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REVIEW ARTICLE: COMPARISON OF THE USE OF VACUUM AND NON-VACUUM PACKAGING ON THE QUALITY OF PROCESSED FISH PRODUCTS

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KeyWords
Quality Analysis, Moisture Content, pH, TPC, Storage, Vacuum Packaging, Non-Vacuum Packaging

ABSTRACT

Fish is also one of the food ingredients that are easily damaged or experience a decline in quality. This study aims to compare the use of vacuum and non-vacuum packaging on the quality of processed fish products. The type of packaging can affect the quality during storage. Therefore, in the production of processed fish, appropriate packaging is needed so that the quality of fish products can be stored for a long time without reducing the quality of processed fish. Vacuum and non-vacuum packaging cannot be used for all types of processed fish, so many studies have made comparisons in order to determine the most suitable packaging. The method used in this research is literature exploration: Research Gate, Directory of Open Access Journals, Elsevier, Springer, and Google Scholar. The keywords used to search for relevant discussion topics include quality analysis, various fishery products, packaging, smoking, storage, vacuum packaging, non-vacuum packaging and room temperature.

The results of this study indicate that vacuum packaging is more recommended in maintaining the quality of processed fish products than using non-vacuum packaging. Several studies have shown that the quality of processed fish products in vacuum and non-vacuum packaging can be determined by measuring water content, pH and TPC. If the water content is high, the growth process of microorganisms will increase so that it can cause faster foaming, seen from several journals, it is known that the increase in water content occurs mostly in non-vacuum packaging. A good pH measurement for preserved fish is between 2.0-5.6 while pH is 6.0-8, 0 is a good medium for the growth of microorganisms. Several studies have shown that non-vacuum packaging has a higher pH than vacuum packaging. Meanwhile, if the TPC value is higher in the measurement of a package, it is not suitable for consumption. From this study, it is known that the highest TPC value is found in non-vacuum packaging compared to vacuum packaging.

INTRODUCTION

Indonesia is a maritime country with a fairly wide sea. The Indonesian Sea has great resource potential, especially the potential for marine fisheries in terms of the number and diversity of species. Indonesia's marine area is approximately 5.8 million km2 with a coastline of 81,000 km. The vast Indonesian seas provide marine fish resources with sustainable potential of 6.4 million tons per year which are widely distributed in Indonesian waters and in the waters of the Indonesian Exclusive Economic Zone (EEZ). The amount of catch allowed in Indonesia is 80% of the sustainable potential of marine fish resources, which is 5.12 million tons [1]. Basically, fish is a food that is susceptible to biological damage by enzymes or spoilage microorganisms. Therefore, fish require special treatment to maintain their quality. The most common food spoilage is spoilage caused by bacteria.

Smoking is defined as the penetration process of volatile compounds in wood-burning fish that can produce products with a certain taste and aroma with a long shelf life due to antibacterial activity, inhibition of enzymatic activity in fish, so that it can affect the quality of smoked fish. Wood smoke chemical compounds are generally in the form of phenols (acts as antioxidants), organic acids, alcohols, carbonyls, hydrocarbons and nitrogen compounds such as nitrous oxide, aldehydes, ketones, esters, ethers, which stick to the surface and then penetrate into fish flesh [2] and temperature control is difficult and pollutes the air [3].

Indonesia's fish production is quite large, especially capture fisheries and aquaculture, in 2006 amounted to 7,488,708 tons and in 2010 increased to 10,826,502 tons [4]. These fishery products are generally eaten fresh, while those that are exported and processed are modern or traditional. The high fishery resources in Indonesia do not make Indonesia superior in processing fishery products. Indonesia only controls 11% market share in processed fishery products, far behind Thailand with 48% market share for processed products. Meanwhile, the Indonesian sea is bigger than the Thai sea. This is not comparable to the potential and resources of fisheries in Indonesia. One of the most important factors in increasing processed production is in the processing and packaging process.

