Jurnal TEKNO
(Civil Engineeering, Elektrical Engineeering and Industrial Engineeering)
Vol. 20, No : 1, April 2023 , p-ISSN:1907-5243, e-ISSN: 2655-8416

Application of Anthocyanin Extracted from Purple Sweet Potato and Nata de Coco Film in The Smart Food Packaging Technology

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Abstract

Chicken liver is one of the products consumed by the majority of Indonesians. Chicken liver is in high demand by the public because it is cheap. To analyze the freshness of chicken liver in the package easily and practically, so analytical tools were needed. The purpose of this study was to develop an edible freshness sensor based on anthocyanin purple sweet potato with bacterial cellulose membrane from nata de coco. The edible freshness sensor can be applied as a freshness sensor to determine the freshness level of chicken liver by various parameters. The color change of an edible freshness sensor was observed visually. The results showed that a change in the color of the freshness sensor, namely light blue when chicken liver was fresh, and dark blue when chicken liver was no longer fresh.

Keywords: anthocyanin, freshness sensor, nata de coco, chicken liver

1. INTRODUCTION

One of the most demanded organs of chicken entrails is the liver. Chicken liver is one of the products consumed by the majority of Indonesians. Chicken liver is in high demand by the public because it is cheap. Fresh chicken liver falls within the normal pH range, which is 5.5 to 6.0 [1]. Color changes and an increase in pH are one of the reasons for the spoilage process when chicken liver is left open. In modern markets, chicken liver is often sold in packaged form. The weakness of the packaging is that it is difficult to detect the quality deterioration of chicken liver because consumers cannot know the texture and smell to ensure the quality of chicken liver. In order to overcome these problems, several studies have been conducted to monitor freshness, one of which was to make freshness indicator labels. The result is that the smart wrap sensor is able to respond well to chicken and liver freshness, which is indicated by the appearance of color changes in the sensor [2]. Smart package performance can be attained via the applications of indicators, sensors, barcodes, and radio-frequency identification (RFID) systems [3]. Indicators inform the changes occurring in a food product or its environment through visual or other changes. The commonly used indicators in the meat industry freshness indicators. Colorimetric indicators are used to monitor the quality and safety as well as sense the spoilage in meat-based products by measuring the changes in color by means of cameras or other image-capturing devices or in some instances by the naked eyes [4-6]. One indicator that can be used as an observer to decrease the quality of a product is to make visual changes using a pH indicator. Anthocyanins are one of the natural dyes that can be used as an indicator to monitor changes in pH. Anthocyanins are natural based, non-toxic, water-soluble pigments that provide the purple, blue and red color of many plants and fruits. Since pH changes are an important factor to inform spoilage in many food products, numerous efforts have been made toward the development of visual pH indicators as one type of smart food packaging technologies, due to several advantages including small size, great sensitivity, and low costs. Generally, visual pH indicators consist of a pH sensitive dye and a solid matrix to immobilize the pH dye [7]. The use of colorimetric indicators requires a membrane as a reaction medium between reagents and analytes in a sensor manufacture. The use of bacterial cellulose as an edible membrane can be an option because it is made from natural materials, environmentally friendly and safe for consumption [8]. One of the commonly known bacterial cellulose products is nata de coco [9]. This study aims to determine whether the edible freshness sensor based on purple sweet potato and nata de coco film can be applied as an indicator of chicken liver freshness.

2. METHODS

The materials used in this study were chicken liver and purple sweet potato purchased at the Modern Market in Jakarta Indonesia, unsweetened nata de coco purchased at the marketplace, aquades, 96% ethanol, chitosan and acetic acid. The membrane cellulose is made from basic ingredients of nata de coco using the mixing and casting method and then drying the sample. The mixing method is mixing the ingredients using a hot plate stirrer or magnetic stirrer. The mass of chitosan as an additive was varied from 0.1 gram; 0.2 gram; 0.3 gram and 0.4 gram, while the mass of nata de coco and acetic acid used remained at 16 grams and 20 ml. For pH testing, 1 g of the sample was crushed and dissolved in 20 mL of distilled water and homogenized. The acidity level was measured with a pHmeter that had been previously calibrated with standard buffers 4, 7, and 10.

