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IMPROVING MARKETING MANAGEMENT WITH THE EFFECTS OF COATING CHITOSAN INHIBITION TO INCREASE QUALITY OF FISH FILLET UPENEUS MOLUCCENSIS AT ROOM TEMPERATURE STORAGE

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Abstract

The shelf life of fishery products is an important factor in marketing management. It is important to estimate the shelf life of the product with information available from trusted sources. Seafood products classified as fresh, frozen, or ready-to-eat (RTE) each have unique food safety risks and spoilage processes that influence the end of their durable life. Fresh fish shelf life can be extended by adding antibacterial compounds such as synthetic chemicals or natural materials. One of the natural ingredients that are safe to use to prolong the freshness of the fish is chitosan. Chitosan is able to provide quality deterioration inhibitory effect of fillet of Upeneus moluccensis. The rate of decline in the value of organoleptic fillet of Upeneus moluccensis treated chitosan solution is slower when compared to no treatment tilapia fillet chitosan solution. In the organoleptic test until the 18 hours of storage, 4% chitosan solution capable of maintaining the highest organoleptic value for the parameter sightings meat, texture, and smell fillet. The use of 4% chitosan solution provided the best results based on the parameters of the appearance of meat, the texture, the smell, the pH value and the value of TVB fillet. This solution can be used furtherly to enhance the marketing management due to extended storage time. Therefore, increasing the chance of sales and transport time.

Keyword: Improving shelf life, shelf life management, chitosan, extend storage time

1. INTRODUCTION

Shelf life is the period of time during which a food product remains safe and acceptable for consumption under specified storage conditions [1]. For fishery products, shelf life is influenced by many factors, such as the species, the harvesting method, the processing technique, the packaging material, the storage temperature, and the distribution chain. Understanding the shelf life of fishery products is important for marketing management implications, such as product development, quality assurance, pricing, promotion, and distribution [2]. One of the main challenges of marketing fishery products is to ensure that they reach the consumers in a fresh and wholesome condition. Fishery products are highly perishable and susceptible to microbial spoilage, chemical deterioration, and sensory changes [3]. Therefore, they require proper handling and preservation throughout the supply chain, from harvest to consumption[4]. The shelf life of fishery products depends on the initial quality of the raw material, the type and extent of processing applied, and the storage conditions maintained [2]. Different fishery products have different shelf lives, ranging from a few hours to several months[1].

The shelf life of fishery products can be determined by various methods, such as microbiological analysis, chemical analysis, sensory evaluation, or predictive modeling. Microbiological analysis measures the growth and activity of spoilage microorganisms in the product [5]. Chemical analysis measures the changes in chemical components, such as water activity, pH, lipid oxidation, or biogenic amines. Sensory evaluation measures the changes in appearance, odor, flavor, and texture of the product. Predictive modeling uses mathematical equations to estimate the shelf life based on the product characteristics and environmental factors.

The shelf life of fishery products has significant implications for marketing management. First, it affects the product development process, as it determines the feasibility and profitability of new product ideas. For example, if a new product has a short shelf life, it may not be suitable for long-distance transportation or distribution. Second, it affects the quality assurance process, as it defines the quality standards and specifications for the product. For example, if a product has a long shelf life, it may require more stringent quality control measures to ensure safety and consistency. Third, it affects the pricing process, as it influences the cost and value of the product. For example, if a product has a short shelf life, it may have a lower price than a similar product with a longer shelf life. Fourth, it affects the promotion process, as it shapes the communication strategy and message for the product. For example, if a product has a long shelf life, it may emphasize its convenience and versatility in its promotion[6]. Fifth, it affects the distribution process, as it determines the logistics and inventory management for the product. For example, if a product has a short shelf life, it may require more frequent deliveries and lower stock levels than a product with a longer shelf life [7].

The shelf life of fishery products is an important factor in marketing management. It is important to estimate the shelf life of the product with information available from trusted sources. Seafood products classified as fresh, frozen, or ready-to-eat (RTE) each have unique food safety risks and spoilage processes that influence the end of their durable life. To make the fishery product arrive at the customer at the right time and in the right quality is required an effective marketing system and either food chain support or adding the shelf life of the product [3].