Unhealthy processing methods, as well as storage in unprotected or well packaged conditions in tropical conditions, make traditional processed fish products very vulnerable to microbiological damage. This damage can cause spoilage of the product by either pathogenic bacteria or fungi or by the toxins produced. Processing combined with heating and contamination by the processor is unavoidable, so smoked seafood products are also susceptible to the growth of Staphylococcus aureus. Another danger that occurs is poisoning due to the growth of Clostridium Botulinum, a highly heat-resistant sporogenic bacterium, which produces botulism toxins. Decrease in fish quality is caused by enzymatic and bacterial action,

One way or method used to provide good quality is to use packaging so as to provide protection for food in the form of packages or placing food in containers [5]. Packaging serves to provide processing results or industrial products so that they have a higher product value and facilitate storage, protect products from damage during transportation and distribution. Developments in the post-harvest sector, packaging has brought many innovations in the form and materials of product packaging. Among them are vacuum and non-vacuum packaging.

Vacuum packaging is a packaging technology that uses vacuum plastic (vacuum packaging). Vacuum packaging is one of the packaging of food products so that the products inside are protected from the exchange of water or gas from the outside. According to [6] vacuum packaging using plastic can prevent contamination between microorganisms, extend the shelf life of food products, and reduce the amount of oxygen in the packaging. In addition, vacuum packaging can also provide a good visual effect for food. The permeability properties of plastic packaging can affect the product into vacuum packaging. Vacuum packaging is a vacuum packaging system, in which the pressure can be less than 1 atm. Vacuum packaging is done by removing air from the packaging so that it can extend the shelf life.

Many studies have discussed the quality analysis of processed fish products using vacuum and non-vacuum packaging. This study aims to determine the development of quality analysis of processed fish products using vacuum and non-vacuum packaging in Indonesia and its application.

Research methods

The method used is literature exploration: Research Gate, Directory of Open Access Journals, Elsevier, Springer, and Google Scholar. The keywords used to search for relevant discussion topics include quality analysis, various fishery products, packaging, smoking, storage, vacuum packaging, non-vacuum packaging and room temperature. The theoretical framework can be arranged according to the subject matter of the discussion.

Results and Discussion

Water content

The value of the moisture content of smoked skipjack tuna in vacuum packaged products appeared to be stable (no change) in the value

of the water content for 21 days of storage. This is because vacuum storage can hold smoked skipjack products. Storage at room temperature with uncontrolled temperatures can affect the increase and decrease in water content in vacuum packaged products [7]. Furthermore, with vacuum packaging there is no evaporation and absorption of the free water contained. Meanwhile, for products that were not vacuum packed, the water content decreased significantly during 21 days of storage. This may be due to the evaporation of the product due to the influence of the temperature and humidity of the environment being lower than the humidity of the product [8]. The standard value for the moisture content of smoked fish based on [9] is a maximum of 60-65%. The results showed that smoked seafood products that were vacuum-packed and not vacuum-packed during storage for 21 days had water content that was still within the standard limits determined by [10]. Moisture content is an important parameter in determining the quality of smoked fish produced. The water content in smoked fish can affect the shelf life of smoked fish. Because the water content is a medium for microbial breeding [11].

In the processed product of instant goldfish paste with the first week of storage, the water content is low in both vacuum and non-vacuum packaging, which is around 30%. Bekasam on storage increased in both treatments of packaging methods. This is due to the characteristics of the packaging material. Polyethylene is a packaging material that has a fairly high permeability [12]. There are other factors that affect the increase in water content. Instant bekasam which is packaged in non-vacuum has increased water content faster than vacuum packaging. This is caused by the internal activities of the product. Instant bekasam with non-vacuum packaging undergoes the breakdown of the compound content in the product by microorganisms and oxygen. The availability of oxygen causes an increase in the activity of aerobic bacteria which releases free water. This is reinforced by [13], the increase in water content until the 12th day of storage can be caused by the process of breaking down protein into components such as ammonia, indole H2S, skatole which causes a foul odor and is followed by the release of bound water into free water by microorganisms.

