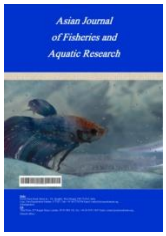

Asian Journal of Fisheries and Aquatic Research

14(4): 29-34, 2021; Article no.AJFAR.72577
ISSN: 2582-3760

Preservation of Squid (*LOLIGO SP*.) Using Yogurt in Low Temperature Storage on Organoleptic Characteristics

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Authors' contributions

This work was carried out in collaboration among all authors. Author SY designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors EA and ER managed the analyses of the study. Author EL managed the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJFAR/2021/v14i430303
Editor(s):
(1) Dr. Luis Enrique Ibarra Morales, State University of Sonora, Mexico.
Reviewers:
(1) David Juan Ramos Huallpartupa, Jose Maria Arguedas National University, Peru.
(2) Maria Erna Kustyawati, University of Lampung, Indonesia.
Complete Peer review History: https://www.sdiarticle4.com/review-history/72577

Original Research Article

Received 20 June 2021
Accepted 30 August 2021
Published 11 September 2021

ABSTRACT

This research aims to determine the shelf life of squid (*Loligo* sp.) using Lactic Acid Bacteria in yogurt and its organoleptic characteristics. This research was carried out at the Fishery Product Processing Laboratory, Faculty of Fisheries and Marine Sciences, Padjadjaran University in November 2020. This research was carried out using yogurt as a preservative for squid (*Loligo* sp.) in the treatment of LAB concentrations used 0%, 1, 5%, 3%, 4.5%, and 6%. Observations were made for 11 days and stored at a temperature of 5-10^{o}C, and organoleptic testing (discoloration, brilliance, aroma, and texture) was carried out on days 1, 3, 5, 7, 8, 9, 10, 11 for the treatment 1.5%, 3%, 4.5% and 6% and organoleptic testing on days 1, 3, 5, 7, 8 for control samples. The observed data were analyzed for pH and organoleptic with Friedman test and Chi-Square test. The results showed that 1,5% Lactic Acid Bacteria into yogurt as a preservative in squid has the best effect on the shelf life and organoleptic characteristics of squid during storage at low temperatures with an acceptable limit of up to 10 days.

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Keywords: Squid, shelf life, pH, organoleptic, yogurt.

1. INTRODUCTION

Squid (Loligo sp.) is a genus of cephalopod that has potential as a commercial commodity. [1]. According to research Vaz-Pires & Seixas, [2], the level of freshness of squid were stored in crushed ice usually rot on day 9 during storage at a temperature of ± 2°C. The squid has a fresh smell (odor typical squid) and has a texture that is dense and elastic, while the squid that are not fresh or has entered the beginning of the decay marked by the appearance of feathers pale, less bright red to purple., begin to smell neutral and texture is less elastic. the squid foul characterized by the appearance pale brown color on the feathers with a fishy aroma and rotten squid and a soft and inelastic texture, fatty acids undergoing an oxidation process [3].

The decline in quality causes a decrease in consumer acceptance because of sensory impairment such as color, texture, aroma, and appearance. The process of squid quality degradation will continue if not inhibited, one of them is preservation.

Preservation aims to inhibit or prevent damage, maintain quality, avoid toxicity and ease of handling and storage [4]. One of the natural preservative that produces such good bacteria (Lactobacillus bulgaricus and Streptococcus thermophilus) is yogurt. Lactic acid bacteria of yoghurt will reduce the acidity of the squid that can inhibit the growth of spoilage bacteria. Decrease in pH will continue for all treatments adding yogurt to a certain time of LAB production will stop.

2. MATERIALS AND METHODS

2.1 Tools

The tools used for the preservation of squid in this research are: coolbox, pH meters, scales, pots, mixers, stove, glass bottles, refrigerators, plastic plates, cling wrap, beaker glass, tissue towels and mortar.

2.2 Material

The materials used for the preservation of squid in this research are squid, milk, yogurt seeds, alcohol, and distilled water.

2.3 Method

This research used an experimental method with four soaking treatment with 5 semi-trained panel as a test. The panel in this research were students of Fisheries and Marine Sciences, University of Padjadjaran. Observations were conducted to see the effect of immersion squid in yogurt against a shelf life based on organoleptic characteristics. Observations made during the 11 days and stored at a temperature of 5-10^{0}C and organoleptic tests performed on days 1, 3, 5, 7, 8, 9, 10, 11 for the treatment of 1.5%, 3%, 4.5% and 6% and organoleptic tests on days 1, 3, 5, 7, 8 for the control sample. The pH measurement was carried out using a pH meter.

pH results were analyzed descriptively and organoleptic tests using Friedman's analysis of variance test two-way Chi-Square test, with the formula:

$$X^2 = \frac{12}{bk\ (k+\ 1)} \sum_{i-1}^{x} (Rj)^2) - 3b\ (K+1)$$

If there are the same numbers, the FK calculation is carried out with the formula:

$$FK = 1 - \frac{\sum T}{\mathrm{bk}\ (k^2-1)} \qquad H_C = \frac{x^2}{\mathrm{FK}}$$

The significance value of the observed Hc value can be determined by using the critical Chi-square value with db = k-1 ; = 0.05. If the price of Hc <x^2 (K – 1), then H0 is accepted and H1 is rejected, and if the price is Hc>x^2 (K – 1), then H0 is rejected and H1 is accepted. If H1 is accepted, then there is a significant difference to the treatment given so that this test is carried out to determine the unequal median values and to find out the difference between treatments with several comparison tests using the formula:

|*Ri - RjZ* {α / k(K-1)} bk(k+1)/6

3. RESULTS AND DISCUSSION

3.1 Degree of Acidity (pH)

The observations during the research showed that there is the effect of adding yogurt to pH of squid. The pH value of squid during low temperature storage (Table 1).

