Global Education Journal
Vol. 3, 1 (January-April, 2025), pp. 311-316
EISSN: 2808-5094, DOI: 10.59525/gej.v3i1.795

Identification of Bacteria in Yellowfin Tuna (Thunnus albacares) with the Addition of Salt

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ARTICLE INFO

Keywords:

Bacteria, Garlic, Salt, Se'i Fish, Shelf Life.

Article history:

Received 2025-06-19
Revised 2025-07-12
Accepted 2025-09-29

ABSTRACT

One of the processed fishery products is se'i fish. Se'i is smoked meat that is traditionally processed using a smoking method with firewood and kosambi leaves. This study aims to identify the presence of Salmonella sp. and Escherichia coli bacteria in se'i tuna (Thunnus albacares) with salt addition treatment, as well as to evaluate factors that influence product safety. This study used a quantitative experimental method with various salt addition treatments in the manufacture of se'i tuna. Tuna se'i samples were treated with coarse and fine salt additions with variations of 5 g and 10 g, as well as a control without salt. Bacterial identification was carried out using standard microbiological methods. The results showed that all samples, both control and salt treatment, were negative for Salmonella sp. and E. coli. This indicates that salt variation did not affect the results because all samples did not contain these bacteria. The dominant influencing factor was the use of garlic as a spice containing allicin compounds with antibacterial properties that can inhibit the growth of spoilage bacteria. In addition, the packaging aspect plays an important role in improving the safety, quality, and competitiveness of se'i tuna products because they are safe to consume and have great potential as a traditional specialty product.

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1. INTRODUCTION

Indonesia is a maritime nation with a vast maritime territory, encompassing numerous islands and waters. The majority of the Indonesian population lives in coastal areas, rich in biodiversity, including a wide variety of fish, from small to large (Suman et al., 2017). One important fishery commodity is tuna (Thunnus albacares), which has high economic value in both the fishing and processing sectors. Tuna plays a vital role in the Indonesian economy, supplying over 16% of global tuna production. The potential for tuna resources in Indonesian waters is significant and has increased from 2000 to 2015,

(Firdaus, 2019).

One popular tuna-based product in East Nusa Tenggara is tuna se'i. Se'i is smoked meat prepared using firewood and kosambi leaves (Scheiechera oleosa merr) (Leki & Mardyaningsih, 2017). This product has distinctive organoleptic characteristics that consumers like, such as color, aroma, and taste (Muchtar & Hastian, 2023). The economic aspect of smoked tuna production also benefits financially from this processing method.(Giesen, 2023)The characteristic of se'i meat is its color, which varies from brown to red. The brown color comes from the browning process during heating and smoking, while the red color is obtained from saltpeter, which can also act as a preservative. Saltpeter substances such as potassium nitrate (KNO3) or sodium nitrate (NaNO3) are considered less safe chemicals (Saturday & Suryatni, 2015). Therefore, food safety remains a critical issue, particularly regarding contamination by pathogenic bacteria such as Salmonella sp. and Escherichia coli. Both are important indicators in determining the quality and safety of food products.

To achieve high-quality se'i fish processing, implementing comprehensive handling and packaging strategies that maintain the freshness and safety of the fish product is crucial. Proper handling, starting with the catch and landing process, can prevent ATP depletion and lactic acid accumulation.(Maeda et al., 2014). Processing and packaging of fish-based products is one way to increase the economic value of processed fish products (Juhaeri'ah et al., 2020). Good shelf-life will also inhibit the growth of microorganisms (bacteria) that cause decay (Iacumin et al., 2017). The use of natural additives such as garlic with the compound allicin is known to have antimicrobial activity (Heo et al., 2016). Based on this background, this study aims to identify the presence of Salmonella sp. and Escherichia coli bacteria in tuna se'i with the addition of salt.

This study aims to identify the presence of Salmonella sp. and Escherichia coli bacteria in tuna (Thunnus albacares) se'i with salt addition treatment, as well as to evaluate factors that influence product safety. This research is expected to make a significant contribution to the development of tuna se'i as a regional specialty food that meets safety and quality standards. Furthermore, it is expected to encourage communities and small and medium enterprises (SMEs) in the fish processing sector to optimize the use of natural additives such as garlic, which has proven antimicrobial properties, while also utilizing modern packaging technologies such as vacuum packaging.