In research [14] processed products of tuna packed with vacuum increased the value of water content significantly compared to products that were not packed with vacuum. The increase in water content is due to the absorption of water vapor in the surrounding environment even though it is packaged with plastic packaging materials, but because plastic has water vapor permeability properties, it will facilitate the penetration of water vapor. fish. The high-water content in the packaging material causes the plastic to have a high moisture content during the packaging process and promotes rapid microbial growth. This is because the difference in pressure inside and outside the package will result in the entry of water vapor into the package and the water vapor is absorbed by the product thereby increasing the water content of the product during storage. [15], states that the moisture content of a product is affected by the relative humidity of the surrounding air. If the humidity of the room is higher, the product will absorb water, and if the humidity of the storage room is low, the product will evaporate the water.

According to research [16] processed white prawn jerky products from the aw test showed that on day 0 and day 6 there was no significant difference, while for day 3 and day 9 there was a significant difference. The lowest value for vacuum-packed jerky was around 0.747 and the highest was 0.87, while the lowest value for non-vacuum-packed jerky was 0.78 and the highest value was 0.97. White shrimp jerky products are recommended to be packaged using vacuum packaging because the quality (physical, chemical and microbiological) has been tested and complies with the [17] standard.

Research by [18] furthermore, smoked stingray processed products with vacuum packaging showed smoked stingray in vacuum packaging at room temperature (± 30 o C) on the first day (0) aw lower than storage at refrigerator temperature (± 5 C), as well as on days 4, 6 and 8. Based on statistical analysis of a_w on smoked stingrays stored in vacuum packaging at room temperature (± 30oC) and refrigerator temperature (± 5oC), there was no significant difference.

Power of Hydrogen (pH)

Whole smoked tuna (Katsuwonus pelamis L) had a pH value that was vacuum packed for 0 days which was still good, namely 5.68, and for non-vacuum packaged 5.85 the value began to increase which was not good. while the pH on day 2 which has entered the criteria is not good because it is a good medium for bacterial growth for vacuum 6.12 and for non-vacuum 6.08. Differences in pH occur due to the level or activity of lactic acid bacteria and the other of organic acids in smoked fish [19]. Fish meat that has a high pH is caused by the appearance of alkaline compounds such as ammonia, trimethylamine and other volatile compounds, which can also reduce the organoleptic value of the product. In the process of glycolysis, enzymes play an important role in the formation of lactic acid [20]. The pH value of food during storage can vary due to the presence of proteins which are broken down by proteolytic enzymes and the help of bacteria into carboxylic acids, sulfides, ammonia and other types of acids. Therefore, the pH value of smoked skipjack tuna produced even though it was increased, it was still under acidic conditions. The pH value is one of the indicators used to determine the level of freshness of fish.

On research [21] It is known that instant tamarind products have an increase in acidic compounds during fermentation. The results of the analysis showed that the average pH levels of carp excavated fish ranged from 5.89 to 6.05. The pH value of foodstuffs during storage can change due to the presence of proteins that are decomposed by proteolytic enzymes and the help of bacteria into carboxylic acids, sulfide acids, ammonia and other types of acids. The magnitude of the pH value is related to the formation of alkaline compounds during storage and will affect microbial growth. According to [22], changes in pH to become more alkaline are caused by a number of spoilage bacteria found in meat that are able to carry out the fermentation process and produce ammonia.

Based on research results [23], obtained the average pH value of smoked tuna during storage in vacuum and non-vacuum packaging. The average pH value of smoked tuna at 0 days of vacuum packaged storage was 5.87 and non-vacuum was 5.83. The average pH value of tuna in 2 days of vacuum-packed storage is 6.17 and non-vacuum is 6.31. Based on the pH value data, it was shown that vacuum and non-vacuum packaged fish on the 2nd day of storage showed a pH value which was a good medium for the growth of micro-organisms. According to [24]

a good pH for preserved fish is between 2.0-5.6, while a pH of 6.0-8.0 is a good medium for the growth of microorganisms.

On research [25] changes in the degree of acidity (pH) in smoked stingrays with vacuum packaging showed that the degree of acidity (pH) in vacuum packaging at refrigerator temperature (± 5C) was lower than in vacuum packaging at room temperature (± 30C). Based on statistical analysis, the pH of smoked stingray stored in vacuum packaging at room temperature (± 30C) and refrigerator temperature (± 5C) was not significantly different. Similarly, on the 4th, 6th and 8th days, it continued to increase although it was not significant. This happens because the pH in smoked stingrays will continue to rise along with the decomposition process that occurs. During storage, protein degradation produces a number of volatile bases such as ammonia, histamine, and trimethylamine. The enzymatic action is independent of oxygen, but the action of proteolytic enzymes is temperature dependent. The enzymatic action decreases at low temperatures. Control of enzymatic action can be done by lowering the temperature, while side effects can be overcome by waterproof packaging and oxygen impermeable film. Enzymes become inactive on heating the product [26].

