

Effectiveness of Aloe Vera Extract in Reducing Formalin Levels in Catfish Fillets (*Pangasius* sp.)

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Abstract. This study used a quantitative experimental laboratory method with a research design. Completely Randomized Design (CRD) with treatments K0B0, K1B1, K1B2, K1B3, K2B1, K2B2 and K2B3. The research variables include chemical quality tests, namely formalin levels, protein levels and organoleptic tests (appearance, aroma and texture) with 3 replications in each treatment using 25 panelists. The purpose of this study was to determine which treatment can reduce formalin content, maintain protein levels and organoleptic values of catfish fillets. The treatment that can reduce the highest formalin levels and increase the highest protein levels is the K2B3 treatment with a percentage decrease in formalin levels of 82.339% and an increase in protein levels with a percentage increase of 48.128%. Based on the results of the organoleptic test, the best appearance was produced in treatments K1B1 and K2B1 with a median of 7 which means the color is specific to the type and less bright. The best aroma was produced by treatments K1B1, K1B2, K2B1 and K2B2 with a median of 5 which means musty and slightly rancid. The best texture was produced by treatments K1B1 and K2B2 with a median of 7 which means dense, less compact and less elastic.

Keywords: Aloe Vera, Catfish, Formalin

1 Introduction

Aloe vera is a multifunctional plant, namely as an additional food ingredient, cosmetics, medicine and decoration. Aloe vera is the oldest and most widely used medicinal plant. Aloe vera contains several important nutrients, including vitamins, minerals, amino acids, enzymes, and natural sugars, making it a beneficial ingredient for health [1]. The aloe vera plant is a plant that can be used to reduce formalin content because it contains saponin compounds and is not harmful for human consumption [2]. Aloe vera contains quite a high amount of saponin, around 5.651% per 100 grams [3].

Formalin is a liquid chemical commonly used to preserve corpses and as a chemical in industry. Formalin is a colorless and pungent-smelling solution made from the chemical compound formaldehyde. Formaldehyde is a chemical compound of the aldehyde group which is very reactive when compared to other aldehyde compounds [4]. Formalin can be identified by its sharp odor and sometimes causes eye irritation.

Catfish have a delicious taste, a high population and are easy to cultivate so the fillet industry in Indonesia is proliferating [5]. This fish is rich in protein and has a moderate fat content [6]. The high water content in catfish facilitates the entry of destructive microbes, because this condition can potentially lead to producer mischief in the use of formalin to preserve catfish. Food containing formalin is a threat to public health, this requires efforts to reduce the levels of formalin contained in food ingredients. The purpose of this study was to determine which aloe vera extract soaking treatment can reduce the formalin content while maintaining the protein content and organoleptic value of catfish fillets. The results of preliminary research showed a decrease in the level of formalin in catfish after soaking in aloe vera extract.

Research on efforts to reduce formalin levels in several food ingredients using aloe vera extract has been conducted by Yulianti and Surahmida (2022) in native chickens [3], Nurfi and Sopandi (2014) on boiler chicken meat [7], Rullyansyah et al., (2020) on tuna [8] and Daniel et al., (2018) on tofu [9]. The use of aloe vera extract as a formalin reducer is by utilizing the saponin content in aloe vera. Food preservation using formalin is due to the presence of aldehyde groups that bind to proteins and form methylene compounds, methylene compounds are cross-links that are difficult to break down. Methylene compounds can be broken down using saponins into

formalin and protein [10]. Saponins are glycosides consisting of sugars bound to aglycones, or saponins, which have a triterpenoid or steroid structure and are non-polar. This structure makes saponins similar to soap or detergents so that they function as surfactants [11]. The surfactant properties of saponin reduce the surface tension of water because the polar part of saponin binds to water, making it easier for water to enter and speeding up the hydrolysis process [3].

2 Method

The research method used in this study is the experimental method. The experimental method is an approach used to identify the effects of certain treatments. Experimental research methods are generally used in laboratory research [12].