The pH value of squid during storage at low temperatures shown in table 1 ranged from 6.3 to 7.1. All samples were treated initially decreased pH due to the immersion process with yoghurt. This is influenced by the activity of LAB yogurt in the treatment of 1.5%, 3%, 4.5%, and 5%. Based on Table 1 shown that until the 10th day of soaking treatment storage squid with a concentration of 1.5% has the lowest pH value compared with other treatments. This is due to an increase in LAB activity from yogurt which can inhibit the growth of spoilage bacteria in squid. LAB ferment carbohydrates to lactic acid formation in which the formation of lactic acid causes an increase in acidity or pH value decrease [5].

The decrease in pH at the beginning of the storage period is caused by the process of glycogenesis which can produce ATP and lactic acid. These conditions resulted in increased acidity of the meat [6].

The pH value tends to increase on the 4th day. According to [7], chemical changes in the meat begins with the decrease in pH caused by the activity of glucokinase enzyme that breaks down glycogen to lactic acid that plays a role in the decrease in pH. Then the pH will increase again caused by microbes. Amino acids are overhauled by microbes from autolysis protein into ammonia and carbohydrates in the form of ATP to cause an increase in pH alkaline ammonia. The increase in the pH value was also caused by the reduction of trimethylamine oxide (TMAO) into the base compound is trimethylamine (TMA) are degraded by bacteria. The increase in the pH value indicates the growth activity of spoilage bacteria by a number of enzymes in fish tissue that produce ammonia.

3.2 Organoleptic

Sensory organoleptic analysis using human senses as the main test tool can provide an overview of the organoleptic results of squid treated with yogurt immersion. Organoleptic characteristics observed in this research is the appearance, aroma, and texture.

3.3 Appearance

Appearance is an important parameter because it is a sensory property that is first seen by the panelists. The decrease in value is evidenced by the average score of the panelists with a value of 9 which decreased to a value of 7 as an acceptance limit. Nurjanah et al. [8] states organoleptic value will increase along with increasing storage time.

Table 1. Average pH value of squid during low temperature storage

Day of storage	pH value				
	0% (control)	1.5%	3%	4.5%	6%
1	6.6	6.4	6.5	6.5	6.6
2	6.6	6.3	6.4	6.4	6.5
3	6.6	6.3	6.4	6.6	6.4
4	6.8	6.8	6.7	6.6	7
5	6.8	6.9	6.7	6.8	6.8
6	6.9	6.9	6.9	6.8	6.9
7	7	6.6	6.9	6.9	7
8	7.1	6.8	6.8	7	7
9		6.7	7	6.9	7
10		6.8	7	7.1	7.1

Table 2. Median value of appearance's scoring test

LAB Concentration (%)	Median Value of Appearance on Fresh Squid Storage (Day-)							
	1	3	5	7	8	9	10	11
0%	9	7	5	5	3	-	-	-
1.5%	9	8	7	7	7	6	5	3
3%	9	8	7	7	6	5	5	3
4.5%	9	8	7	6	6	5	3	3
6%	9	8	6	5	5	5	3	1

Based on Table 2 it can be seen that the control squid has a shelf life of up to day 3, while the treatment squid 1.5% have a shelf life of up to day 8 and 3% has a shelf life of up to day 7 and squid with 4.5% has a shelf life of up to day 5 and treatment 6% have a shelf life of up to day 3. On the 9th day, all squid samples had entered the rejection limit with an average value of 5.

The organoleptic test results showed that the appearance of fresh squid soaked in yogurt decreased during the storage period. On the 1st day the squid had a very bright color, while at the time of rejection with a limit below the value of 5, the appearance of the squid was slightly browned and pale. On day 3, all samples had a bright color and specific to squid. Sample 0% has a significant decreasing, where on days 5-7 squid color beige, pale, and less bright. On day 8, the squid has a value of 3 is beige, browned, and pale.

The decrease in the organoleptic value of squid was seen from the color change to beige, pale, and less bright. The decrease in organoleptic value was caused by the activity of spoilage bacteria [9]. Soaking squid using yogurt can inhibit the growth of pathogenic bacteria that can cause the color of the squid to turn pale, because it can produce organic acids, lower the pH value of the environment, and can produce compounds that can inhibit spoilage bacteria and prevent oxidation. [10].