Fresh fish shelf life can be extended by adding antibacterial compounds such as synthetic chemicals or natural materials. These compounds can diffuse into the surrounding environment and inhibit or stop the growth of bacteria [8]. Antibiotic material are grouped into antibiotics that are effective against some types of bacteria (narrow spectrum) and antibiotics that are effective against many types of bacteria (broad spectrum). Material synthetic antibiotics such as tetracycline already banned its use for health reasons, therefore there is no longer an effective antibiotic material used in the handling of fish catches. One of the natural ingredients that are safe to use to prolong the freshness of the fish is chitosan[9].

Chitosan is a product of chitin derivative of the formula Nasetil-D-Glucosamine, a cationic polymer having a monomer amount of about 2000-3000 monomer, non-toxic and has a molecular weight of about 800 kD [10]. Increasing the number of shrimp production will generate more waste processed shrimp that can be utilized as chitosan. Based on the results of research into the effects of chitosan on some of the bacteria that cause spoilage of fish, this research tries to take advantage of the chitosan to extend the lasting power of fillet goatfish at room temperature storage. This study aims to determine the effect of chitosan at various concentrations to the lasting power fillet of goatfish (Upeneus moluccensis) were stored at room temperature. Furthermore, it can increase the shelf life of the fishery product and extends the marketing area.

2. LITERATURE REVIEW

2.1. Chitosan

Chitosan is a polysaccharide derivative derived from shrimp waste. Utilization for the food industry in Indonesia has not been widely applied. Chitosan can be used as a stabilizer, thickener and emulsifier forming a clear protective coating for food products. Romanzi [9]states that chitosan is a natural polysaccharide which is both biodegradable and non-toxic. Chitosan has the chemical name (1-4) -2-amino-2-deoxy-D-glucose. Chitosan specific form and contain amino groups in the carbon chain. This causes the positively charged chitosan which is opposite to the other polysaccharide [7].

Chitosan has the same properties as the material forming the synthetic textures such as CMC (carboxymethylcellulose) that can improve the appearance and texture of a product because it has water and oil binding force is strong and heat resistant. There are so many benefits of chitosan that have been examined, ranging from the fields of food, microbiology, health, agriculture, and so on. Chitosan can be used as an antimicrobial agent because it is biodegradable and non-toxic [8]. Kulawik et al. [5] suggest that chitosan has the potential to be used in the fields of pharmaceutical, food, agriculture, and environment. Chitosan can function as an antimicrobial, antitumor and anticancer. Camacho et al. (2010) states that one of the benefits of chitosan is that it can be used as an antifungal.

2.2. Edible Film

Edible film constitutes a specific category from food packaging defined as a type of packaging that resembles a film, a sheet or thin layer as an integral part of the food product and can be eaten together with the product [11]. Edible film is used in food products to prevent the mass transfer among the food products with the surrounding environment or between different phases of the mixed food products (such as aw which differs in the same food product). Hence, the film is used to avoid damage to the quality of food because of the physico-chemical changes, texture or chemical reaction such as fat oxidation, Maillard reactions and enzymatic reactions[12].

Protective bulkhead can be formulated to prevent the transfer of water vapor, air, flavor or fat and furthermore to improve the quality of food and increases the shelf life. Perez et al [12] stated that edible film edible film serves as a barrier to water vapor so that the shelf life of a product can be extended. Bonilla et al. [11]declared that oxygen is one of the factors which can degrade the quality of food products. Therefore, the use of edible film is one of the ways that can be performed to reduce the oxygen.

3. RESEARCH METHODS

3.1. Time and Place

The present research is performed in the Laboratory of Aquaculture, Faculty of Fisheries and Marine, Airlangga University. This research is conducted since 2022 till now.