2.1 Research Tools and Materials

The tools used in this study were measuring flasks, stirring rods, beaker glasses, measuring cups, dropper pipes, analytical scales with the Sojikyō brand, Erlenmeyer flasks, Scilogex brand hor plates, blenders, digital scales, plates, tofu filter cloths, knives, telemans, basins, stepwatches, mortars, pestles, burettes and stands.

The main material used in this study was aloe vera meat as much as 5,540 kg of aloe vera to obtain approximately 3,500 kg of aloe vera meat obtained from Mrs. Tun's garden in Pabean area, Sidoarjo Regency. The sample material used was 2,7 kg of patin fish obtained from Mr. Sutajib's pond in Sedati area, Sidoarjo Regency. The materials used for analysis were 37% formalin solution, dilute hydrogen peroxide (H₂O₂), 1 N NaOH, pp indicator, 0,1 N HCl, K oxalate and distilled water.

2.2 Experimental Design

The number of treatments in this study was seven treatment combinations. Each treatment was carried out in three repetitions. The experimental design applied in this study was a Completely Randomized Design (CRD), namely:

- a. K0B0 = Aloe vera extract concentration 0%, soaking time 0 minutes
- b. K1B1 = Aloe vera extract concentration 90%, soaking time 30 minutes
- c. K1B2 = Aloe vera extract concentration 90%, soaking time 60 minutes
- d. K1B3 = Aloe vera extract concentration 90%, soaking time 90 minutes
- e. K2B1 = Aloe vera extract concentration 100%, soaking time 30 minutes
- f. K2B2 = Aloe vera extract concentration 100%, soaking time 60 minutes
- g. K2B3 = Aloe vera extract concentration 100%, soaking time 90 minutes

2.3 Research Procedures

A. Making Aloe Vera Extract Solution

Aloe vera is sorted, peeled and the gel is taken, weighed as much as 900 g for 90% concentration and 1,000 g for 100% concentration, smoothed using a blender at speed one for 60 seconds, then filtered using a 100 mesh filter cloth.

B. Perendaman Ikan Patin dalam Ekstrak Lidah Buaya

Formalin-treated catfish fillets were weighed at 50 grams and then soaked using aloe vera extract according to the concentration and soaking duration variations K1B1, K1B2, K1B3, K2B1, K2B2 and K2B3.

C. Chemical and Organoleptic Analysis

The next step is a chemical analysis of each treatment including formalin levels using the Acidi Alkalimetry method [13], protein content calculation using the Formol method [14]. Organoleptic analysis was carried out by measuring the quality level of fish fillets by 25 panelists after soaking according to a scale of 1-9 with specifications of appearance, smell/aroma and texture.

2.4 Data Analysis

The parametric analysis used is the Analysis of Variance (ANOVA) method. This study uses data analysis methods that include parametric and non-parametric analysis. Parametric data must follow a normal distribution,

while non-parametric data, such as organoleptic tests, are categorical (ordinal) data that are not normally distributed and are not continuous [15].

3 Results and Discussion

3.1 Formalin Level

The results of the study on formalin levels in catfish after being soaked in aloe vera extract can be seen in table 1 below:

Table 1. Average Levels of Formalin in Catfish

Treatment Code	Treatment	Average formalin levels (ppm)	Percentage of formalin reduction (%)
K0B0	Concentration 0%, soaking time 0 minutes	0,0142 ^c	
K1B1	Concentration 90%, soaking time 30 minutes	0,0113 ^d	20,722
K1B2	Concentration 90%, soaking time 60 minutes	0,0104 ^{cd}	26,729
K1B3	Concentration 90%, soaking time 90 minutes	0,0088 ^{bc}	38,018
K2B1	Concentration 100%, soaking time 30 minutes	0,0075 ^b	46,772
K2B2	Concentration 100%, soaking time 60 minutes	0,0065 ^b	53,797
K2B3	Concentration 100%, soaking time 90 minutes	0,0025 ^a	82,339
KK= 9,5039360% (BNJ)			

Note: The same letters after the numbers in the mean indicate no significant difference according to the Honestly Significant Difference (HSD) test at the 5% confidence level.