2. METHODS

This study uses an experimental quantitative method with a variety of salt addition treatments in the manufacture of tuna se'i. This study was conducted in May-June 2025. Yellowfin tuna fish were obtained at the Larantuka Inpres market as much as 3 kilograms, then separated from the head, guts, skin and gills. Fish meat (fillet) was washed thoroughly after that weighed as much as 1,000 grams then given 5 treatments namely control without salt, fine salt 5 grams and 10 grams and coarse salt 5 grams and 10 grams then marinated with garlic as much as 0.185 grams for each treatment for 1.5 hours. The next step is smoking using kosambi wood and kosambi leaves to produce a distinctive aroma and unique taste for 30 minutes or the meat is cooked and reddish brown. The cooked and cooled se'i fish meat is then packed in vacuum plastic and taken to the laboratory for bacterial identification.

The smoking of fish se'i was carried out in the processing laboratory of the Fisheries Product Technology Study Program of the IKTL while bacterial identification was carried out at the UPTD NTT Provincial Health Laboratory. Isolation of the target, namely fish meat, was then incubated for 24 hours at a temperature of 28°C, then expanded using 3% TSA media and incubated for 24 hours at a temperature of 28°C. After that, biochemical tests were carried out (catalase test, oxidation test, mortality test, carbohydrate fermentation test, MR-VP test, citrate test, TSIA test, indole test and substrate utilization test). After 24 hours, the results of the biochemical tests were read and then identified using conventional methods.(Srinivasan & Saranraj, 2017)The data from this research were analyzed using descriptive analysis with reference to a bacterial identification book.

3. FINDINGS AND DISCUSSION

This study used an experimental method with varying salt additions in the production of tuna se'i.

The treatments consisted of a control (no salt), 5 g of coarse salt, 10 g of coarse salt, 5 g of fine salt, and 10 g of fine salt. Samples were then tested in the laboratory using standard microbiological methods to detect the presence of Salmonella sp. and Escherichia coli. The NaCl content in the coarse salt samples in East Flores Regency did not meet SNI 3556:2010 (Batafor, 2020).

Table 1. Results of examination of Salmonella sp. and E. coli bacteria

No	Type of salt added (grams)	Check up result Salmonella sp. and E. coli bacteria
1.	control	negative
2.	coarse salt 5	negative
3.	10g coarse salt	negative
4.	5 fine salt	negative
5.	10g fine salt	negative

Source: processed primary data, 2025

The identification results in Table 1 are negative for Salmonella sp. and E. coli, meaning that the tested samples do not contain Salmonella sp. and E. coli bacteria. This indicates that the tested products are safe from these pathogenic bacteria. The main contributing factor is the use of garlic as a seasoning, which contains the compound allicin with antibacterial properties. Garlic can help maintain the quality of fish meat by inhibiting the growth of spoilage bacteria and extending the shelf life of fish. Garlic has demonstrated antimicrobial activity against various pathogenic bacteria. In addition, garlic can also boost the immune system of fish and help prevent infection.(Heo et al., 2016)Salmonella sp. bacteria are an indicator of the safety of meat and processed meat commodities. A negative salmonella test is essential to ensure food safety and prevent the spread of diseases caused by this bacteria. Its immunostimulant effects, combined with its antimicrobial properties, make garlic a valuable natural additive for maintaining fish meat quality and potentially acting as a broad-spectrum antimicrobial (Prihandani, 2015).

Besides the use of garlic in tuna se'i meat, the packaging used in the resulting product is equally important. Packaging plays a crucial role in extending the shelf life and improving the quality of fish products. Various packaging technologies, such as vacuum packaging, modified atmosphere packaging (MAP), and active packaging, are used to inhibit microbial growth and delay spoilage. The integration of these advanced packaging and processing technologies not only enhances the economic value of fish products by increasing their marketability but also ensures compliance with food safety regulations.(Ha & Bekhit, 2024). In addition, consumer satisfaction and sales can be significantly improved through the adoption of quality-based packaging strategies, which can increase product sales by 25% and increase consumer satisfaction by 90% (Susanti & Rudiyanto, 2024).

