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Original Article

The Effect of pH on The Color Change of Anthocyanin Compound from Butterfly Pea Flower Extract (*Clitoria ternatea*)

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Abstract: An Indonesian plant called the butterfly pea flower (*Clitoria ternatea*) is being cultivated to take advantage of the antioxidant properties of its anthocyanin concentration. Several solvents must be used to acquire anthocyanins from butterfly pea flower extract during the extraction procedure. Flowers have many various anthocyanin compositions and exhibit a range of colors. These color differences are utilized in food and beverages as natural colorants. The purpose of this study was to ascertain how the anthocyanin chemicals in butterfly pea flowers respond to acidic conditions in terms of color stability. The extraction was placed over the course of 18 hours with a 60% ethanol solvent, and it was evaporated using a rotary evaporator at a temperature of 60°C. Anthocyanin extract of Butterfly pea flower was examined to investigate how pH changes affected color. The anthocyanin extract that had been obtained was subjected to acidity tests by using HCl at pH 1 to 7 and NaOH at pH 7 to 14. Anthocyanins become more stable in an acidic or low pH environment, giving an object its red color. While this continues, greater anthocyanin pH values will cause blue color fading.

Keywords: *anthocyanin, butterfly pea, color, flower, pH*

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INTRODUCTION

Anthocyanins are flavonoid derivatives composed of sugar groups (glycones), non-sugar groups (aglycones), and acyl groups. Anthocyanins are organic pigments that can dissolve in water to give color to fruit, vegetables, and fruit can give color to fruit, vegetables and flowers [1]. This organic anthocyanin pigment can be an alternative natural food coloring that is good for health [2]. Several studies have been carried out to extract anthocyanins from natural ingredients such as butterfly pea flowers [3], roselle [4], onion [5], kidney bean[6], red cabbage [7], grapes [8] and gondola [9]. One of the shortcomings of natural pigments from plants is color stability when used, so the brightness level of food colors is quite low.

Some indicator that influences the color and stability of anthocyanin pigments is pH, light, temperature, and anthocyanin structure. Anthocyanins are red in acidic conditions but turn blue when the pH rises[3]. Red pigment results from better stability of anthocyanins in acidic conditions (low pH). Anthocyanins will help fade the blue color with a higher pH value. Therefore, anthocyanin as a food coloring has a significant effect on food coloring both at high pH and at low pH. So, this research aims to determine the effect of acidity conditions (pH) on the color change of anthocyanins in butterfly pea flower extract. The solvent commonly used to extract anthocyanin compounds is ethanol [10]. The choice of ethanol solvent because of its polar nature has a good ability compared to ethyl acetate in extracting anthocyanins from butterfly pea flowers[11].

MATERIALS AND METHODS

Materials

The materials used were dried butterfly pea flowers from the local market, 60% ethanol purity, and distilled water obtained from the local chemical store.

Methods

Extraction Method of Anthocyanin

Butterfly pea flowers that have been taken in a fresh state were washed. Then, it dried using an oven Memmert UN 30 at 50°C for 30 minutes. The dried butterfly pea flowers were mashed and filtered using a 50-mesh sieve to equalize the size. 20 grams of butterfly pea flowers were extracted for a duration of soaking 18 hours using 60% ethanol solvent with each as much as 400 ml. After soaking, the mixture will be filtered, and the solvent will be evaporated using an IKA HB digital rotary evaporator at a temperature of 60°C and 50 rpm rotation [11]

Color Analysis of Anthocyanin Extract

Anthocyanin extracts from butterfly pea flowers were analyzed for color change with increasing pH. Anthocyanin extract samples were put into 14 glass bottles of 1 ml. Bottles 1-6 added 4 ml of acid compound, bottle 7 added 4 ml of neutral compound, and bottles 8-14 added 4 ml of base compound. After that, the pH of each was measured with a pH meter. Add 1.5 M HCl to bottles 1-6 to form pH 1-6; bottles 7 added HCl until the pH reached 7. Bottles 8-14, added 0.5 M NaOH to form pH 8-14. Analyze the color change that occurs at each pH.

