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USE OF GINGER ON EDIBLE COATING CARAGENCY-BASED TO EXTEND THE SHELF LIFE OF TILAPIA MEATBALLS

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ABSTRACT

This research aims to determine the effectiveness of ginger in edible coating to extend the shelf life of tilapia meatballs. The parameters observed were chemical characteristics (pH) and biological characteristics (total numbers of bacteria). The method that used in this research is an experimental method consisting of 4 treatments, these are without given edible coating and without the addition of ginger, given edible coating and adding ginger with concentrations of ginger are 0,5%, 1%, and 1,5%. This research was conducted in January 2019 at the Fisheries Product Processing Laboratory of the Faculty of Fisheries and Marine Science, Padjadjaran University. The results showed that the used of edible coating on tilapia meatballs had an effect on the shelf life of tilapia meatballs seen from the number of microbes during the storage period. The addition of ginger has the best influence on the shelf life of tilapia meatballs according to SNI 7388-2009, namely at a concentration of 1% with a reception limit up to 12 days and a microbial amount of 6,5 x 10^6 cfu/g.

INTRODUCTION

Tilapia meatball is one of the food products made from the main ingredient that is tilapia meat and then mixed with other ingredients, then formed round and subsequently boiled. Meatballs have a short shelf life because it includes perishable food (easily damaged food) that is easily contaminated by microbes during the storage process. Meatballs are easily damaged because it has a high protein content and water content and has a neutral pH [1]. Therefore, it is necessary to do the preservation technique of tilapia meatballs using natural packaging and also natural antimicrobial agents, so as to extend the shelf life of tilapia meatballs. One of the natural packaging that can be used to extend the shelf life of tilapia meatballs is edible coating.

Edible coating is a thin layer that is formed directly by dipping, spraying, or panning to the surface of the food products to protect and increase the value added products [2]. The edible coating function is to protect the product from physical damage, chemical, and microbiological activity. The edible coating that has antimicrobial properties can potentially prevent pathogenic contamination in various foodstuffs. The combination of edible coating with antimicrobial to control microbial growth in food can extend the shelf life and improve food quality [3].

One of the antimicrobial that can be added is ginger (*Zingiber officinale*). Ginger belongs to the type of natural antimicrobial source that deserves to be used as food preservatives [4]. Ginger has an effect in inhibiting some bacteria that can decrease the quality of processed fish such as *Escherichia coli, Staphylococcus aureus,* and *Salmonella typhiumurium* [5].

Therefore, to know the effectiveness of ginger as a natural antimicrobial, it is necessary to do research on the use of ginger in edible coating packaging to extend the shelf life of tilapia meatballs.

MATERIAL AND METHODS

Place and Time

This research was conducted in January 2019 at the Fisheries Product Processing Laboratory of the Faculty of Fisheries and Marine Science, Padjadajaran University.

Materials and Tools

The materials used in this research are tilapia filet, tapioca flour 15% of the weight of meat, onion and garlic respectively 3% from the weight of meat, salt 2,5%, flavourings 1%, pepper powder 0,5%, ice cubes 15% of the weight of meat, water to boil meatballs, aquades as a medium, carageenan as raw material manufacture edible coating, gelatin flour to increase the concentration of coating, glycerol as plasticizer, ginger as a natural antimicrobial, Solution of pH Buffer 4 and pH 7, alcohol for hygiene, and nutrient agar (NA) as a material for the TPC (Total Plate Count) test.

The tools used are a food processor, digital scales, basin, pan, plate, measuring cup, gas stove, thermometer, beaker glass, magnetic stirrer, hot plate, sieve, pH meter, scissors, tweezers, cups and mortar, reaction tubes, rack tubes, aluminium foil, measuring pipette, petri dish, Erlenmeyer, oven, plastic wrap, and colony counter.

Research Method

The method used in this research is an experimental method with the treatment of ginger intake at different concentrations and with the test that carried out in duplicate. The method consists of four treatments that consisted were without given edible coating and without the addition of ginger, given edible coating and adding ginger with concentrations of ginger were 0,5%, 1%, and 1,5%. The day of observation with the treatment without the addition of ginger starts from the day 1, 5, 6, 7, 8, and 9. The observation day with the addition of ginger starts from the day 1, 5, 6, 7, 8, 10, 11, 12, and 13 adjusted to the number of microbes during the storage period. Tilapia meatballs without the addition of ginger and without edible coating were observed on days 1,3,5,6,7,8, and 9, while those given an edible coating with the addition of ginger were observed on days 1,3,5,6,7,8 9,10,11,12 and 13.