3.4 Aroma

The sensory characteristics of the squid aroma were tested through the sense of smell. The decrease in value was evidenced by the average score of the panelists at a value of 9 which decreased to a value of 7 as the acceptance limit of squid.

The decrease in the aroma value of the treated squid began to be seen on the 3rd day where all the squid still smelled fresh. The control's sample is decrease significantly from 8 to 5 where the squid has begun to smell fishy and slightly rotten squid. Constant decline in value during storage. Squid with LAB concentrations of 1.5% can be received up to 9 day, the 3% sample can be received up to 8 day, the 4.5% and 6% has an aroma that can be received up to 7 day. According Junianto [9], changes the smell of fish caused by the destruction of proteins from bacterial activity, there is a contact between the number of bacteria by smell of fish is directly proportional.

Giving Lactic Acid Bacteria affects the smell of squid because LAB activity can inhibit the growth of bacteria that cause changes in the scent of decay. The longer the storage time, the more the squid aroma increases which causes the organoleptic value of the aroma by the panelists to decrease. This is because the bacteria in foodstuffs proliferate to produce enzymes and break down the proteins that cause the unpleasant smell. The smell that appears on the squid is due to changes in protein and fat which are overhauled by peptide enzymes and amino acids that affect the aroma. (Winarno, 1980).

3.5 Texture

The results of organoleptic testing with a scoring test on the texture of squid during observations.

At the beginning of storage, the texture of squid is dense and elastic. The texture of squid declined during the storage period at low temperatures resulting in the texture of the squid becomes elastic and soft. The control squid had a decrease in value, where on the 3rd day the squid texture was less elastic, and on the 5th day the squid texture was inelastic and slightly soft and the next day the squid texture was soft. The decline in value is due to the decomposition of proteins by bacteria that cause mucus discharge into a soft texture. This is due to the autolysis process that causes changes in fish meat eg meat texture will soften (Suptijah et al, 2008).

The texture of squid in the control treatment was not significantly different from squid 4.5% and 6% but significantly different from 1.5% and 3%. While 1.5% and 3% were not significantly different from 4.5% and 6%, but the 1.5% treatment was the best because it had the highest value. This is because, at a concentration of 1.5%, LAB can grow well by optimally utilizing the presence of glucose in squid with the time required for the breakdown of glucose into glycogen longer than the treatment with concentrations of 3%, 4.5%, and 6%. so that spoilage bacteria grow longer than other treatments.

Squid with 1.5% LAB concentration has a texture that can be accepted up to the 8th day and 3% can be accepted until the 7th day of storage, squid with 4.5% can be accepted up to 7th day

and the 6% LAB concentration can be accepted up to the 3rd day of storage.

The change in texture occurs due to the process of autolysis the squid's body by enzyme activity. The decrease in elasticity and density of the squid's body chemically is caused by the activity of enzymes and bacteria. This is caused by the release of water bonds so that more free water comes out of the meat tissue, this condition results in a loss of elasticity and the texture of the meat becomes soft. [6]. Fluidity in texture during decomposition due to interruption of meat and connective tissue cell walls are broken.

Table 3. Rank average score on squid appearance

LAB concentration %	Average
0%	1a
1.50%	4b
3%	3.6ab
4.50%	3.2ab
6%	2.8ab

Description: The average value followed by the same letter indicates that the treatment is not significantly different from the test level of 5%.

Table 4. Median value of squid's aroma scoring test

LAB Concentration (%)	Median Aroma Value on Fresh Squid Storage (Day-)							
	1	3	5	7	8	9	10	11
0%	9	8	5	3	1	-	-	-
1.5%	9	8	7	7	7	7	5	3
3%	9	8	7	7	7	5	5	3
4.5%	9	8	7	7	5	5	5	3
6%	9	8	7	7	5	5	3	1

Table 5. Rank average score on squid aroma

LAB concentration %	Average
0%	1.0a
1.5%	4.0b
3%	4.0b
4.50%	3.2ab
6%	2.8ab

Description: The average value followed by the same letter indicates that the treatment is not significantly different from the test level of 5%.

Table 6. Median value of squid's texture scoring test

LAB Concentration (%)	Median Value of Discord on Fresh Squid Storage (Day-)							
	1	3	5	7	8	9	10	11
0%	8	7	5	3	1	-	-	-
1.5%	9	8	8	7	7	5	5	3
3%	9	8	8	7	5	5	3	3
4.5%	8	8	7	7	5	3	3	1
6%	9	8	5	5	5	3	3	1

Description: The average value followed by the same letter indicates that the treatment is not significantly different from the test level of 5%.

Table 7. Rating average score on squid texture

LAB concentration %	Average
0%	1.0a
1.5%	4.8b
3%	3.0b
4.5%	3.0ab
6%	3.0ab

4. CONCLUSIONS

The results of research on the preservation of squid (*Loligo* sp.) using yogurt at low temperature storage, it can be concluded that the addition of 1.5% LAB into yogurt as a preservative in squid has the best effect on the shelf life and organoleptic characteristics of squid during storage at low temperatures with an acceptable limit of up to 8 days.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle4.com/review-history/72577