The results of this study indicate that all samples of yellowfin tuna (Thunnus albacares) se'i, both in the control treatment and with the addition of coarse and fine salt in variations of 5 g and 10 g, did not detect any Salmonella sp. or Escherichia coli bacteria. This finding indicates that the processing of tuna se'i through traditional smoking stages with wood and kosambi leaves, as well as the use of natural spices in the form of garlic, is able to maintain the microbiological safety of the product. This finding is in line with the research of Iacumin et al. (2017) which states that the smoking process in fish products functions not only as a flavor enhancer, but also as an inhibitor of the growth of pathogenic microorganisms through phenolic compounds and formaldehyde produced from wood combustion.

The absence of Salmonella sp. and E. coli in the tuna se'i samples in this study is also consistent with the results of Heo et al.'s (2016) study, which emphasized the role of the allicin compound in garlic as a natural antibacterial agent. This compound is known to damage bacterial cell walls, inhibit essential enzymes, and suppress the growth of pathogenic microbes in food products. Thus, the addition of garlic in the marinating process of tuna se'i not only improves flavor but also plays an important role in extending the product's shelf life. In this context, Prihandani's (2015) study also supports the potential of garlic as a broad-spectrum antimicrobial, making it effective for use in processing animal protein-based foods.

The results of this study also show that varying the use of salt, both coarse and fine, with varying concentrations, did not significantly impact the presence of pathogenic bacteria. This contrasts with the findings of Batafor (2020), who emphasized that the NaCl content in local salt in East Flores did not fully meet national standards (SNI 3556:2010). However, in this study, salt did not appear to be a significant factor, as smoking and garlic were the dominant factors in suppressing microbial growth. In other words, salt functions primarily as a flavor enhancer and helps reduce water activity (aw), but is not the primary factor determining the microbiological safety of tuna se'i.

From a food processing theory perspective, these findings reinforce the concept that food safety control cannot rely solely on a single factor, but rather is the result of a synergy of various aspects, such as fresh raw materials, the use of natural additives, appropriate processing methods, and packaging technology (Juhaeri'ah et al., 2020). The smoking process, carried out for 30 minutes until the meat is cooked and reddish brown, has been proven effective in reducing the risk of microbial contamination, as reported by Giesen (2023) that traditional smoking methods not only increase the economic value of the product but also provide natural antimicrobial effects.

Another important aspect of this study is the role of vacuum packaging in maintaining the quality of tuna se'i products. The results showed that although no Salmonella sp. and E. coli were found, packaging factors remain a key strategy for maintaining freshness and extending product shelf life. This is in line with the study by Ha & Bekhit (2024) which emphasized that modern packaging technologies such as vacuum and modified atmosphere packaging (MAP) can inhibit fat oxidation and microbial growth, making fish-based products safer and more economically valuable. Research by Susanti & Rudiyanto (2024) also added that good packaging not only increases consumer satisfaction but also has a significant impact on increasing sales.

Thus, the results of this study confirm that the microbiological safety of tuna se'i is not solely determined by the addition of salt, but rather by the combination of the use of natural ingredients with antimicrobial properties (garlic), a traditional smoking process that produces bacteria-inhibiting compounds, and effective packaging technology. These findings provide an important contribution to the development of traditional processed fish products that are safe, high-quality, and highly competitive. Tuna se'i not only has cultural and economic value, but also has great potential for wider marketing as a typical product of East Nusa Tenggara that meets food safety standards.

4. CONCLUSION

The results obtained in tuna se'i meat did not contain Salmonella sp. or Escherichia coli bacteria because the se'i meat contains garlic which functions to inhibit the growth of spoilage bacteria and extend the shelf life of the fish. The level of freshness of the fish also affects the growth of bacteria so that fresh fish and the addition of garlic will make the se'i fish meat last longer. Se'i meat products from yellowfin tuna can be consumed safely and are one of the typical souvenirs from East Nusa Tenggara Province which can be obtained at an affordable price but need more attractive packaging, certification from BPOM and good promotion.

Se'i, a yellowtail tuna meat product, could become a signature souvenir from East Nusa Tenggara Province. What's needed now is more attractive product packaging, certification from the Food and Drug Authority (BPOM), and a promotional strategy through social media and online sales platforms. This support will enable se'i tuna to become a leading product that provides economic benefits to the local community.

ACKNOWLEDGEMENT

Thanks to the head of the fishery product processing laboratory of the Larantuka Teacher Training and Technology Institute and the NTT Provincial Health Laboratory UPTD.

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