Parameter Observed

Observations made consist of microbiological and chemical testing. Microbiology test is done to know the total number of microbes in tilapia meatballs during the storage period with TPC test method (Total Plate Count). Chemical test is done to know the pH value during the stored tilapia meatballs.

Bacterial Number Test (Total Plate Count)

The calculation is done by the Total Plate Count method. The equipment is sterilized by autoclave (at a pressure of 15 psi for 15 minutes, and the temperature is 121°C). Nutrient Agar (NA) is weighed and inserted into Erlenmeyer and given Aquades as much as 250 ml afterwards homogenized with a rotary magnet (Magnetic Stirrer) boiled until dissolved and sterilised by autoclave (for 15 minutes, at a pressure of 15 psi, temperature 121^{o}C). Dilution solution 0.9% NaCl is prepared, each of the first level breeding 90 ml and Erlenmeyer mouth is covered in aluminium foil, while for the second and third dilution level respectively taken 9 ml NaCl 0,9% then inserted into the tube with a cover [6].

The samples were mashed and weighed 10 grams aseptically then inserted into the 90 ml NaCl 0,9% so that obtained a solution with a dilution level of 10^{-1}. From dilution 10^{-1} inserted using a pipette as much as 1 ml into the reaction tube 2, then homogenized so that obtained dilution 10^{-2}, continue until obtained dilution 10^{-4}. From each dilution taken 1ml move to a sterile petri dish that has been coded for each sample at a certain dilution level. Poured aseptically NA as much as 15-20 ml into all petri bowls. After the pouring, the petri dish is shaken slowly as it is rotated 3 times to the left, to the right, then to the front, backward, left and right, then cooled down to make it harden. After solid NA (Natrium Agar) is inserted into incubator for 48 hours at 37^{o}C with reverse position. After the incubation period ends, the number of bacteria is calculated and the number of bacteria multiplied by 1 per diluted. The number of colonies are count using formula as follows:

$$Total\ bacteria = \frac{Number\ of\ bacterial\ colonies\ x\ 1}{Dilution}$$

Chemical Test

Chemical test conducted is determining the pH value of tilapia meatballs. The pH value is used to declare the acidity or basicity of a compound. Determination of pH was performed after the pH meter was first calibrated with pH 4 and pH 7. The sample is prepared and the temperature is measured, and the pH meter is set at that temperature. Stabilization of pH meters is done for 15-30 minutes. After that the electrode is rinsed with aquades and dried. The electrode is dipped into the sample solution and the pH measurement can be set. The electrode is left to dip a few moments until a steady readout is obtained, then a sample pH can be noted [7].

RESULTS AND DISCUSSION

Number Test (Total Plate Count)

The amount of bacteria in foodstuffs is one of the indicators that can be used in determining the safety of food for health. The amount of bacteria contained in foodstuffs as much as 10^{6} cfu/g is a limit so that the food is still safe to consume [8]. Each of the treatments in this study observed the value of the total number of bacteria that can be seen in table 1. Based on the results of the study in table 1, total microbial tilapia meatballs increase along with the length of the shelf life. It is suspected because the longer the storage period, microbial growth activity is increasing, so that the number is increasing. Tilapia meatballs control has the highest number of microbes on the first day, namely 9,85 x 10^{3} cfu/g. The presence of bacterial contamination from the outside environment in the control Indigo meatballs can be the cause of the large number of microbes. The higher the concentration of ginger does not result in the initial amount of bacteria becoming smaller.

