ANALYSIS OF THE BROWNING INDEX OF CHITOSAN GLUCOSE GAMBIER COMPLEX (MAILARD REACTION) AS A BASIC STUDY OF NATURAL PRESERVATIVES FOR PROCESSED FOOD PRODUCTS

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ABSTRACT

The increasing number of shrimp shells has caused environmental pollution problems, and no suitable concept of natural preservation has been discovered. Chitosan and gambier have antibacterial characteristics. Glucose chitosan has antioxidant characteristics. However, there has been no research on the formulation that forms a complex solution. This research is intended to be a basic study of the determination of natural preservatives while searching for the ideal formulation of chitosan, glucose, and gambier. The

browning index was examined in this study to determine the optimal Maillard reaction to be used as a natural preservative. The experiment adopted a complete randomized design and was conducted with three groups. The treatment used gambier concentrations (A): A1 = 2%, A2 = 4%, and A3 = 6%, which used the same chitosan and glucose concentrations of 1%. The research samples were prepared with modifications of chitosan, glucose, and gambier that were changed into a preservation solution. Testing the browning index, or Maillard Reaction used a spectrophotometer in Sriwijaya University laboratory. Treatment A3 had the highest absorbance which was 1.389, whereas treatment A1 had the lowest absorbance which was 0.386. According to this research, the higher browning color meant it had a high antionxidant. Based on the research, namely 6% gambier concentration, treatment A3 produced a high antioxidant.

Keywords: Browning, Chitosan, Gambier, Mailard, and Preservative

1. Introduction

The Ministry of Marine Affairs and Fisheries (MMAF) has a dream to realize shrimp production to two million tons by 2024. Shrimp production is currently one of the things that are considered. Shrimp production in 2018 reached 110,000 tons until 2020 reached 856,753 tons (Surianti et al., 2020). Shrimp production which is targeted up to 250 percent is production in shrimp farms. The program was carried out to restore the national economy due to the Covid-19 pandemic. Programs to

produce shrimp such as millennial shrimp farming (MSF) or millennial farms. The abundant shrimp production target can cause shrimp shells in Indonesia to also increase. The problem has not been resolved until now. Abundant fishery products become a problem when they have not found a solution in preservation. The urgency of the research is that the improvement of shrimp shells causes environmental pollution problems. In addition, abundant fisheries production is targeted to reach 7.13 billion dollars in 2022 as one of the economic recovery strategies (Widiati, 2021). Previous studies examined natural preservatives to inhibit seeing antioxedan and antibacterial results but have not been optimal. It encourages you to look for the right combination. Combination by utilizing shrimp shell waste that is used as chitosan so that the waste can be more useful and have more value. Raw materials are abundant and easy to obtain such as gambier. Gambier is a typical plant in Toman Village, Babat Toman Banyuasin District, South Sumatra.

Gambier is proven to inhibit bacteria and is used in some natural preservatives because it contains catechins compounds (Suparno et al., 2020). The combination that has been carried out is research on chitosan monosaccharide complex can produce antioxidants to produce contributors to be used as

antioxidants (Sari et al., 2019) besides that it can inhibit pathogenic bacteria (Sari et al., 2020). The research produced antioxidants and antibacterials that produce natural preservatives. However, these three things have never been done in combination. Basic research has also not been conducted. It is hoped that with initial studies looking at mailard reactions or brown color can be a reference in antioxidant or antibacterial testing. The combination is expected to be more optimal and functional in preservation. Gambier has benefits as an antioxidant called catechins polyphenolic compounds (Sari et al., 20) (Aditya and Ariyanti, 2016). Chitosan is used in several applications due to its antimicrobial and antioxidant properties (Tarigan et al., 2012).