3. RESULTS AND DISCUSSION

First, we have successfully made a membrane as an indicator label media. The membrane is made from basic ingredients of nata de coco using the mixing and casting method and then drying the sample, as shown in Figure 1. The mixing method is mixing the ingredients using a hot plate stirrer. The mass of chitosan as an additive was varied from 0.1 gram; 0.2 gram; 0.3 gram and 0.4 gram, while the mass of nata de coco and acetic acid used remained at 16 grams and 20 ml. Make a natural indicator tag using purple sweet potato extract by weighing 100 grams of purple sweet potato cut into small pieces, then adding 200 mL of 96% ethanol and 2 mL of HCL. Then all the ingredients are in a blender until smooth, then store in a closed container and measure the pH 0. After that, wait for the maceration for 2 hours and measure the pH of the extract resulting from the maceration. Cut the nata de coco film into 2 x 1 cm then soak in the solution for 30 minutes, dry and observe the changes by storing it with the chicken liver.

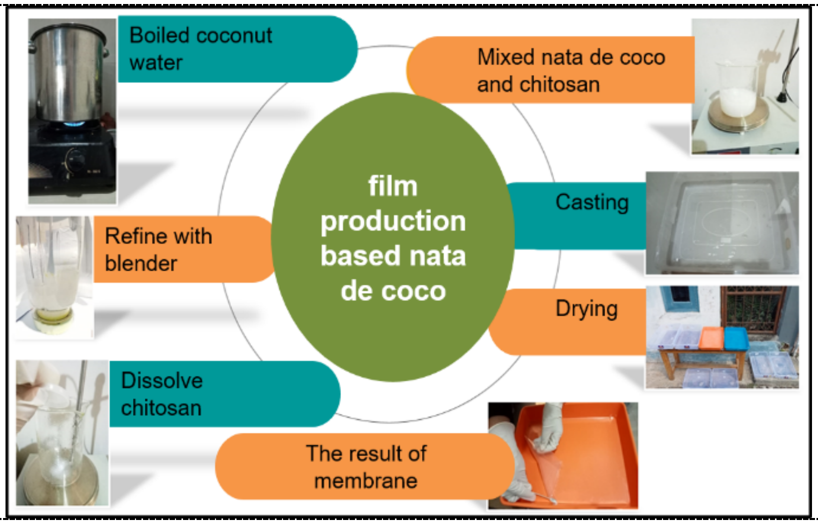


Figure 1. The process of membran made based nata de coco with variation of chitosan.

Films based on nata de coco with variations of chitosan have been successfully made using mix-and-pour methods. Mix and cast methods are often used in making edible films because the process of mixing the materials can be evenly distributed in the resulting film [10]. Figure 2 shows the physical appearance of the nata de coco film with chitosan variations. Based on the table and figure above, it can be seen that all nata de coco variants have a light color like plastic. However, the level of transparency at the surface of the film produced in each variation shows a difference. The nata de coco film with 0.4 gram chitosan variations and 0.3 gram chitosan variations produced a very transparent surface compared to the 0.1 gram chitosan and 0.2 gram variations of chitosan. This shows that the higher the concentration of chitosan added to the nata de coco film, the higher the transparency value of the film. This is because the form of chitosan is a white powder which when dissolved will form a clear suspension, so with the addition of a higher concentration of chitosan it can increase the value of film transparency and will produce a film with a high level of clarity, as a result, the degree of transparency increases [11].

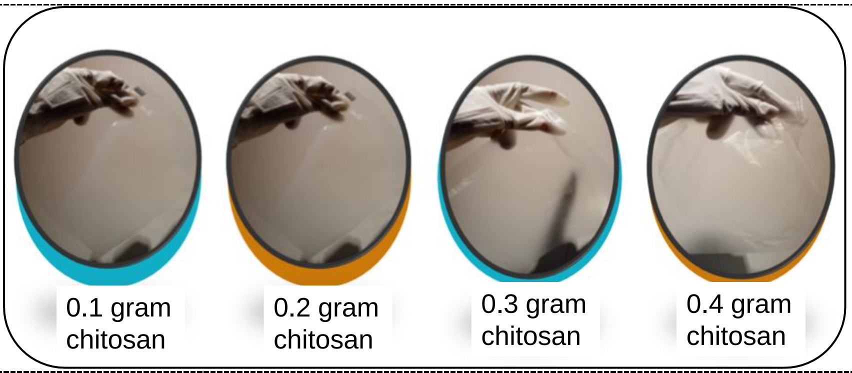
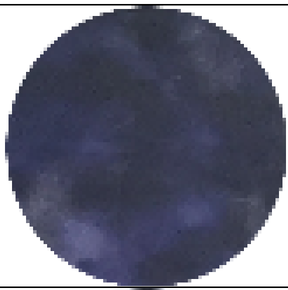