Microbes in tilapia meatballs control are rising starting on the first day until the 7th day. The average log value of the total amount of microbial meatball control during the storage period from the first day until the 7th day is 0,50. The amount of microbial meatball control on the first day amounted to 9.85 x 10^{3} cfu/g, then on the 3rd day increased to 1,2 x 10^{4} cfu/g, and continue to grow until the 6th day of microbial amount of 4,55 x 10^{5} cfu/g. The total number of microbes in meatball control have reached 1,00 x 10^{6} cfu/g on the 7th day which is far from the maximum value of the corresponding microbial. The increase in the number of microbes lasts quick-ly so that it can become an indicator of corruption. Increasing the number of bacteria during the shelf life due to the process of au-tolysis that occurs by the enzymes contained in fish meat [9]. Autolytic enzymes (proteinase) hydrolyzed protein fish produce peptide and amino acids [10]. The number of bacteria increases with the length of the storage due to the optimal environment for the growth of bacteria that causes bacteria to grow optimally.

The edible coating that has antimicrobial properties can potentially prevent pathogenic contamination in various foodstuffs. Tilapia meatballs compound packed with edible coating that added ginger with a concentration of 0,5% has a shelf life up to the 11th day with a microbial amount of 9,2 x10^6 cfu/g. On the 12th day of the microbial amount of tilapia meatball packaged with edible coating that added ginger with a concentration of 0,5% has exceeded the maximum value of microbes. The average log value of the total increase in the amount of microbial meatballs that are packed with edible coating that added the ginger antimicrobial with a concentration of 0,5% during the storage period from the first day until the 11th day is 0,47. Tilapia meatballs packed with edible coating that added ginger with a concentration of 0,5% can extend the shelf life of tilapia meatballs for 4 days from tilapia meatballs control. The average value of the log of the total number of microbes in tilapia meatballs with edible coating and lower ginger addition than tilapia meatballs control, so it can be concluded that microbial growth in tilapia meatballs with edible coatings and additions ginger is lower than the control.

Tilapia meatballs packed with edible coating that added ginger with a concentration of 1% have a shelf life up to the 12th day with the amount of microbes 6,5 x 10^6 cfu/g. The average value of the total log value of the value of the added number of microbial meatballs packaged with edible coating that added ginger with a concentration of 1% during the storage period from the first day to the 12th day is 0,49. Tilapia meatballs packed with edible coating that added ginger with a concentration of 1% can extend the shelf life of tilapia meatballs for 1 day from tilapia meatballs packed with edible coatings that added ginger with a concentration of 0,5%. Tilapia meatballs packed with edible coating that added ginger with a concentration of 1,5% have a shelf life up to the 12th day with a microbial amount of 9,2 x 10^6 cfu/g. The average value of the total log value of the value added by the number of microbial meatballs packaged with edible coating that added ginger with a concentration of 1,5% during the storage period from the first day until the 12th day is 0,49. The degree of bacterial cell damage can differ from low to high, so there is a difference in the recovery time of cell injuries in the appropriate medium [11].

Decreasing the number of bacteria in the packaging treatment of tilapia meatballs using an edible coating with the addition of ginger occurs because bacteria are not able to adapt (stress) so that the bacteria lose their ability to multiply and die. This dissuitable environment is due to the use of low temperature so that bacteria that do not include bacterial psychophilic bacteria are stunted growth and death. The total number of bacteria usually decreases during cooling or freezing times, but the decline occurs only in thermophilic and mesophilic bacteria [12]. In addition, inappropriate environment is also influenced by ginger that containing antimicrobial compounds of phenols, flavonoids, terpenoids and essential oils that are a group of bioactive compounds that have an ability to inhibit microbial growth.

Table 1. Number of microbes during storage

Storage Days	Number of microbes (cfu/g)			
	Tilapia Meatballs Control	**Tilapia Meatballs with *Edible Coating* Ginger 0,5%**	**Tilapia Meatballs with *Edible Coating* Ginger 1%**	**Tilapia Meatballs with *Edible Coating* Ginger 1,5%**
1	9,85 x 10^3	9,25 x 10^3	4,25 x 10^2	7,45 x 10^2
3	1,2 x 10^4	1,64 x 10^4	6,3 x 10^3	1,48 x 10^4
5	6,55 x 10^4	1,90 x 10^4	7,15 x 10^4	6,4 x 10^4
6	4,55 x 10^5	3,85 x 10^5	8,9 x 10^4	9,2 x 10^4
7	**1,00 x 10^6**	4,8 x 10^5	9,2 x 10^4	1,1 x 10^5
9	-	3,5 x 10^5	1,96 x 10^5	2,15 x 10^5
10	-	6,5 x 10^6	2,65 x 10^5	3,75 x 10^5
11	-	**9,2 x 10^6**	3,9 x 10^5	4,85 x 10^5
12	-	2,4 x 10^7	**6,5 x 10^6**	**9,2 x 10^6**
13	-	-	1,07 x 10^7	1,79 x 10^7

Chemical Test (pH Test)

Observations of tilapia meatballs pH can be seen in table 2. Measurement of pH carried out from the first day of storage tilapia meatballs. Each treatment has a different pH level. It does that pH measurements of products during storage to determine the level of product acidity [13].