RESULT AND DISCUSSION

In the results of butterfly pea flower extraction after pH testing using a pH meter, the resulting pH value has a different value. The variation of 60% ethanol with a soaking time of 6, 12, and 18 hours has a pH value of 3.3, 5.4, and 3.6, respectively. From our previous research, a soaking time of 18 hours gave the highest percentage of anthocyanin recovery, namely 29.25%. From the results of the pH test that has been carried out, the resulting pH value has an average pH value of 4.1 and is acidic. The condition is the expected state of anthocyanin stability, with a pH in an acidic atmosphere resulting in most anthocyanins becoming more colorful [12]. A comparison of anthocyanin color due to the effect of pH can be seen in Figure 1.

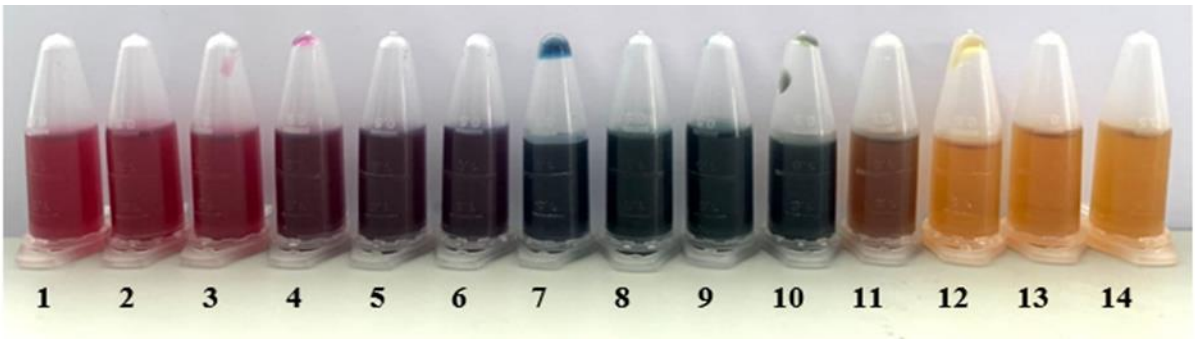

Figure 1. Color of anthocyanin extract at pH 1-14 with an ethanol solvent

According to Figure 1, anthocyanin extracts from butterfly pea flowers are red at a strong acidic pH of 1-3, purple at a weak acidic pH of 4-6, blue at pH 7, green at a weak base pH 8–10, and yellow at pH 11–14.

Using a reference [13] Explains that anthocyanins are predominant at pH 1-3 in the form of red flavylium cations. At pH 6, anthocyanin partially transforms into the blue compound quinoidal and partially into the purple compound carbinol. The main quinoidal, green between pH 7 and 10, changes to yellow chalcones above pH 10. As stated by [12], anthocyanins lose some red hue in weak acids and become more blue. The most stable form of anthocyanins at low pH values (pH 1-2) is flavilium cation. Flavilium cations are converted into colorless carbinol at pH 3, which gives off a subtle red color. As the pH increases to pH 7, the flavilium cation's vivid red color transforms to a blue quinonoidal base or an odorless pseudobase carbinol. The response was displayed in Figures 2 and 3.

Bright food colors are more attractive to consumers. The higher the anthocyanin content, the brighter the color and the lower the pH. So anthocyanins are stable at acidic pH levels. It is recommended to color food using natural anthocyanin dyes using high purity anthocyanin extracts, to produce bright colors. This is because natural anthocyanin dyes are unstable at high temperatures so they fade quickly. Anthocyanins are more stable in acidic conditions, giving an attractive color, a red pigment. Meanwhile, the higher the pH value of anthocyanin will fade the blue color. So, as food coloring, anthocyanins with various pH levels significantly affect food coloring [14].