Total Plate Count (TPC) Data

The data showed that the TPC value in the product that was not aspirated during storage on day 2 had increased and had the highest value (2,46X103) indicating an increase in bacteria. While the lowest value is found in vacuum packaging products with 0 days of storage, namely (4.95X102). From the data above, it can be seen that vacuum packaged products look better because fewer bacterial colonies grow than non-vacuum products [27]. Bacterial growth in fish is strongly influenced by temperature, the lower the temperature of the fish, the slower bacterial growth, cell division does not occur in the early stages of microorganism growth [28]. Furthermore, after being able to adapt to their new environment, bacterial cells will grow and divide exponentially to the maximum number. According to [29] lack of oxygen for the metabolic needs of bacteria, where bacteria are difficult to reproduce even though the water content contained in the product is sufficient for bacterial activity.

According to research [30] total bacteria in non-vacuum packaged instant containers was higher than vacuum packaging with the highest total bacteria, namely log 7.32 CFU/g at the 3rd week of storage. Meanwhile, the lowest total bacteria ware found in the vacuum packaged instant container at the 0th storage, namely log 4.92 CFU/g. This is confirmed by [31], the total microbe of instant tilapia fish reached the highest value, namely log 5,936 CFU/g on the first day of storage. The TPC figure for instant cassava is still relatively high. This is caused by several factors, namely the fermentation process that utilizes the work of lactic acid bacteria, so it is possible that the bacteria that are counted are bacteria that work during the fermentation process. The second factor is the presence of spoilage bacteria which increases with storage time.

Based on research [32] products packaged in vacuum and non-vacuum still meet the quality requirements of smoked fish recommended by the Indonesian National Standard Agency [33] until the 2nd day of storage. Where the maximum limit of the TPC value is 1.0 x 105 colonies/g. The results of the study during storage there was an increase in the value of TPC in vacuum and non-vacuum products. This increase could be due to the fact that during the 0th day of sampling the fish handling from the processing site did not pay attention to sanitation and hygiene during processing to the final product, so as to control the occurrence of microbial contamination and proliferation.

On research [34] It is known that the value of the Total Plate Count (TPC) of vacuum-packed white shrimp jerky has the highest value on the 9th day of 3.27 log 10 (1.8 x 103 CFU/g) and the lowest on the H-0 day of 3.00 log 10 (1.0 x 103 CFU/g), while the highest value of the Total Plate Count (TPC) of non-vacuum packaged white shrimp jerky was 6.12 log 10 (1.3 x 106 CFU/ g). Based on [35] regarding beef jerky products, it states that the maximum limit for the total plate number set for beef jerky is 1x105 colonies/g, thus beef jerky stored in a vacuum is still suitable for consumption because the highest TPC value is on the 9th day of storage, namely 1.8 x 103 CFU/g, while for the highest TPC value in non-vacuum packaged beef jerky on the 9th day, namely 1.

Conclusion

In this review article, it is known that the analysis of the quality of fishery products in vacuum and non-vacuum packaging can be seen from the water content, pH, and TPC. If the water content is high then the growth process of microorganisms will increase so that it can cause faster decay, seen from several journals it is known that the increase in water content mostly occurs in non-vacuum packaging. A good pH measurement for preserved fish is between 2.0-5.6 while pH 6.0-8.0 is a good medium for the growth of microorganisms. Several studies have shown that non-vacuum packaging has a higher pH than vacuum packaging. Meanwhile, if the TPC value is higher in the size of a package, it is not suitable for consumption. From this research, it is known that the highest TPC value is found in non-vacuum packaging compared to vacuum packaging. The conclusion of this review article is that vacuum pack-aging is more recommended in maintaining the quality of processed fish products than using non-vacuum packaging.

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