3.2. Materials and Equipment

The tools used in this study include digital scales, filter paper, plastic, knives, cutting boards, basin, paper labels, rubber binders, analytical tools that include pH-meter, pipettes, petri dish, a vortex, spatula, incubators, test tubes, erlenmeyer, cup conway, homogenizer tool, measuring cups and goblets. The materials used in this study is a live tilapia weighing 500-600 grams counted 20 head, chitosan, acetic acid, distilled water, nutrient agar (NA), saline, trichloroacetic

(TCA), K2CO3, HCl 0.01 M, boric acid, and a buffer solution.

3.3. Research Methods

This study consisted of two phases: a preliminary research stage and the primary research phase. The preliminary study aims to determine the concentration of chitosan which has an inhibitory effect on the decline of the quality of the fish fillet see organoleptic changes due to the influence of chitosan solution concentration used. The main research aims to determine the effect of chitosan concentration optimal solution to the freshness of goatfish fillets. Fresh goatfish fish weighing 500-600 grams killed first, and then prepared into a fillet skin on.

Upeneus moluccensis fillets are further divided into groups for treatment concentration and treatment subgroups for longer storage. Fillet soaked for 3 minutes in a solution of chitosan, then stored at room temperature for 6 hours. Fillet left open at room temperature without packaging. Setbacks in organoleptic quality of the fillet is observed, the measurement of the potential hydrogen value (pH), calculating the value of total plate count (TPC), and calculating the value of total volatile base (TVB). The experiments were conducted three replications. Data from the main study then tested statistically.

3.4. Observations and Measurements

3.4.1. Potential Hydrogen Value

pH measurement is done using digital pHmeter. Prior to use, the tool pH meter rinsed with distilled water and dried with a tissue. Furthermore, calibrated using buffer solutions pH 4 and pH 7 buffer dipped in and allowed a moment to steady.

3.4.2. Total Volatile Base Value (TVB)

Test Total Volatile Base is one of the methods of measurement to determine the freshness of fish is based on the evaporation of the basic compounds. TVBN analysis conducted by weighing a sample of 100 grams and added with 300 ml of 7% TCA and then mashed. The solution was filtered with filter paper to obtain a clear filtrate. Make distillation, distillate accommodated with 15 ml of HCl 0.01 M. Add a few drops of phenol red indicator in the distillate is then titrated with NaOH 0.01 M until pink.

3.4.3. Total Plate Count Value (TPC)

Microbiological test is done by calculating the number of microbes in the sample by dilution as necessary and done in duplicate. A mixture of 1 ml was taken and put into a tube containing 9 ml of sterile 0.85% saline solution in order to obtain dilution 10-2. Then performed a similar procedure for dilution of 10-3 and so on up to 10-5 dilution. For sterile incorporated into a sterile petri dish and allowed to clot. 0.1 ml of diluted sample is pipetted on the agar surface. Example leveled on the surface of agar using a sterile glass rod and incubated at 10 °C for 5 days.

4. RESULTS AND DISCUSSIONS

4.1. Potential Hydrogen Value (pH)

The determination of the degree of acidity (pH) is one indicator measuring the level of freshness of the fish. In the process of decaying fish, fish meat pH changes caused by the process of autolysis and bacterial attack. The pH value of goatfish fillets during the study ranged from 6.34 to 6.78. The average value of pH fillet of Upeneus moluccensis can be seen in Table 1.

Table 1: The Average Value of Ph Fillet of Upeneus Moluccensis with Chitosan Coating

Solution during Storage at Room Temperature

storage time (hours)	chitosan 4%
0	6,78
6	6,56
12	6,34
18	6,34

The pH value of the fish fillets with the treatment of chitosan solution will continue to decline due to the presence of acetic acid as the solvent chitosan. The presence of acid in a solution of chitosan can affect the pH of the material. The pH of the chitosan solution used during the study ranged from 4 to 6. The pH value of Upeneus moluccensis fillet with a solution of chitosan decreased during storage 18 hours. It is suspected chitosan is able to inhibit the activity of bacteria that breakdown of proteins by bacteria become blocked so that the increase in non-protein nitrogen content which can lead to the accumulation of bases also hampered. Chitosan is a substance that can be used as an antibacterial because it has the ability to inhibit the growth of microorganisms' destroyer and coating products to protect the product from environmental contamination.

