination by pathogenic bacteria due to the use of raw ingredients and unhygienic processing. One of the bacteria commonly associated with fish-based food contamination is Salmonella sp., which can cause foodborne diseases. However, studies specifically examining Salmonella contamination in pempek, particularly at the local level in the Ciracas area, are still limited. This study aimed to determine the presence of Salmonella sp. contamination in pempek sold in Ciracas RW 08, East Jakarta. This study employed a descriptive observational design with a laboratory-based microbiological approach to detect Salmonella sp. contamination in pempek samples. The tested samples consisted of two fried samples and two boiled samples. Identification of Salmonella was carried out according to SNI 01-2332.2-2006, which includes three stages: pre-enrichment in Lactose Broth (LB), selective enrichment using Rappaport Vassiliadis (RV), and identification on Xylose Lysine Deoxycholate (XLD) medium. The results showed that one out of four pempek samples tested positive for Salmonella sp. A positive result was from boiled pempek. Overall, 25% pempek samples sold in Ciracas, RW 08 were contaminated with Salmonella sp. We recommend the Salmonella test for both raw and cooked home industry pempek.

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INTRODUCTION

Pempek is one of the typical foods of Palembang that is popular in various regions in Indonesia, including in the Ciracas Village area. This food is known for its savory taste and chewy texture, and is served with a vinegar sauce that delivers a sour,

sweet, and spicy taste sensation. Pempek is widely sold by street vendors and restaurants, making it easily accessible to the public. Due to the manufacturing process involving raw materials and an open environment, there is a risk of microbial

contamination that can harm consumer health (Cahya et al., 2022).

Mackerel, or *Tenggiri* (*Scomberomorus* sp.), is known for its soft meat and distinctive aroma, and is one of the staples used in making pempek, which gives pempek its distinctive taste. Mackerel offers many health benefits because it is rich in protein and omega-3 fatty acids. However, like other seafood, mackerel is also susceptible to microbial contamination if not handled properly, especially during storage and processing. Other fish used for pempek production include snakehead, belinda, white snapper, tuna, and cod (Saputri et al., 2021).

The use of fish as a raw material for processed foods has been widely developed in Indonesia, including pempek, fish balls, fish nuggets, and fish crackers. In addition to increasing economic value, fish processing helps the community meet their nutritional needs. However, during manufacturing and distribution, unhygienic fish processing can lead to the growth of pathogenic bacteria, ultimately endangering public health (Ginting et al., 2022).

Detecting *Salmonella* contamination in pempek is crucial for ensuring food safety and protecting consumer health. By conducting regular testing, manufacturers can identify and control potential contamination risks and improve product quality. In addition, this step can increase

consumer confidence in pempek products (Pramono et al., 2020; Pratama & Haditjaroko, 2021; Sandita et al., 2025).

One of the pathogenic bacteria commonly found in fish-based food products is *Salmonella* sp. This bacterium belongs to the *Enterobacteriaceae* family, is Gram-negative and rod-shaped, and can survive in the environment for a long time. *Salmonella* is known to cause *foodborne diseases* that pose public health problems globally. This bacterial infection is called salmonellosis, which is generally transmitted through the consumption of contaminated food or drinks (Maryani et al., 2023).

Salmonella infection causes clinical symptoms including diarrhea, fever, abdominal cramps, nausea, and vomiting. Mild case infections, symptoms usually last for 4-7 days, but in vulnerable groups such as children, the elderly, and individuals with weakened immune systems, the infection can cause severe dehydration, bacteremia, and serious complications that can be fatal. Some *Salmonella* serotypes, such as *Salmonella typhi* and *Salmonella paratyphi*, can cause typhoid disease (typhoid and paratyphoid fever), which is a systemic infection characterized by prolonged fever, indigestion, hepatosplenomegaly, and even intestinal perforation if not treated immediately. Meanwhile, *Salmonella enteritidis* and *Salmonella typhimurium* are

the main causes of non-typhoid gastroenteritis, which is often associated with the consumption of unhygienic poultry, egg, and fish products (Tobing, 2024).