Table 2. PH value of tilapia meatballs during shelf life

Storage Days	Tilapia Meatballs Control	Tilapia Meatballs with *Edible Coating* Ginger 0,5%	Tilapia Meatballs with *Edible Coating* Ginger 1%	Tilapia Meatballs with *Edible Coating* Ginger 1,5%
1	6,8	6,9	7	7
3	6,4	6,1	6,3	6,3
5	6	6,1	6,3	6,3
6	6,3	5,8	5,7	5,5
7	6,5	5,9	5,9	5,8
9	6,6	6,5	6	6,3
10	6,6	6,5	6	6,3
11	6,7	6,1	6	6,6
12	6,8	6	5,9	6,6
13	6,8	5,2	5,5	6,2

The average pH value ranged from 6,06 to 6,55 with the highest value in the control of 6,55. The pH value of the constituent component greatly affects the product pH value [14]. The fresher the fish used then the protein content of the product will also be higher and the pH value of the product will approach the pH value of meat. Then the pH of antimicrobial also affects the pH value. The pH value of ginger extract used is 5,9.

The pH value of tilapia meatballs has decreased on the 5th day to 6,0. The pH value of tilapia meatballs with edible coatings added by ginger decreases on day 6. The pH value of tilapia meatballs with edible coatings and added ginger with a concentration of 0,5% on day 6 to 5,8. The pH value of tilapia meatballs packed with edible coatings added ginger with a concentration of 1% on the 6th day in 5,7. The pH value of tilapia meatballs packed with edible coatings added ginger with a concentration of 1,5% on day 6 in 5,5. Control treatment has the highest pH value of 6,0 and the lowest pH is the treatment with the introduction of edible coating with the addition of ginger with a concentration of 1,5%. It can happen due to contamination of tilapia meatballs from the outside environment before the tilapia meatballs packed with an edible coating layer.

Tilapia meatballs with edible coating has a higher pH reduction value compared to the control on Day 6. The decrease in the pH value of tilapia meatballs coated edible coating added by ginger with a concentration of 1,5% higher compared with other treatment. The activity of the enzyme in breaking fat into fatty acids on edible tilapia meatballs on day 1 until day 6 higher than the treatment of tilapia meatballs control from Day 1 to day 5.

The increase in the pH value of tilapia meatballs control occurs on the 6th day while the pH value of the tilapia meatballs treatment is edible coating with the addition of ginger experiencing a hike on the 7th day. Tilapia meatballs control continue to experience a pH increase since the 6th day of storage until the next day with a pH value of final 6,8. Tilapia meatballs packed with edible coating that added ginger with a concentration of 0,5% increased pH on the 7th day, but decreased back in the 11th day with the final pH 5,2. Tilapia meatballs packed with edible coating that added ginger with a concentration of 1% increased pH on the 7th day, but decreased back in the 12th day with the final pH of 5.5. Tilapia meatballs packed with edible coating that added ginger with a concentration of 1.5% increased pH on the 7th day, but decreased back in the 13th day with the final pH 6.2. Increased pH can be said to be directly proportional to microbial activity. Accumulation of metabolites and the formation of volatile base compounds increase the pH and the addition of the number of bacteria because the alkaline compounds are suitable media for the growth of the decay bacteria. The results of the metabolites of microbial activity in a processed product is ammonia. Ammonia resulting from microbial activity is alkaline so that the pH value of the product rises during the storage period. The pH value will rise close to neutral [15].

Conclusion

The use of edible coating in tilapia meatballs managed to extend the shelf life of tilapia meatballs. Addition of ginger 1% in the edible coating package becomes an effective treatment in extending the shelf life of tilapia meatballs based on the number of microbes with a storage period of up to 12 days with a microbial amount of 6,5 x 10^6 cfu/g.

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