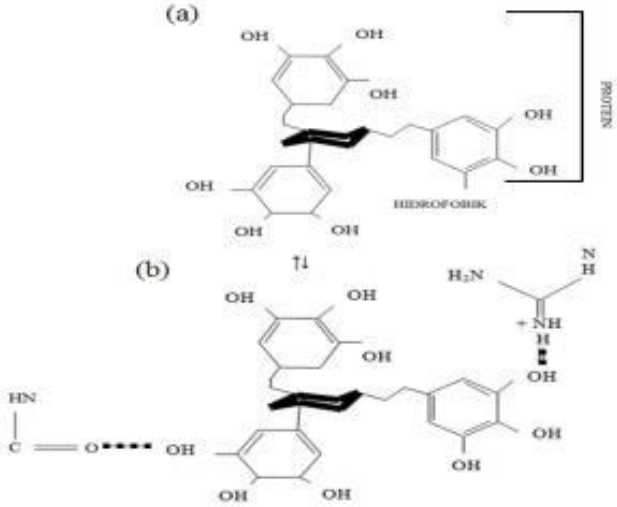
The use of natural preservatives is carried out separately so that the results carried out are not optimal or there is no basic study. Food preservation today still uses many chemicals. In line with the focus on optimizing downstream products and the design of PT strategy on fisheries processing. Therefore, it is necessary to preserve the right combination and maximum in inhibiting bacteria and having antioxidant functions. The combination of chitosan, glucose and gambier becomes a solution that can preserve food or processed fishery products. This is the background of research to increase antibacterial and antioxidant from a combination

solution of chitosan, glucose and gambier. This study aims specifically to optimize preservation before becoming a preservative solution, so this study was conducted to find the right formulation at the concentration of chitosan and glucose modified gambier. This research became the basis by looking at the mailard reaction formed. The feasibility study of this research is a solution with potential as a natural preservative because the more brown or formed the mailard reaction is expected to be more optimal in antibacterial and antioxidant. This preservation must be done immediately in order to solve the problem of waste reduction, postharvest and functional natural preservative alternatives.

1.1 Basic Study of Mailard Reaction in Antibacterial and Antioxidant Activity

Antibacterial catechins from gambier are functional compounds of the polyphenol group. Protein bonding to polyphenols (catechins) allows the formation of many hydrogen bonds between hydroxy groups to catechins and the functional properties of carbonyl groups can fuse to peptide bonds in proteins. Polyphenols (catechins) and complex proteins or called protein catechins complex are proven to produce reactions for the formation of hydrogen bonds and

hydrophobic interactions (Saad et al., 2020). This can be explained in Figure 1.



Source : Saad et al (2020)

Figure 1. Polyphenol-protein complex: (a) insert/cut polyphenols (b) hydrogen bonds to the protein surface

Figure 1. describes the binding of proteins to polyphenols, forming many hydrogen bonds between hydroxy polyphenol molecules and improving the function of carbonyls to protein peptide bonds. This proves that the content of polyphenols such as catechins with complex proteins always results in the formation of hydrogen bonds and hydrophobic interactions (Sari et al., 2020). What happens in fish, the bond forms a complex of protein catechins that can reduce mucus in fish and

inhibit bacterial growth. One way to prevent the formation of oxidation processes and cause rancidity is to form antioxidant compounds. Antioxidant compounds can be formed from the processing process, antioxidants from the food and antioxidants added to food. Foods that contain a lot of fat are susceptible to oxidation so that antioxidants are needed. The solution ever was to form a Maillard reaction. Heating glucose and chitosan will form a Maillard reaction that forms better antioxidants without reducing the antibacterial properties of chitosan because the Maillard reaction has reducing properties, namely giving donors and making a charge more stable (Yusliana et al., 2019). Maillard reactions are reactions between carbohydrates, especially reducing sugars, and primary amine groups. Reduction sugar is sugar that has the ability to reduce. This is due to the presence of aldehyde groups or free ketones. Oxidizing or reducing compounds are oxidizing metals such as Cu(II). Examples of sugars that include reduction sugars are glucose, mannose, fructose, lactose, maltose, and others. While what is included in non-reduced sugar is sucrose (Dwi et al., 2016)

2. Research Methodology

The experimental design used was the Complete Randomized Design. The stage in the research is the

