ISSN: 2710-0588

Application of Rosette Quorum Sensing Inhibitor in Fish Preservation

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Abstract

This study screened fish derived spoilage bacteria as the research object, and a development approach was used to determine the inhibitory effect of rose polyphenols on the secretion of the quorum sensing (QS) signal molecule N-acyl homoserine lactone (AHLs) by fish spoilage bacteria. The effect of rose QS inhibitors applied to fish preservation coatings on the putrefaction of spoilage bacteria was studied by measuring the changes in texture, pH, and thiobarbituric acid reactive substances (TBARS) during the storage process of fish. The findings demonstrated that the dominant strain causing fish spoilage was Sphingomonaspaucimobilis, and rose polyphenols could significantly inhibit the ability of the spoilage bacteria to secrete AHLs. The application of different concentrations (1 and 2 mg/mL) of rose polyphenols in fish preservation coatings can slow down the growth of TBARS, and 2 mg/mL of rose polyphenols has a better inhibitory effect on the oxidation of fish fat, By measuring the L*, a*, and b* values of different treatment groups, it was found that the addition of rose polyphenols delayed the decrease of L* and the increase of a* value in fish meat, but had no significant effect on b* value, The 2 mg/mL rose polyphenol coating treatment group had the slightest pH change, according on tracking measurements of pH changes during fish storage. The sensory assessment results of fish meat from different treatment groups during storage showed that the 2 mg/mL rose polyphenol treatment group decreased the least among all treatment groups, which means applying it to the fish meat preservation coating can effectively delay the rate of quality decline during storage. The findings of this work may serve as a theoretical foundation for the use of naturally occurring rose polyphenols, a QS inhibitor, in the preservation of fish.

Keywords

Fish; Fresh; QS; Corruption; Inhibitor.

1. Introduction

For a long time, it has been believed that bacteria exist in the natural environment to obtain nutrients and reproduce as individual cells. In recent years, research has found that bacteria can perceive changes in the environment and the population size of their own and other populations. This communication mechanism between bacteria is called QS [1,2]. Bacteria communicate through small molecules called "signalling molecule". When the population reaches a certain threshold, these info molecules trigger cascades of events, allowing for coordinated activities that individual bacteria cannot achieve alone, such as regulating bioluminescence, biofilm formation, production of antibiotics and bacteriocins, and synthesis of antimicrobial peptides [3,4]. The phenomenon of quorum sensing among bacteria has attracted attention in various fields such as medicine, agriculture, and biotechnology. Current research has shown that interfering with quorum sensing in foodborne spoilage bacteria can reduce their pathogenicity. In the field of food, scientists have proposed the hypothesis that quorum sensing may be closely related to food spoilage, suggesting that quorum sensing plays

ISSN: 2710-0588

an important role in the process of food spoilage. Existing studies have shown that the expression of characteristics related to food spoilage in spoilage bacteria, such as protease activity and siderophore production, is regulated by quorum sensing [5-8]. Therefore, quorum sensing inhibitors based on microbiological research can contribute to the development of novel preservatives [9,10].

China is a major producer and consumer of aquatic products, with the total production of aquatic products ranking first in the world for over 30 years. However, the spoilage of fresh aquatic products in China is a serious problem, with an average loss rate of around 15%. Bacterial decay is one of the main causes of aquatic product spoilage. The spoilage of aquatic products is a complex process mainly caused by the growth of specific spoilage bacteria, and the growth and expression of their characteristics are regulated by the QS system of spoilage bacteria [11]. Therefore, targeting quorum sensing signal molecules to control the spoilage of aquatic products provides a new strategy for their storage. It has been found that AHLs can be detected to varying degrees in food spoiled by Gram-negative bacteria, and AHLs can only be detected when the number of spoilage bacteria reaches a certain level, indicating a correlation between AHL levels and the number of spoilage bacteria [12,13]. Gram-negative bacteria that can utilize AHLs as signal molecules to regulate QS and cause food spoilage include Pseudomonas aeruginosa, Yersinia enterocolitica, Aeromonas hydrophila, Serratia marcescens, Enterobacter cloacae, Erwinia carotovora subsp. carotovora, and Hafnia alvei [14-18]. AHLs have also been detected to varying degrees in aquatic products, indicating that fish spoilage bacteria mainly use AHLs as signal molecules to regulate the production of spoilage factors and toxins, thereby affecting the quality of food [19,20].