Based on the results of the Analysis of Variance (ANOVA), it shows that soaking using aloe vera extract with different soaking times and concentrations has a very significant effect on the formalin content of catfish fillets, with a significance value of $0,001 \leq 0,05$. The highest percentage of formalin reduction was obtained in the K2B3 treatment of 82,339% with a formalin content of 0,0025 ppm because it used a high aloe vera extract content for a long time, while the lowest percentage of formalin reduction was produced by the K1B1 treatment of 20,722% with a formalin content of 0,0113 ppm.

The higher the concentration of aloe vera extract and the longer the soaking time, the greater the decrease in formalin levels. This is in accordance with the opinion of Yulianti and Surahmaida (2022) who stated that increasing the concentration of aloe vera extract will increase the decrease in formalin levels in samples [3]. Sarwindah and Wadoyo (2019) stated that with increasing soaking duration, the amount of formalin bound to saponin also increases [16]. Perlakuan perendaman fillet ikan patin dengan formalin menyebabkan terjadinya proses pengawetan karena adanya interaksi gugus aldehida yang terdapat pada formalin bereaksi dengan protein. Ikatan yang terbentuk antara formalin dan protein yaitu senyawa methyl-ol atau metilen dan cross linking. Senyawa methyl-on atau metilen mudah dipecah karena memiliki sifat yang reversible sedangkan cross linking merupakan ikatan silang formalin dan protein yang stabil atau irreversible [17].

The decrease in formalin levels in catfish fillets is caused by the saponin content in aloe vera extract. Saponin is a glycoside compound that has aglycones in the form of steroids and terpenoids found in plants. Saponin reduces formalin levels through a working mechanism involving saponification or saponification reactions. Saponin is amphipathic, so it acts as an emulsifier that reduces surface tension, making it easier for water to enter food ingredients [3]. Formalin will be bound by saponin and form mycelium. The structure of mycelium at the poles has polar properties that will interact with water, causing formalin to dissolve in water [18]. Mycelium which is non-polar will avoid contact with water [19]. This is in line with findings from Daniela et.al., (2018), 100% is the best treatment because it can reduce the highest level of formalin, namely 5,541% [9]. The properties that show that aloe vera can reduce formalin in tofu with a concentration of formalin that is easily soluble in water also play a role in reducing formalin levels. This is supported by research by Safrida et al., (2020) which states that saponin compounds can reduce formalin levels together with water [20]. Formalin cannot be completely removed 100% due to the presence of cross-links between formalin and protein or stable or irreversible cross-linking compounds [17].

3.2 Protein Content

The results of the study on protein levels in catfish after being soaked in aloe vera extract can be seen in table 2 below:

Table 2. Average Protein Content of Catfish

Treatment Code	Treatment	Average formalin levels (ppm)	Provides increased protein content (%)
K0B0	Concentration 0%, soaking time 0 minutes	5,059 ^a	
K1B1	Concentration 90%, soaking time 30 minutes	6,117 ^b	17,301
K1B2	Concentration 90%, soaking time 60 minutes	7,866 ^d	35,693
K1B3	Concentration 90%, soaking time 90 minutes	8,948 ^{ef}	43,464
K2B1	Concentration 100%, soaking time 30 minutes	6,981 ^c	27,541
K2B2	Concentration 100%, soaking time 60 minutes	8,213 ^{de}	38,407
K2B3	Concentration 100%, soaking time 90 minutes	9,753 ^f	48,128

KK = 4,0349569% (BNT)

Note: The same letters after the numbers in the mean indicate no significant difference according to the Least Significant Difference (LSD) test at the 5% confidence level.