Figure 2. The result of membrane with various chitosan

Table 1. The result of observation sample during 24 hours

Hours	Sample	Colour Analysis
0		 HEX: #4e4b5f RGB: rgb(78,75,95) HSV: 249° 21.05% 37.25%
1		 HEX: #43485f RGB: rgb(67,72,95) HSV: 229° 29.47% 37.25%

3		 HEX: #2d2e4b RGB: rgb(45,46,75) HSV: 238° 40% 29.41%
5		 HEX: #313353 RGB: rgb(49,51,83) HSV: 236° 40.96% 32.55%
7		 HEX: #373a4d RGB: rgb(55,58,77) HSV: 232° 28.57% 30.2%
10		 HEX: #2b3044 RGB: rgb(43,48,68) HSV: 228° 36.76% 26.67%

12		 HEX: #303145 RGB: rgb(48,49,69) HSV: 237° 30.43% 27.06%
16		 HEX: #241d2d RGB: rgb(36,29,45) HSV: 266° 35.56% 17.65%
20		 HEX: #161522 RGB: rgb(22,21,34) HSV: 245° 38.24% 13.33%
24		 HEX: #1e1c29 RGB: rgb(30,28,41) HSV: 249° 31.71% 16.08%

Furthermore, the process of immobilization of purple sweet potato extract on the membrane. The membrane used was a membrane with a composition of 16 gram nata de coco, 0.3 chitosan and 20 ml of acetic acid. Purple sweet potato extract is made from 100 grams of purple sweet potato that has been mashed using a blender then added 200 ml of 96% Ethanol and 2 ml HCl. Then all the ingredients are in a blender until smooth, then store in a closed container and measure the pH 0. After that, wait for the maceration for 2 hours and measure the pH of the extract resulting from the maceration. Next, make an indicator label by immobilizing the purple sweet potato extract on a piece of membrane with a size of 2cm x 1cm for 30 minutes and dry it. After the sample was dry, the membrane was put into a closed container with plastic wrap containing 10 ml of NH_4OH solution, then do the same with the solution to measure the pH. Then monitor both for 30 minutes-1 hour once in 24 hours.

Test the indicator label of the purple sweet potato extract was done by cutting the cellulose membrane with a size of 3cm x 2cm, then dripping 10 drops of purple sweet potato extract then let stand for 30 minutes and dry. The test was carried out using chicken liver. Fresh chicken liver was stored with an indicator label in a closed container and then the pH was measured for some time. Color of indicator labels stored with fish for 0-24 hours was shown in Table 1. The color change on the label that is put into a container containing chicken liver after rotting is the same as the color change on the label that is dripping with NH_4OH. This shows that the purple sweet potato indicator label can work in responding to the decline in chicken liver quality. The color change in the curcumin extract solution when the pH was varied using acetic acid and NaOH, to determine whether purple sweet potato extract could be an indicator of freshness to chicken liver. The pH value of chicken liver was determined using a pH meter. The results of pH observations can be seen in Table 2.

Table 2. The result of pH test.

Hours	pH
0	5.5
1	5.5
3	5.8
5	6
7	6.8
10	7.2
12	7.5
16	8
20	8.5
24	9

Based on the tests that have been carried out, the label based on purple sweet potato extract can be used to detect the freshness of chicken liver. Rotten chicken liver can be detected by observing the color change on the label. The label will turn darker as the chicken liver goes bad. Chicken liver is categorized as fresh when the pH value is at pH 5.5. Meanwhile, chicken liver is categorized as not fresh when pH 9 is on a dark freshness indicator label. This is in accordance with the results of color measurements that the label with pH is sensitive to a decrease in the quality of chicken live.

4. CONCLUSION

Purple sweet potato based edible freshness sensor with membrane nata de coco bacterial cellulose can be applied on the packaging of chicken liver as an indicator freshness. The edible freshness sensor is light blue when the chicken liver is fresh and dark blue when the chicken liver is rotten. The pH value was observed to increase as the freshness level of the chicken liver decreased.

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Acknowledgments

Thank you for the Riset Keilmuan Terapan Dalam Negeri Dosen Perguruan Tinggi Vokasi research grant from the Ministry of Education, Culture, Research and Technology, Republic of Indonesia No. 0769/D6/KU.04.00/2021.