4.2. Total Volatile Base Value (TVB)

Test Total Volatile Base is one of the methods of measurement to determine the freshness of fish is based on the evaporation of the basic compounds. The higher the value of TVB shows that meat quality has declined. TVB value coating fillet of Upeneus moluccensis with chitosan during storage ranged from 11.23 up to 24.58 mg N / 100 g sample. Value TVB fillet of Upeneus moluccensis increased with the length of storage time. Increasing the value of TVB fish during storage occur due to degradation of protein or derivatives, which produces a number of volatile bases such as ammonia, histamine, hydrogen sulfide, and a foul-smelling trimethylamine. The average value of TVB fillet of Upeneus moluccensis can be seen in Table 2.

Table 2: The average value of TVB fillet of goatfish with chitosan coating solution for room temperature storage

storage time (hours)	chitosan 4%
0	11,23
6	13,65
12	15,47
18	24,58

The value TVB fillet of Upeneus moluccensis obtained during these observations included the product category is still fit for consumption as it is still below the standard value of TVB, which is 30 mg N / 100 g sample, which refers to the standard freshness of the fish based on the value of TVB. According Parra.et al. (2004) an increase in the value of TVB during storage due to degradation of the protein resulted in a number of volatile bases such as ammonia, histamine, and trimethylamine. Chitosan has a positively charged polikation able to bind to proteins, one of which is an enzyme. Chitosan which binds to the enzyme is able to minimize the action of the enzyme. The binding of the enzyme by chitosan only take place on the surface of the fillet coated with chitosan. Chitosan is unable to effectively get into the meat muscle tissue to bind the enzyme as a large molecular weight chitosan. Soluble chitosan acid generally has a molecular weight ranging from 800 kD to 1000 kD (Janesh 2003, referred to in Suptijah 2006).

4.3. Total Plate Count Value (TPC)

The number of bacteria that grow on Upeneus moluccensis fillet sample results of the study ranged 1, 34.104 to 8, 56.106 colonies / g sample. The average results of the analysis of microbes on fillet of Upeneus moluccensis with chitosan coating during storage at room temperature are presented in Table 3.

Table 3: The Average Value of TPC Fillet of Upeneus Moluccensis with Chitosan Coating Solution for Room Temperature Storage

storage time (hours)	chitosan 4%
0	$1,34.10^4$
6	$3,56.10^4$
12	$4,34.10^5$
18	$8,56.10^6$

Chitosan has an antibacterial ability in inhibiting the growth of microbes. A thin layer (edible coating) chitosan to cover the entire surface of the fish will inhibit the entry of O2 and water through the surface of the fish's body and able to cause microbes to be difficult to evolve [1].

Chitosan can bind to the bacterial cell membrane protein, binds also particularly phosphatidyl choline (PC) thereby increasing the permeability of the inner membrane. Permeability of the inner membrane gave an easy road for the discharge of the bacterial cell. β galactosidase enzyme components can be detached In E. coli after 60 minutes, meaning it can go out to the cytoplasm even carrying components of other metabolites, resulting in lysis. With increasing lysis there will be no cell division (regeneration), it can even unto death [2].

5. CONCLUSIONS AND SUGGESTIONS

5.1 Conclusions

Chitosan is able to provide quality deterioration inhibitory effect of fillet of Upeneus moluccensis. The use of 4% chitosan solution provide the best results based on the parameters of pH, TPC and value TVB fillet. Using chitosan can extend the shelf life of the fish body, thus increasing the capabilities of marketing management to ensure the product reach the customer at the best quality possible. Increasing in shelf life also ensure the expand of marketing area that can be reach.

5.2 Suggestions

Undertake research to test the activity of chitosan against the whole fish at chilling temperature storage with K-value method to see the level of freshness of the fish that are more specific. An additional analysis needs to be done in future studies include proximate analysis, amino acid content, free fatty acids, and enzyme activity katepsin.

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