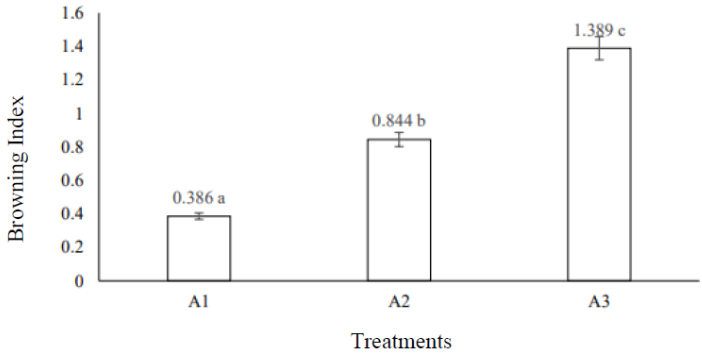
manufacture of a complex solution of gambier glucose chitosan with differences in the concentration of gambier used. The experimental design used was a Complete Randomized Plan conducted with three groups. The treatment is the concentration of gambier (A): A1 = 2%, A2 = 4% and A3 = 6%, while the chitosan and glucose treatment with the same concentration is 1%.

3. Results

3.1 Browning Index Analysis of Chitosan Glucose Gambier Complex (Mailard reaction)

The Maillard reaction is a reaction between proteins (free amino acids) and carbonyl compounds, specifically those derived from reducing sugars. This reaction produces a compound that is brown in color. This study of free amino acid compounds found in chitosan, (Sari et al., 2013) states that chitosan molecules have amino acids which are components of protein formation. While carbonyl compounds or reducing sugars are found in glucose. Color analysis of Maillard reactions has been the subject of observation for a long time. Therefore, brown color analysis with a spectrophotometer is one simple way to determine the level or intensity of brown color from each sample. The absorbance value of each

treatment has different levels. The absorbance value of each treatment is shown in Figure 2.



Description: A1: Chitosan 1%, Glucose 1%, Acetic Acid 1%, Gambir 2% A2: Chitosan 1%, Glucose 1%, Acetic Acid 1%, Gambir 4% A3: Chitosan 1%, Glucose 1%, Acetic Acid 1%, Gambir 6%

Figure 2. Absorbance value of brown colour chitosan glucose gambier complexes

4. Discussion

4.1 Browning Index Analysis of Chitosan Glucose Gambier Complex (Mailard reaction)

Based on Figure 1 that the highest absorbance value is found in treatment A3 which is 1.389 and the lowest absorbance in treatment A1 is 0.386. A1 treatment (chitosan solution with the addition of 2% gambier) so that it forms a color not so brown. The color of the 6% gambier glucose chitosan complex (A3) is brownest compared to the 4% gambier glucose chitosan

complex (A2) and the 2% gambier glucose chitosan complex (A1). The A1 treatment differs markedly from the A2 and A3 treatments. This factor is due to the Maillard reaction which is formed by the formation of glycoamine substituted in the N group found in chitosan and because of the brown color of gambier pollen (Sari et al., 2013). This color change becomes the benchmark of Maillard Reaction Products (PRM) and antioxidant power. In addition to contributing to the color and changing the taste of a food, several studies prove that the modified Maillard reaction of fructose can also contribute as an antioxidant and antibacterial (Jiang et al., 2018). Research (Sari et al., 2013) glucose chitosan complex (A2) and glucose chitosan complex (A1) showed a browner reaction than fructose chitosan complex (A3) in producing the Maillard reaction. The different structure of fructose is that it has a ketone group and makes the chitosan mixture more easily dehydrated than the aldose sugar, one of the less brown formations because in ketose sugar (fructose) the solubility level is longer and requires a long enough temperature to dissolve it.

5. Conclusion

The results showed that the brown color attribute (mailard reaction) can affect antioxidants and

antibacterials, the highest absorbance value was found in A3 treatment, which was 1.389 and the lowest absorbance in A1 treatment was 0.386. The higher brownish color means it has high antioxidants so this study resulted in the best treatment in A3 treatment, which is a concentration of 6% gambier.

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