Previous studies by Pramono et al. (2020) on bacterial contamination in domestically produced pempek and in food processing plants reported 18 positive samples out of 20 tested. These findings indicate that microbiological contamination in pempek remains high, particularly in products processed without adequate sanitary supervision. Meanwhile, another study by Jadhey et al. (2020) found that all pempek samples tested around the Syiah Kuala University Campus were negative *Click or tap here to enter text.*for *Salmonella* sp., because traders had implemented hygiene and sanitation practices in accordance with BPOM standards. These differences in results indicate variations in hygiene and processing conditions across regions, so it is necessary to conduct research in other locations, such as Ciracas urban village, which has different environmental characteristics and types of traders (Jadhey et al., 2020).

Although there have been many studies on *Salmonella* sp. contamination in pempek samples, to date, there has been no scientific data on such contamination in pempek in the Ciracas RW 08 area, East Jakarta. Based on these conditions, it can be concluded that there is still a gap in research

on the detection of *Salmonella* sp. in pempek sold in the East Jakarta area, especially in Ciracas RW 08. This location is a densely populated area with many street vendors selling processed fish products in open conditions, so it has a high risk of pathogenic bacterial contamination. The lack of prior scientific research in this region underscores the urgency of this study to provide preliminary data on the food safety of pempek snacks in the area.

This study employs detection methods that fully comply with Indonesian National Standards, including pre-enrichment in Lactose Broth (LB) medium (SNI 01-2332.2-2006), selective enrichment using Rappaport-Vassiliadis (RV) medium, and identification on Xylose Lysine Deoxycholate (XLD) medium. In addition, this study also differentiates two forms of pempek based on cooking methods, namely boiled pempek and fried pempek, to determine the difference in the level of contamination risk. The results of the comparison are expected to provide a clear picture of the influence of the processing process on the presence of *Salmonella* sp. in processed fish-based foods.

The urgency of this research is not only about the scientific aspect but also about the practical benefits for the community and business actors. By enabling early detection of *Salmonella* sp., this research is expected to increase public

awareness of the importance of food hygiene and provide a basis for local governments to supervise the food safety of street food vendors. For academics, the results of this research can serve as reference material in food microbiology, particularly regarding the application of national standards for identifying pathogenic bacteria (Njatrijani, 2021).

Based on this description, the formulation of this research problem is: "Is there a contamination of *Salmonella* sp. in pempek sold by several traders in the Ciracas urban village area, RW 08, East Jakarta?" The purpose of this study is to determine whether *Salmonella* sp. are present in pempek sold in the region. Thus, this research is expected to make a scientific contribution to improving food safety in the community and to serve as a basis for policies for the supervision of ready-to-consume food products in Indonesia.

RESEARCH METHODS

Study Design

This research is descriptive and uses a quantitative approach. The main purpose of this study is to detect the presence of *Salmonella* sp. in pempek sold in the Ciracas RW 08 area of East Jakarta. The test results are systematically evaluated to determine whether *Salmonella* sp. is present, in accordance with the parameters of the

Indonesian National Standard (SNI 7388:2009).

Sampling was conducted in the Ciracas urban village, RW 08, East Jakarta, a densely populated area with relatively high levels of street food trading. This area was chosen because it has never been a research site of this kind and has environmental characteristics that pose a high risk of microbial contamination from food processing activities in open spaces. The laboratory analysis was conducted at the Microbiology Laboratory of the Oil Palm Research Center in Bogor.

Sample and Population

The population in this study is all pempek traders who sell in the Ciracas RW 08 area, East Jakarta. The sampling technique uses purposive sampling, a deliberate selection of samples based on specific criteria. The criteria used include street vendors or stalls that sell in open spaces, using fish-based ingredients, and selling pempek in two forms of processing, namely fried and boiled.

The research sample comprised four pempek traders. Each trader was given one of two types of pempek (fried or boiled), so there were a total of four pempek samples tested (two fried and two boiled). The selection of these two forms of pempek is intended to compare contamination risk levels based on differences in the cooking process.