There are three main approaches to use QS to inhibit food spoilage: inhibiting the synthesis of signal molecules. inactivating or degrading signal molecules, competing with receptor proteins by utilizing structural analogues of signaling molecules [11]. Research has found that there are QS inhibitors present in seaweed, crops, and soil, which can be used to prevent fish spoilage and extend shelf life [21]. However, safety is crucial in the selection of preservatives for aquatic products. Therefore, research on QS inhibitors for aquatic product spoilage mainly focuses on natural extracts such as polyphenols and flavonoids found in plant extracts [22-24]. Previous studies have shown that active molecules such as cannabidiol [25] and curcumin in plant extracts can inhibit QS by interfering with biofilm formation. Rose polyphenols, as a natural active molecule with multiple functions, have been extensively studied for their antioxidant and anti-aging properties. However, further research is needed on the QS inhibitory effects of rose polyphenols on aquatic product spoilage bacteria. This study explores the feasibility of using natural extract rose polyphenols as QS inhibitors for fish preservation. The changes in texture, pH, TBARS, and other indicators were measured to investigate the application of rose polyphenols in fish preservation.

2. Materials and Methods

2.1. Materials and Instruments

Fresh fish (purchased from the local market), Rose flowers (purchased from a local pharmacy in Nanjing), Analytical reagents (all of analytical grade).

2.2. Experimental Method

1) Microbial isolation and identification: fish meat diluted with physiological saline gradient, take 100 μL onto solid LB medium, incubate for 24 - 48 hours, transfer the single colony to a sterile test tube containing 3.0 mL of LB medium, 37 oC 220 rpm 24 hours, purify 3 times. Select typical colonies and streak them on nutrient agar for 24 hours. Prepare a bacterial suspension of 0.5-1.0 MCF. Identify them using the VITEK 2 fully automated microbial identification system.

ISSN: 2710-0588

2) Preparation of rose polyphenol group sensing inhibitor: rose flowers were treated with a mechanical crusher. 200 g of rose powder was added to 4 L of distilled water to prepare a solution. The solution was sonicated at 30 oC and 80 W for 1 hour. Filter the solution with gauze to separate the residue, 10000 g 15 minutes. The supernatant was taken and evaporated at 50 oC to 100 - 200 mL. The concentrated solution was freeze-dried into powder and stored at -20 oC for later use.

3) Determination of rose polyphenol content by Folin phenol method: the concentration of gallic acid mother liquor is 1 mg/mL, and it is sequentially prepared into 4 different concentrations of standard solutions containing 0.5, 1.0, 1.5, and 2.0 mg of rose polyphenols in 1 mL. Add 5 mL of standard solution (control with 5 mL of distilled water) to 5 mL of Fulin reagent, shake for 3 min, add 5 mL of 10% Na2CO3 to each, shake evenly then dilute to 50 mL, color rendering at room temperature for 1 hour, measure the absorbance at 700 nm, and draw the equivalent standard curve of rose polyphenol and gallic acid. Take the freeze-dried powder of rose polyphenol samples and use the same method as the standard curve to determine the content of polyphenols in the samples.

4) Preparation and treatment of coating solution: The fish is peeled and cut into pieces, then vacuum packaged and irradiated with 8 kGy for 2 h. After treatment, it is stored in a -20 oC freezer for future use. Ordinary coating, dissolve 2 g of chitosan in 100 mL of an acid solution containing 2% lactic acid. Rose polyphenol coating (rose polyphenol concentration of 1 mg/mL), dissolve 2 g of chitosan in 100 mL of an acid solution containing 2% lactic acid and 1 mg/mL concentration of rose polyphenol. Rose polyphenol coating (rose polyphenol concentration 2 mg/mL), dissolve 2 g of chitosan in 100 mL of an acid solution containing 2% lactic acid and 2 mg/mL concentration of rose polyphenol. Shake the solution evenly under sterile conditions, and soak the fish in the coating solution for 1 min.

Each treatment and corresponding code are shown in Table 1.