Based on the results of Analysis of Variance (ANOVA) showed that each different treatment gave a very significant effect on the protein content of catfish fillets with a significance value of $0.001 \leq 0,05$. The protein content in untreated catfish fillets had an average value of 5,059%. After soaking using aloe vera extract according to the treatment, there was an increase in protein in catfish fillets. The highest protein increase was obtained in the K2B3 treatment of 48,128% with an average protein content of 9,753% while the lowest protein increase was obtained in the K1B1 treatment of 17,301% with an average protein content of 6,117%. The findings of this study indicate that increasing the concentration of aloe vera extract and longer soaking duration will increase the protein content in catfish fillets. This increase in protein content is in line with the decrease in formalin levels in catfish fillets [21].

Foodstuffs containing protein, when soaked in formalin will experience a reaction where the aldehyde group in formalin binds to the protein to form a methylene bond. Aldehydes are lipid oxidation products that can react with proteins and cause oxidation which is characterized by a decrease in protein levels [22]. The methylene bond will break down again into protein and formalin compounds with the presence of saponin content [21]. As explained by Daniela et al., (2018), saponins can increase protein levels through saponification reactions [9]. The broken methylene bonds will be broken down so that the protein content of the catfish fillets can increase again.

3.3 Organoleptic

The method used in this organoleptic test research is the scoring test method. Scoring test is an assessment method using a scale of numbers from 1 to 9, with specifications for each number that provide a certain meaning for the panelists.

3.3.1 Appearance

The results of the organoleptic test of the appearance of the patin fish fillet after being soaked with different times and concentrations produced the highest value of 7, which means the specific color of the type is less bright. The mean organoleptic appearance of the patin fish fillet is seen in Figure 1:

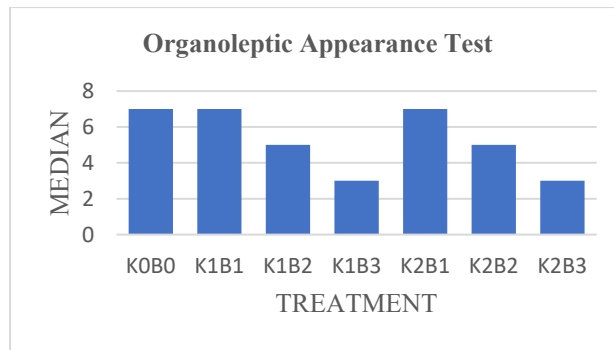


Figure 1. The Average Value of Organoleptic Appearance Treatment

The median results of the appearance test on catfish fillets in Figure 1 show that the K1B1 and K2B1 treatments gave the same appearance value, namely 7, which means that the catfish fillets were assessed as having a specific type of color appearance, which was less bright [23]. The soaking treatment of catfish fillets using aloe vera extract affected the appearance of the catfish fillets to become less bright. Changes in appearance of catfish fillets are also caused by soaking catfish fillets in aloe vera extract for too long, this is similar to the opinion of Fadhilah et al., (2013) changes in appearance of catfish fillets are also caused by soaking fish fillets for too long so that the color changes to dull and less bright [2]. Insani et al., (2016) stated that fish fillets that had been soaked had a paler color, this was due to the binding of the solution by the meat tissue which caused the color to change [24].

3.3.2 Smell

The results of the organoleptic test of the appearance of the patin fish fillet after being soaked with different times and concentrations produced the highest value of 5, which means musty and slightly rancid. The mean organoleptic appearance of the patin fish fillet is seen in Figure 2:

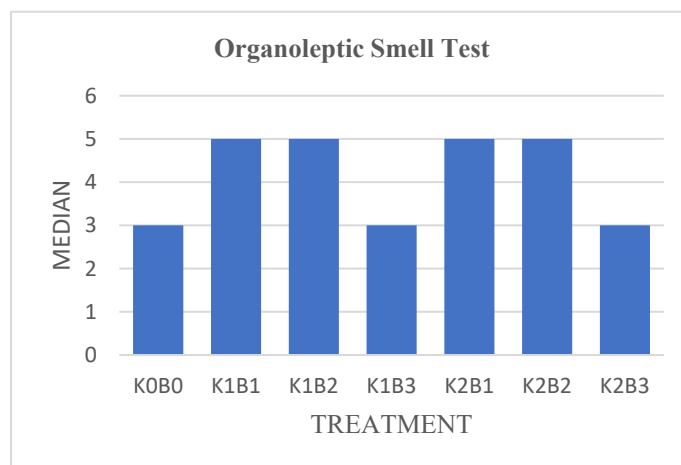


Figure 2. The Average Value of Organoleptic Smell Treatment

The results of the smell test on catfish fillets in Figure 2 show that the treatments K1B1, K1B2, K2B1 and K2B2 have the same smell value, namely 5, which means musty and slightly rancid. The treatments K1B3 and K2B3 are low smell values, namely 3, which means sour, slightly ammoniacal and rancid. The average smell of catfish fillets. The pungent smell like acid in fish fillets is due to formalin soaking as explained by Fadhilah et al., (2013), namely the pungent odor like acid is due to the addition of formalin solution to the fish [2]. The pungent, sour smell of the fish fillet is then mixed with the soaking of aloe vera, causing a musty odor in the fish fillet because the aloe vera flesh can emit a rancid smell due to the presence of the aloin compound in the aloe vera mucus [25].

3.3.3 Texture

The results of the organoleptic test of the appearance of catfish fillets after being soaked with different times and concentrations produced the highest value of 7, which is dense, less compact and less elastic. The mean organoleptic appearance of catfish fillets is seen in Figure 3:

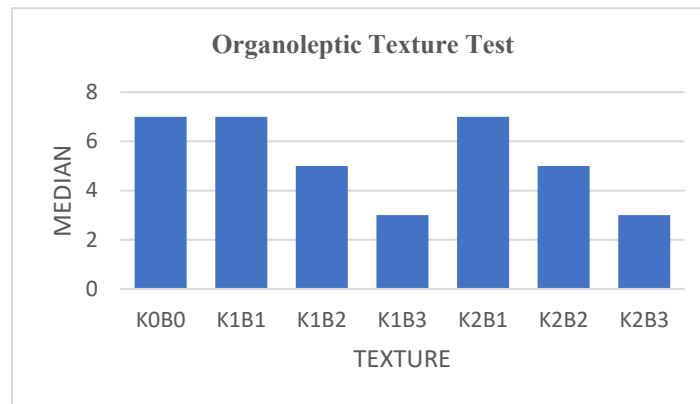


Figure 3. The Average Value of Organoleptic Textur Treatment

The results of the catfish fillet texture test in Figure 3 show that the differences in each treatment affect the assessment of texture. The highest texture assessment was obtained from the K1B1 and K2B1 treatments with an average treatment of 7, which means that the catfish fillet is dense, less compact and less elastic. The lowest treatment results were obtained from the K1B3 and K2B3 treatments because these treatments used the longest time, namely 90 minutes, which resulted in the texture of the catfish fillet becoming soft due to the rotting process. The high water content in catfish fillets is also one of the causes of the texture of catfish fillets becoming soft. This is in accordance with the statement of Nofreeana et al., (2017) that the free water content in the product can facilitate the growth of microorganisms such as mold, yeast and bacteria which then affect the texture of the product [26]. Insani et al., (2016) stated that changes in the texture of fish are also influenced by the amount of water in the fish's body. The main thing that causes changes in texture in fish is the inability of the fish's flesh tissue to maintain its water content [24].

4 Conclusion

The difference in concentration and duration of soaking of aloe vera extract gave results that had a very significant effect on reducing formalin levels and increasing protein levels of catfish fillets (*Pangasius* sp.). Based on the results of the study, K2B3 treatment with a concentration of 100% and a soaking time of 90 minutes was the most effective treatment in reducing formalin levels and increasing protein levels of catfish fillets (*Pangasius* sp.) with an efficiency of reducing formalin levels of 82,339% and increasing protein levels of 48,128%.

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