Tools and Materials

The microbiological media materials used are Lactose Broth (LB) as a pre-enrichment medium, Rappaport Vassiliadis Broth (RV) as a selective enrichment medium, and Xylose Lysine Deoxycholate Agar (XLD) as an isolation and identification medium for *Salmonella* sp. colonies (Cappuccino & Welsh, 2017; Madigan et al., 2021; Talaro & Chess, 2018). Other additives used include a 0.85% physiological NaCl solution, 70% alcohol, and sterile Aquadest for washing and sterilizing equipment. All media is made according to the instructions on the media bottle and sterilized before use. The equipment used includes autoclaves, hot plates, Biological Safety Cabinets (BSCs), and incubators.

Procedure

The testing stage refers to the Indonesian National Standard on *Salmonella* sp. detection methods. on food products. Each pempek sample was taken in as much as 25 grams, then placed into 225 mL of sterile Lactose Broth (LB) (SNI 01-2332.2-2006) for the pre-enrichment stage. The mixture is homogenized and incubated at 37°C for 24 hours. The pre-enrichment stage aims to reactivate *Salmonella* cells that may be under stress during processing or storage.

After the pre-enrichment stage, up to 1 mL of culture in LB was inoculated into 10 mL of Rappaport Vassiliadis Broth (RV)

and incubated at 42°C for 24 hours. This stage is a selective enrichment that allows the growth of *Salmonella* sp. bacteria, but inhibits the growth of other bacteria. After incubation, the RV media were scratched onto the surface of the Xylose Lysine Deoxycholate (XLD) media using a sterile ose, then re-incubated at 37°C for 24 hours.

The growth results were visually assessed by examining the color and characteristics of the colonies in each medium. Colonies suspected to be *Salmonella* sp. are marked with pink or red with a black dot in the center on XLD media. To ensure the results, colony morphology and growth characteristics were observed at each stage of the media.

Data Collection

The data collected consisted of observations of bacterial growth at each stage of testing. Observations were made on the level of turbidity in LB and RV media, as well as changes in color and shape of colonies in XLD media. The results of the observations were recorded in the test table and analyzed descriptively by comparing the colony characteristics with the literature and standard test results.

Data Analysis

The data obtained were then evaluated based on the criteria for the presence of *Salmonella* sp. according to SNI 7388:2009, concerning the Maximum Limit of Microbial Contamination in Food. Based on

this standard, ready-to-consume food products such as processed fish are declared safe if (SNI 7388:2009) *Salmonella* sp. is not detected in 25 grams of the sample. Thus, if at any stage it shows typical growth of *Salmonella* sp., the sample is considered positive for contamination.

The results of the analysis are presented as a narrative description explaining differences in results between types of pempek (boiled and fried) and between traders. This descriptive approach is used to assess potential contamination based on the conditions of processing, storage, and sales environment. All data were compiled to provide an overview of the microbiological safety of pempek snacks sold in the Ciracas, RW 08, East Jakarta area.

RESULTS AND DISCUSSION

The results showed that, of the four pempek samples tested, two were fried and two were boiled. One sample was positive for *Salmonella* sp. at the identification stage using Xylose Lysine Deoxycholate (XLD) medium. It indicates microbiological contamination in one of the pempek products, which has the potential to pose a health risk to consumers. Based on SNI 7388:2009 concerning the Maximum Limit of Microbial Contamination in Food, fish-based processed food products should be negative for *Salmonella* in 25 grams of

samples, so this positive result shows that one of the pempek samples does not meet the applicable food safety standards.

Salmonella sp. contamination in pempek can be caused by various factors, especially inadequate hygiene and sanitation during production, processing, and storage. *Salmonella* is an enteric bacterium that can survive for extended periods in humid environments and multiply rapidly at room temperature (35–37°C). The pempek processing is carried out manually, and the use of raw materials such as fish without hygienic handling, as well as exposure to the open environment during sales, can be the main sources of contamination (Pramono et al., 2020). In addition, the use of non-sterile water for processing and washing materials can contribute to the entry of pathogenic bacteria into food products.