Table 1. Treatment and corresponding code used in this study

Treatment	Code
Control (untreated)	1-1
Ordinary coating	1-2
Rose polyphenol coating (with a concentration of 1 mg/mL)	1-3
Rose polyphenol coating (with a concentration of 2 mg/mL)	1-4
Smear spoilage bacteria	2-1
Coating with spoilage bacteria + ordinary coating	2-2
Spoilage bacteria + rose polyphenol coating (with a rose polyphenol concentration of 1 mg/mL)	2-3
Spoilage bacteria + rose polyphenol coating (with a rose polyphenol concentration of 2 mg/mL)	2-4

5) TBARS value determination: 10 g minced meat sample, add 75% trichloroacetic acid, shake for 30 min, filter, take 5 mL of supernatant and add 20 mL of thiobarbituric acid solution. After a 90 oC water bath for 40 min, centrifuge at 1600 r/min for 5 min, add chloroform of the same volume as the supernatant, shake evenly, let it stand for layering, take the supernatant, and measure OD532 and OD600.

6) Chromatism: Use a colorimeter to measure the chromatism of fish meat. The difference measured by the colorimeter during storage can reflect the color change of fish meat during refrigeration. The measurement parameters mainly include L*, a*, and b*.

7) pH: Weigh 10g of minced fish meat sample into a flask, add 100 mL of boiled and cooled distilled water, shake, and measure the pH value of the supernatant using a pH meter.

8) Sensory evaluation: The elasticity, stickiness, and odor of fish are evaluated by direct observation. The evaluation team consists of a fixed group of 5 members and uses numerical

ISSN: 2710-0588

values (1-10) to record the approximate changes in specific senses, and then analyzes its freshness and spoilage. Determine the weight of each item: elasticity 0.3, Adhesion 0.3, Odor 0.4, sensory evaluation value of fish meat = elasticity × 0.3 + viscosity × 0.3 + odor × 0.4.

2.3. Data Processing

All data were expressed as means over three replicates. Suspicious values were excluded using the Schoveler criterion, and Origin7.5 plots were used. SPSS (Statistical Product and Service Solutions) 11.0 was used for repeated measurement analysis of variance, with a significance level set to $P<0.05$.

3. Result and Analysis

3.1. Isolation and Identification of Fish Source Spoilage Bacteria

Common spoilage bacteria in aquatic products include Pseudomonas, Corynebacterium, etc. To determine the main bacterial species studied in this experiment, fish derived spoilage bacteria were isolated and identified from the experimental subjects. In the microbial isolation and identification of this experiment, a total of 13 strains were isolated (Table 2). There are 10 negative bacteria, among which 8 strains were detected as Sphingosine oligokine with a similarity of 96%, which is the dominant strain. There are 1 strain each of Aeromonas salmonicida and 1 strain each of Chryseomonas luteola, with a similarity of 89% and 85%, respectively. The three positive strains are Enterococcus faecium, Leuconostoc mesoides subsp Cremoris and Pentose planococcus each have a similarity of 98%, 93%, and 91%, respectively. Previous studies have shown that the use of QS inhibitors affects the ability of gram-negative bacteria to secrete AHLs, thereby delaying the possibility of food spoilage [3]. Subsequent experiments will focus on Sphingomonas baucimobis as the main research strain to explore the inhibitory effect of rose polyphenols on QS.

Table 2. Isolation and identification results of bacteria

Strain	Name	Similarity	Detection rate (%)
Negative bacteria 1	*Sphingosine oligokine*	96%	61.54
Negative bacteria 2	*Aeromonas salmonicida*	89%	7.69
Negative bacteria 3	*Chryseomonas luteola*	85%	7.69
Positive bacteria 1	*Enterococcus Faecium*	98%	7.69
Positive bacteria 2	*Leuconostoc mesenteroides subsp. cremori*	93%	7.69
Positive bacteria 3	*Pentose planococcus*	91%	7.69