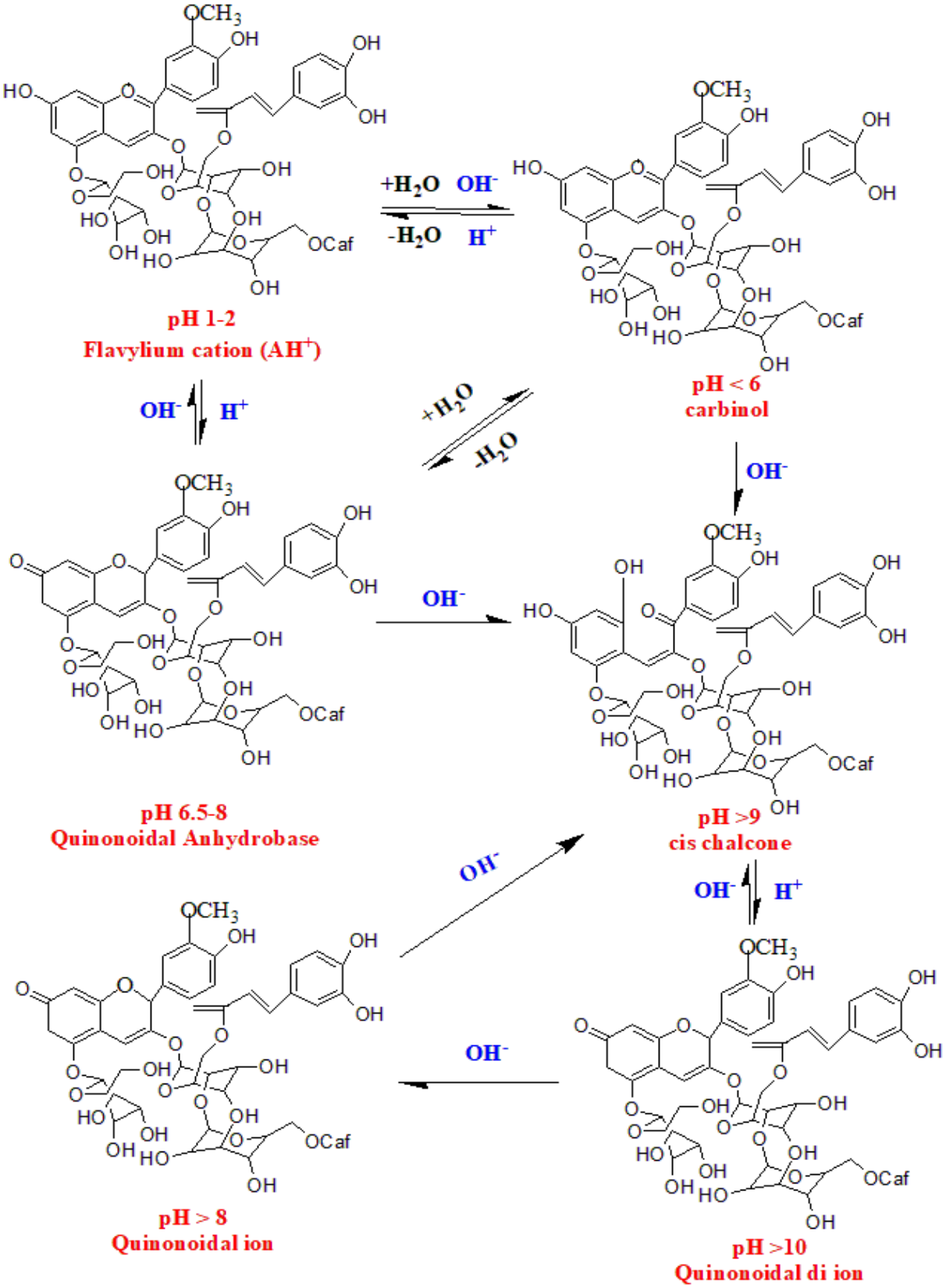

Figure 2. Prediction of changes in anthocyanin structure due to the influence of acidity (pH) 1-10 conditions [15], [16]