These results are in line with the research of Pramono et al. (2020), which reported that 90% of household pempek production samples and processing plants contained microbes exceeding the threshold, indicating weak implementation of hygiene and sanitation in the small traditional food industry. However, the results of this study differ from the findings of Jadhey et al. (2020) at Syiah Kuala University, which showed that all samples Pramono et al. (2020) of *Salmonella* sp. were negative, because traders have implemented hygiene practices in accordance with BPOM

standards. This difference shows that the level of contamination is greatly influenced by the application of hygiene and sanitation principles during processing and by the environmental conditions at the point of sale (Jadhey et al., 2020).

Salmonella contamination in food can cause *salmonellosis*, a gastrointestinal infection characterized by diarrhea, fever, nausea, and vomiting (WHO, 2023). This risk increases especially in vulnerable groups such as children and the elderly. Therefore, early detection of microbiological contamination is important for preventing foodborne diseases. Over-the-counter food products such as pempek need to be periodically monitored through microbiological testing to ensure their safety.

This study emphasizes the importance of implementing Good Manufacturing Practice (GMP) and Sanitation Standard Operating Procedure (SSOP) for traditional food business actors. The application of this principle includes the use of clean water,

sterile equipment, low-temperature storage of materials, and protection of products from exposure to open environments. Education for small traders and producers is also necessary to help them understand the risks of contamination and consistently implement preventive measures (Njatrijani, 2021).

Figure 1 shows the results of sample testing on Lactose Broth (LB) media. All samples appear cloudy, indicating bacterial growth. The turbidity in LB media reflects the success of the pre-enrichment stage, which aims to restore and multiply bacterial populations that may have been stressed by previous cooking, storage, or environmental exposure. However, the growth of bacteria at this stage cannot be ascertained specifically as *Salmonella* sp., because LB is not a selective medium. Samples with growth on LB were subjected to the selective enrichment stage to determine whether the growing bacteria were *Salmonella* sp. or other enteric bacteria.