3.2. Establishment of Standard Curve for the Equivalence of Rose Polyphenols and Gallic Acid

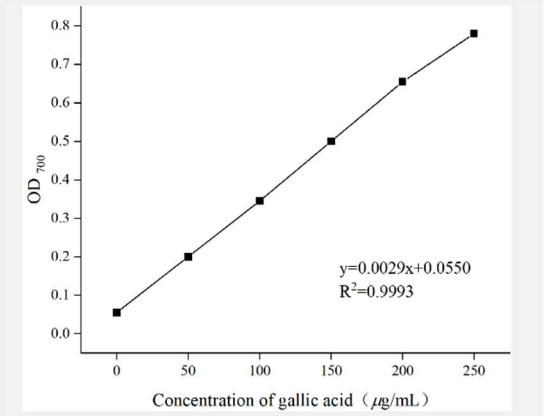

Fig.1 Gallic acid equivalent standard curve

ISSN: 2710-0588

The standard curve of rose polyphenol gallic acid equivalent obtained by the Folin phenol method is shown in Fig. 1, where the concentration of gallic acid standard solution is on the horizontal axis and the absorbance is on the vertical axis, with R2=0.9993 and high fitting degree. The absorbance of the sample was measured under the same reaction conditions, and the data was substituted to calculate the polyphenol content in the rose extract as 111.09 mg/g gallic acid equivalent.

3.3. The Effect of Rose Polyphenol Coating Treatment on the Quality of Fish Meat

3.3.1. The Effect of Rose Polyphenol Coating Treatment on TBARS Value

TBARS value is a commonly used indicator to determine the degree of fat oxidation in meat products, which can directly reflect the freshness of meat products. As shown in Fig. 2, with the extension of time, the TBARS of the samples under each treatment group showed an upward trend. At the same time, the TBARS value of fish meat without coating but with spoilage bacteria was the highest, and the TBARS values showed the same trend in the four treatments of uncoated spoilage bacteria and coated spoilage bacteria. That is, high concentration rose polyphenol coated samples < low concentration rose polyphenol coated samples < ordinary coated samples < uncoated. However, the difference between treatments gradually decreased with time, and at 48 h, the difference was no longer significant, this may be due to the oxidation of the fish meat to a certain extent, which disrupts the coating treatment and no longer has a preservation effect. Based on the above data analysis, it can be concluded that in the early stage of preservation, the application of rose polyphenol coating has a certain impact on the TBARS value of fish, which can slow down the growth of TBARS value and delay the oxidation rate of fish fat [27-29]. Moreover, the preservation effect of high concentration rose polyphenol coating (2 mg/mL) is better than that of low concentration rose polyphenol coating (1 mg/mL).

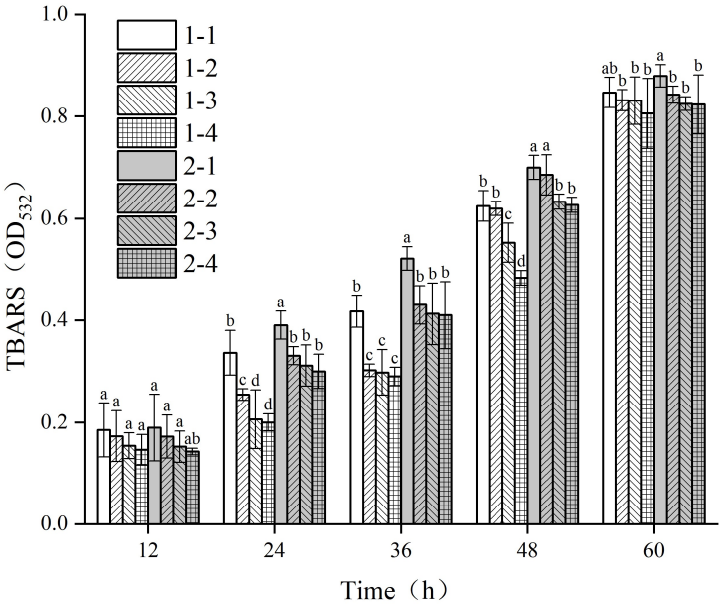

Fig. 2 Histogram of barbiturate reduction value of fat oxidized sulfide in fish within 60 h

Note: Lower case letters refer to significant difference between treatments at same time ($P < 0.05$).