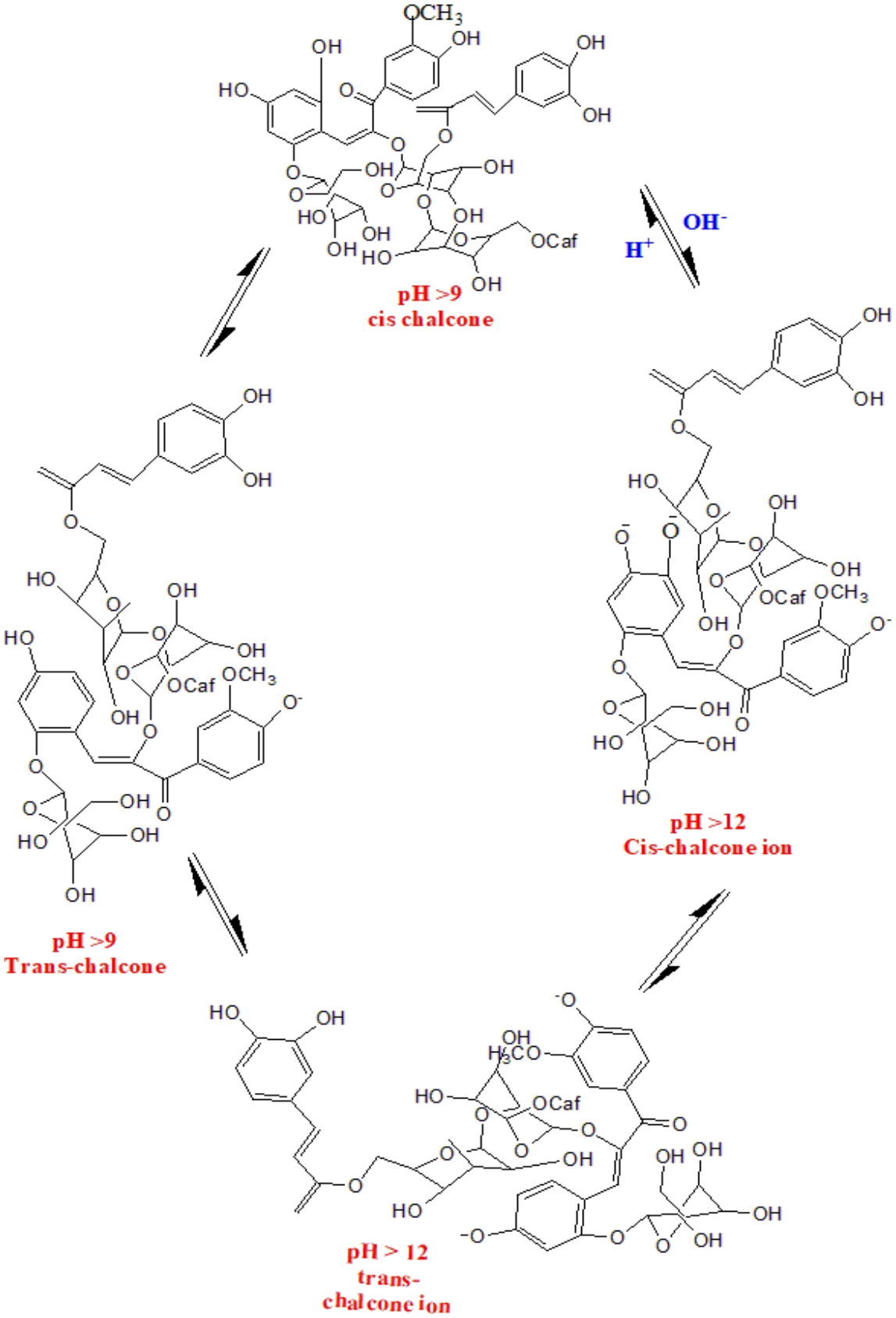

Figure 3. Prediction of changes in anthocyanin structure due to the influence of acidity (pH) 10-14 conditions [15], [16]

The results of these pH changes contribute to the food processing and post-manufacturing processes. This change in anthocyanin color is important for predicting the right time to add natural butterfly pea flower extract coloring to a food manufacturing process and to indicate whether a food product is still good. The addition of anthocyanin extract is recommended at the end of the process because there is no increase in temperature. The increase in temperature can come from the cooking or fermentation processes. If the color of the food has changed, it indicates a change in the pH of the food, and it is contaminated with mold or bacteria.

CONCLUSION

The color pattern of the anthocyanin extract tends to change as the pH increases from 1-14 from red, purple, blue, green, and yellow. In an acidic or low pH environment, anthocyanins become more stable, giving an object its red hue. As long as this goes on, higher anthocyanin pH levels will fade blue color. Anthocyanins' pH substantially impacts the coloration, whether high or low. Based on the experimental results, it shows that the anthocyanin compound extract is stable at low acid levels. Extracts of anthocyanin compounds at low acid levels show bright color changes, matching the original color of anthocyanin, namely red. As the pH level increases, the color of anthocyanin changes to dark and unstable.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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