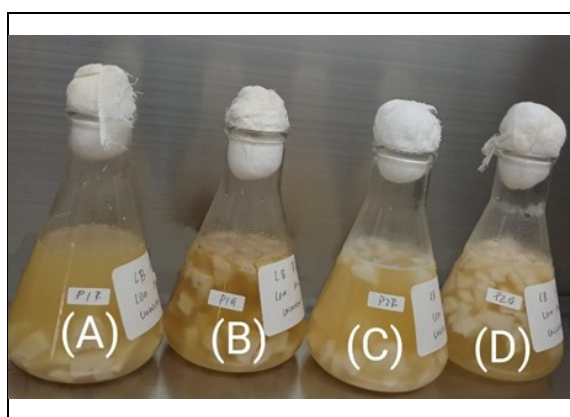


Figure 1. Sample testing on LB media

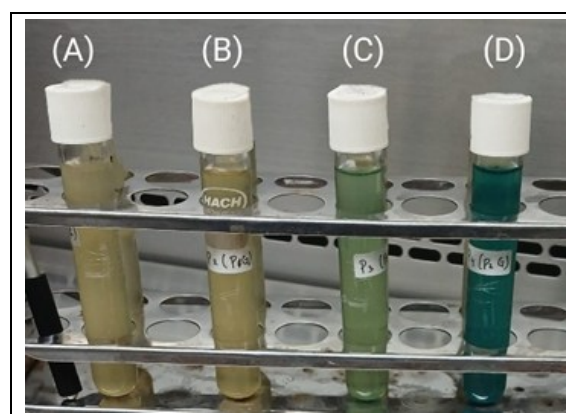


Figure 2. Sample testing on RV media

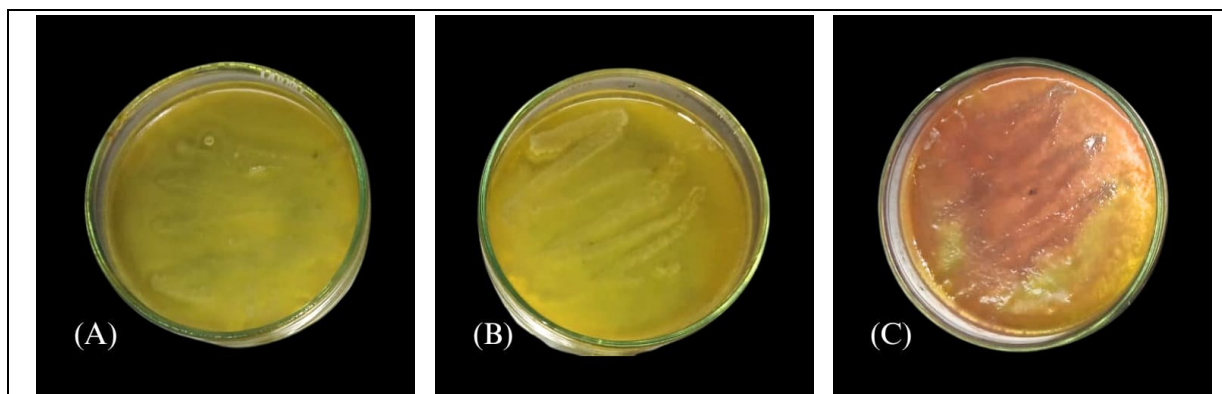


Figure 3. Sample testing on XLD media.

Figure 2 shows the results of inoculating samples into Rappaport-Vassiliadis Broth (RV) medium, which serves as a selective medium that suppresses the growth of bacteria other than *Salmonella* sp. The results showed that the P1R, P1G, and P2R samples were positive for growth, while P2G showed no growth in the RV media. Positive growth indicates that *Salmonella* sp. is likely to be strongly present in the sample, as the composition of RV, including magnesium chloride, malachite green, and a low pH, favors the growth of *Salmonella* more than that of other enteric bacteria. However, because other bacteria may also grow on RV medium, confirmation cannot be made at this stage. Therefore, isolation on XLD medium is required to confirm the presence of *Salmonella* spp.

Figure 3 shows the results of sample testing on Xylose Lysine Deoxycholate (XLD) media, which is the differential identification stage for the specific detection of *Salmonella* sp. This medium showed

differences in colony morphology based on *xylose fermentation*, *lysine decarboxylation*, and H_2S production. Meanwhile, P1R and P1G did not show colonies with these characteristics, so they were negative. Growth on XLD media confirmed that only 1 in 4 pempek samples, namely P2R, was contaminated with *Salmonella* sp.. The consistency of results from previous LB and RV stages supports these findings.

Table 1 summarize the results of testing for the presence of *Salmonella* sp. in four pempek samples using three media stages: Lactose Broth (LB) for pre-enrichment, Rappaport Vassiliadis (RV) for selective enrichment, and Xylose Lysine Deoxycholate (XLD) for differential identification. All samples showed turbidity in LB medium, indicating early bacterial growth. This suggests that enteric bacteria subjected to previous environmental stress were successfully resuscitated during the pre-enrichment stage. However, the growth cannot yet be confirmed as *Salmonella* spp., requiring further selective enrichment.

Table 1. Analysis results

Sample	Lactose Broth	Rappaport Vassiliadis	Xylose Lysine Deoxycholate
P1R	Cloudy	+	-
P1G	Cloudy	+	-
P2R	Cloudy	+	+
P2G	Cloudy	-	-
Controls+	Cloudy	+	+

Note: (+) Bacteria suspected to be *Salmonella* sp. Grow; (-) Bacteria do not grow.

P1R: Trader 1 Boiled

P1G: Trader 1 Fried

P2R: Trader 2 Boiled

P2G: Trader 2 Fried

The bacterial identity confirmation stage was carried out on XLD medium, and the results in the table showed that only the P2R sample produced a typical *Salmonella* sp. colony, which is pink with a black center due to the production of hydrogen sulfide (H₂S). Meanwhile, the P1R and P1G samples did not produce colonies with these characteristics, so they were negative. Thus, of the four pempek samples tested, only one (25%) was microbiologically confirmed to contain *Salmonella* sp., namely pempek from Trader 2 Pempek Rebus. The distribution of these results indicates that bacterial contamination is uneven among all traders and types of pempek processing.