3.3.2. The Effect of Rose Polyphenol Coating Treatment on the Freshness of Fish Meat

The values of L*, a*, and b* are one of the indicators that can directly reflect the freshness of fish, as shown in Table 3. Over time, the brightness values (L *) of all treatment groups decrease. This is due to the continuous oxidation of myoglobin in fish during storage to form

ISSN: 2710-0588

ferrimyoglobin, which accumulates and causes browning and darkening of the meat color. Comparing the L* values of the four treatment groups without and with spoilage bacteria during the same time period, it can be found that the decrease in L* values under high concentration and low concentration rose polyphenol coatings is smaller than that under normal and uncoated treatments. Therefore, it can be concluded that the addition of rose polyphenols can delay the decrease in fish brightness and inhibit fish oxidation.

The changes in a* value during storage are shown in Table 4. With the passage of time, the a* value of all treatment groups increased and the red color worsened, which is caused by the combination of myoglobin and oxygen to produce oxygenated myoglobin in fish meat [30,31]. However, comparing different treatment groups at the same time, it can be found that the a* value of fish meat in the rose polyphenol treatment group changed less during storage, that is, the addition of rose polyphenol can inhibit fish meat oxidation.

The changes in b* value during the storage process are shown in Table 5. Over time, all treatment groups showed irregular trends in b values, which may be related to the types of fish and microorganisms [32].

Table 3. Changes of L value of fish within 60 h

Time (h)	1-1	1-2	1-3	1-4	2-1	2-2	2-3	2-4
0	58.40 ± 0.30^{de}	58.61 ± 0.05^{cd}	58.31 ± 0.10^{e}	58.27 ± 0.22^{e}	59.08 ± 0.14^{ab}	59.14 ± 0.13^{a}	59.07 ±0 .18^{ab}	58.82 ± 0.17^{bc}
12	56.26 ± 0.06^{e}	56.14 ± 0.11^{e}	57.45 ± 0.12^{bcd}	57.16 ± 0.26^{cd}	57.59 ± 0.60^{bc}	57.07 ± 0.25^{d}	58.73 ± 0.04^{a}	57.71 ± 0.05^{b}
24	55.69 ± 0.04^{de}	54.50 ± 0.47^{f}	57.38 ± 0.33^{b}	57.03 ± 0.19^{c}	55.44 ± 0.09^{e}	55.94 ± 0.04^{d}	57.88 ± 0.08^{a}	57.92 ± 0.03^{a}
36	53.67 ± 0.06^{d}	53.48 ± 0.42^{d}	56.15 ± 0.07^{b}	55.26 ± 0.08^{c}	53.14 ± 0.08^{e}	53.76 ± 0.04^{d}	57.01 ± 0.13^{a}	55.38 ± 0.03^{c}
48	52.42 ± 0.37^{d}	51.10 ± 0.13^{e}	54.15 ± 0.09^{b}	54.47 ± 0.04^{b}	51.44 ± 0.05^{e}	52.11 ± 0.02^{d}	55.27 ± 0.09^{a}	53.51 ± 0.37^{c}
60	50.57 ± 0.06^{f}	50.64 ± 0.08^{ef}	53.68 ± 0.09^{b}	54.11 ± 0.27^{a}	50.83 ± 0.03^{e}	51.29 ± 0.04^{d}	53.39 ± 0.04^{c}	53.31 ± 0.17^{c}

Note: Lower case letters refer to significant difference between treatments at same time ($P < 0.05$).

Table 4. Changes of a value of fish within 60 h

Time (h)	1-1	1-2	1-3	1-4	2-1	2-2	2-3	2-4
0	2.63 ± 0.09^{a}	2.60 ± 0.08^{a}	2.66 ± 0.09^{a}	2.62 ± 0.05^{a}	2.65 ± 0.07^{a}	2.69 ± 0.04^{a}	2.64 ± 0.05^{a}	2.62± 0.03^{a}
12	3.12 ± 0.10^{d}	3.19 ± 0.14^{bcd}	3.16 ± 0.16^{cd}	3.05 ± 0.08^{d}	3.68 ± 0.06^{a}	3.66 ± 0.08^{a}	3.36 ± 0.06^{b}	3.33 ± 0.07^{bc}
24	3.46 ± 0.06^{de}	3.59 ± 0.04^{d}	3.44 ± 0.07^{e}	3.18 ± 0.13^{f}	6.77 ± 0.06^{a}	6.60 ± 0.09^{b}	6.53 ± 0.07^{b}	6.04 ± 0.09^{c}
36	3.49 ± 0.12^{e}	3.63 ± 0.03^{d}	3.46 ± 0.12^{e}	3.37 ± 0.03^{e}	8.08 ± 0.07^{a}	7.62 ± 0.08^{b}	7.54 ± 0.05^{bc}	7.48 ± 0.02^{c}
48	4.13 ± 0.04^{e}	4.33 ± 0.14^{d}	4.09 ± 0.07^{e}	4.06 ± 0.04^{e}	8.16 ± 0.07^{ab}	8.02 ± 0.10^{b}	8.21 ± 0.07^{a}	7.75 ± 0.06^{c}
60	4.98 ± 0.06^{d}	4.76 ± 0.04^{e}	4.48 ± 0.06^{f}	4.46 ± 0.06^{f}	9.06 ± 0.05^{a}	9.06 ± 0.07^{a}	8.85 ± 0.07^{b}	8.26 ± 0.06^{c}

Note: Lower case letters refer to significant difference between treatments at same time ($P < 0.05$).

ISSN: 2710-0588

Table 5. Changes of b value of fish within 60 h

Time(h)	1-1	1-2	1-3	1-4	2-1	2-2	2-3	2-4
0	5.74 ± 0.09^{a}	5.72 ± 0.03^{a}	5.08 ± 0.07^{c}	4.06 ± 0.05^{e}	4.76 ± 0.06^{d}	5.12 ± 0.06^{c}	5.28 ± 0.08^{b}	5.06 ± 0.06^{c}
12	5.11 ± 0.10^{e}	4.36 ± 0.05^{f}	5.14 ± 0.07^{e}	5.60 ± 0.08^{c}	4.20 ± 0.06^{g}	5.94 ± 0.13^{a}	5.76 ± 0.09^{b}	5.32 ± 0.04^{d}
24	5.27 ± 0.07^{b}	5.66 ± 0.08^{a}	5.60 ± 0.04^{a}	5.58 ± 0.06^{a}	4.19 ± 0.04^{f}	4.83 ± 0.11^{d}	4.49 ± 0.09^{e}	4.99 ± 0.04^{c}
36	4.39 ± 0.05^{c}	4.43 ± 0.07^{c}	4.36 ± 0.08^{c}	5.58 ± 0.18^{a}	4.19 ± 0.05^{c}	4.83 ± 0.07^{b}	4.49 ± 0.08^{c}	4.99 ± 0.07^{b}
48	6.02 ± 0.18^{a}	4.48 ± 0.06^{c}	5.61 ± 0.06^{b}	5.48 ± 0.14^{b}	4.21 ± 0.04^{d}	5.44 ± 0.03^{b}	5.58 ± 0.05^{b}	4.40 ± 0.05^{c}
60	5.12 ± 0.11^{a}	5.13 ± 0.07^{a}	4.77 ± 0.07^{b}	4.10 ± 0.05^{d}	3.17 ± 0.04^{e}	4.15 ± 0.09^{d}	4.55 ± 0.15^{c}	4.83 ± 0.17^{b}

Note: Lower case letters refer to significant difference between treatments at same time ($P < 0.05$).

3.3.3. The Effect of Rose Polyphenol Coating Treatment on the pH of Fish Meat

Research has shown that the changes in pH of fish during storage are closely related to freshness [33]. The pH of fish in each treatment group at different time periods is shown in Table 6. It can be seen that the pH of all treatment groups shows a trend of first decreasing and then increasing during storage. Among the four treatment groups without inoculation and the four treatment groups with inoculation, the uncoated treatment group had the largest pH change amplitude (0.54, 0.84), The pH change amplitude of the group treated with high concentration rose polyphenol coating was the smallest (0.12, 0.30). It can be concluded that rose polyphenols have an inhibitory effect on spoilage bacteria, and this effect increases with the increase of polyphenol concentration. The pH change of the treated group with inoculation was generally greater than that of the untreated group, due to the accelerated decomposition of nitrogen-containing compounds by the inoculated spoilage bacteria, resulting in the accumulation of alkaline substances. Based on the above data analysis, it can be concluded that rose polyphenols have a certain impact on pH changes, and appropriate concentrations of rose polyphenols can inhibit fish spoilage.