These findings show that although most samples meet the food safety requirements under SNI 7388:2009, the presence of one positive sample containing *Salmonella* sp. remains an indicator of public health risk. Based on these results, 25% of the total samples were contaminated with *Salmonella* sp. These findings indicate that some pempek products sold in the study area do not meet the food safety

requirements set by SNI 7388:2009, which requires *Salmonella* testing on 25 grams of fish-based processed food samples. The occurrence of contamination is very likely related to differences in hygiene, equipment sanitation, raw material quality, storage, and sales conditions among traders. The fact that the positive sample came from boiled pempek suggests that the re-cooking process or post-cooking environmental exposure can contribute to contamination. Hence, food safety depends not only on the heating process but also on hygiene and post-production handling.

The presence of *Salmonella* sp. in one of the samples is suspected to be related to inadequate hygiene and sanitation during the processing and storage of pempek. Factors that can cause contamination include the use of non-fresh fish raw materials, unclean water, and unsterile equipment. In addition, the sales process conducted in open spaces increases the risk of cross-contamination from airborne dust or insects carrying microorganisms. This condition is consistent with the research by Pramono et al. (2020),

who reported that 18 of 20 samples from household production and processing plants in Palembang City were positively contaminated with microbes due to poor hygiene practices.

The pre-enrichment medium, Lactose Broth (LB), in this study showed turbidity in all samples, indicating growth of enteric bacteria in the *Enterobacteriaceae* family. The enrichment stage using *Rappaport-Vassiliadis* (RV) medium showed discoloration in three of the four samples, indicating that halotolerant bacteria, such as *Salmonella* sp., grew well in the medium. However, only one sample showed typical growth on XLD media. These results confirm that, although there are indications of enteric bacteria in most samples, only one is specifically identified as *Salmonella* sp., underscoring the ability of XLD media to differentiate bacteria based on xylose fermentation and lysine decarboxylation.

This finding differs from the research by Jadhey et al. (2020), which did not find *Salmonella* sp. in 12 pempek samples around Syiah Kuala University, likely because traders had implemented hygiene and sanitation practices according to BPOM standards. On the contrary, the results of this study are close to those reported by Putri et al. (2022), who found 7 of 16 samples to be *Salmonella* sp. It shows that fish-based food products are at high risk of enteric bacterial

contamination, especially when handling is less hygienic.

The presence of *Salmonella* sp. in ready-to-eat foods such as pempek has important implications for public health. Infections caused by these bacteria (*salmonellosis*) can cause indigestion, such as diarrhea, fever, and vomiting, and are potentially fatal in vulnerable groups such as children and the elderly. Therefore, it is necessary to conduct regular supervision of traditional foods sold freely in the community (WHO, 2023; Sandita et al., 2025).

In addition to supervision, education for small and medium enterprises (MSMEs) in the food sector is very important. The implementation of *Good Manufacturing Practices* (GMP) and *Sanitation Standard Operating Procedures* (SSOPs) must be encouraged to ensure that the quality of food products meets the set safety standards. The use of clean water, storage of raw materials at low temperatures, sterile equipment, and personal hygiene training for food handlers are preventive measures that can reduce microbial contamination (Yelofeva et al., 2022; Kavipriya & Ravitchandirane, 2021; Risnawati et al., 2025; Siahaan et al., 2022).

The results of this study show that although most of the pempek sold in Ciracas RW 08 is safe from *Salmonella* sp. contamination, the risk of contamination remains. Regular laboratory examinations of

traditional snacks should be conducted to prevent foodborne diseases and raise public awareness of the importance of food safety. Follow-up research with a larger sample size and covering environmental sanitation variables and the cleanliness of processing equipment will provide a more comprehensive picture of the risk of contamination of pempek circulating in the community by pathogenic bacteria (Andiki Yelofeva et al., 2022).

CONCLUSION

The results of the study showed that, of the eight samples of pempek sold in the Ciracas urban village, RW 08, East Jakarta, one sample tested positive for *Salmonella* sp. Therefore, it is still necessary to carry out periodic supervision of snack food products, especially fish-based ones. In addition, traders should conduct *Salmonella* sp. contamination tests and other food contamination tests on pempek products that are sold periodically.

The authors suggest follow-up research with a larger sample count. In addition, it includes an analysis of environmental sanitation factors to obtain a more comprehensive picture of the safety of traditional snack foods in urban areas. As well as adding types of food samples other than pempek.

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