Table 6. Changes of pH of fish within 60 h

Time (h)	1-1	1-2	1-3	1-4	2-1	2-2	2-3	2-4
0	6.31 ± 0.09^{a}	6.27 ± 0.08^{a}	6.32 ± 0.07^{a}	6.33 ± 0.08^{a}	6.31 ± 0.06^{a}	6.29 ± 0.09^{a}	6.27 ± 0.10^{a}	6.35 ± 0.09^{a}
12	6.21 ± 0.07^{a}	6.22 ± 0.08^{a}	6.20 ± 0.05^{a}	6.18 ± 0.08^{a}	6.24 ± 0.06^{a}	6.25 ± 0.06^{a}	6.21 ± 0.08^{a}	6.23 ± 0.08^{a}
24	6.32 ± 0.07^{ab}	6.31 ± 0.03^{ab}	6.25 ± 0.10^{b}	6.20 ± 0.09^{b}	6.42 ± 0.02^{a}	6.31 ± 0.04^{ab}	6.27 ± 0.08^{b}	6.29 ± 0.08^{b}
36	6.45 ± 0.08^{bc}	6.41 ± 0.07^{bc}	6.30 ± 0.08^{cd}	6.25 ± 0.10^{d}	6.71 ± 0.07^{a}	6.52 ± 0.08^{b}	6.37 ± 0.08^{cd}	6.35 ± 0.07^{cd}
48	6.62 ± 0.03^{bc}	6.52 ± 0.08^{cd}	6.35 ± 0.08^{ef}	6.30 ± 0.09^{f}	6.89 ± 0.03^{a}	6.70 ± 0.08^{b}	6.51 ± 0.08^{cd}	6.43 ± 0.07^{de}
60	6.85 ± 0.06^{c}	6.72 ± 0.11^{d}	6.55 ± 0.06^{e}	6.45 ± 0.08^{f}	7.15 ± 0.09^{a}	6.96 ± 0.07^{b}	6.70 ± 0.05^{d}	6.65 ± 0.06^{d}

Note: Lower case letters refer to significant difference between treatments at same time ($P < 0.05$).

ISSN: 2710-0588

3.3.4. The Effect of Rose Polyphenol Coating Treatment on Sensory Indicators of Fish Meat

The sensory evaluation values of fish meat from different treatment groups during storage are shown in Table 7. It can be seen that as time goes on, the quality of fish meat in each group shows a gradually decreasing trend. The decrease in quality in the inoculated treatment group was greater than that in the non-inoculated treatment group. In the inoculated treatment group, the decrease in sensory evaluation scores was the smallest under high concentration rose polyphenol coating treatment, with a value of 3.7, The sensory evaluation value of the sample coated with high rose polyphenol in the non-bacterial treatment group showed the smallest decrease, which is 3.4. It can be inferred that the addition of rose polyphenols can effectively delay the rate of quality decline during fish storage.

Table 7. Changes of fish sensory evaluation in 60 h

Time	1-1	1-2	1-3	1-4	2-1	2-2	2-3	2-4
0 h	8.6	8.6	8.6	8.6	8.3	8.3	8.3	8.3
12 h	8.7	7.3	7.9	8	7.3	7.3	7.7	7.7
24 h	8	8	7.9	7.6	8.3	8	7.6	7.9
36 h	7.3	7.3	7.3	7.3	6.9	6.9	6.9	6.5
48 h	5.9	5.9	6.3	6.3	5.2	6.2	6.2	5.3
60 h	4.5	4.6	4.5	5.2	3.5	3.5	4.2	4.6

4. Conclusion

This study aims to explore the role of rose polyphenols as QS inhibitors in fish preservation. The results show that rose polyphenols have a certain inhibitory effect on fish spoilage bacteria. By measuring the changes in various indicators of fish during storage, it was found that adding rose polyphenols to the coating for fish preservation can delay the rate of quality decline during storage, and the best inhibitory effect on spoilage bacteria is achieved when the concentration range of rose polyphenols is 2 mg/mL. This study verified the feasibility of using natural QS inhibitors such as rose polyphenols for fish preservation, providing a theoretical basis for the application of flavonoid natural QS inhibitors in the preservation of aquatic products, and offering a feasible approach for preserving aquatic products. However, the underlying mechanism of the inhibitory effect of rose polyphenols on the population of spoilage bacteria still needs further exploration.

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