

Comparison of Color Change to pH Range and Acid-Base Titration Indicator Precision Test of Multiple Ethanol Extracts

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Abstract

Natural indicators using anthocyanin compounds can be an alternative to synthetic indicators on acid-base titration because anthocyanin is an organic compound that is unstable with changes in pH. The extraction was carried out with ethanol because the compounds of anthocyanin were polar. This study was to ensure an ethanol extract of some plants could be used as an acid-base indicator that had a pH range of color change and the value of the equality parameter was not significantly different from the phenolphthalein indicator. The research method is to collect research journals on making natural indicators from ethanol extracts of various plants compared to phenolphthalein indicators so that secondary data from these journals can be processed statistically. Research results and conclusions: Based on the results of statistical data processing using the t-test there was no difference in the average pH of the phenolphthalein indicator with the average pH of ethanol extracts of adam air leaves (*Rheo discolor*), white frangipani flowers and *Clitoria teratea* L., with a significance value > 0.05 and the equality test (precision) had the requirements of good equality.

Keywords: Anthocyanin, Indicator of acid-base Titration, Ethanol, Precision

Introduction

Indicators are chemicals that are sensitive enough to display very close color changes in the titration process where equal amounts of analytes and titrants react with each other [1]. The acid-base indicator is a substance that can produce color changes according to the pH of the solution so that it can be known the acidic and basic properties of the solution [2] cause color changes and can be used to predict acidic pH and basic pH [3] has a special color at a certain pH as well as showing changes in pH at the time of titration [4].

Anthocyanins dyes are appropriate as indicators because anthocyanins are organic compounds that are unstable with changes in pH. In pH 1 - 2 is a stable condition of anthocyanin which is in the form of a colored cavity flavilium, when the pH is increased anthocyanins becomes colorless due to changes in pH [5]. In making, this natural indicators the extraction process will affect the withdrawal of the compound, where the selection of the solvent also plays an important role because it determines the success or failure of the extraction process [6]. Because anthocyanin compounds are polar, extraction is carried out using polar solvents such as ethanol [7].

The aim of this research is to ensure an ethanol extract of some plants can be used as an indicator of the acid-base that has a pH range of color changes and the value of the equality parameter is not significantly different from the phenolphthalein indicator.

Materials and methods

Collecting research journals on making natural indicators from ethanol extracts of various plants compared to phenolphthalein indicators so that secondary data from these journals can be processed statistically.

Results and discussion

Utilization of natural materials

According to Yulfriansyah and Novitriani [8], indicators by utilizing anthocyanin compounds in natural materials because they have color characteristics so that at each pH will display and provide different color changes.

Table 1 Natural Ingredients as a Natural Indicator.

No.	Natural Ingredients	Information
1.	Adam's Eve Leaves	Potential study of Adam's Eve Leaf extract (<i>Rheo discolor</i>) as indicator of acid-base titration [9]
2.	Red Cambodian Flower and White Cambodian Flower	Extraction and utilization of natural products (<i>Pulmeria species</i>) grown in Ankpa, Kogi state, Nigeria: An environmentally friendly source of acid-base indicator for titrimetric analysis [10]
3.	Butterfly pea flower	Butterfly pea (<i>Clitoria Ternate</i> L.) extract as indicator of acid - base titration [11]
4.	Black Sticky Rice	Utilization of black glutinous plant extract (<i>Oryza sativa glutinosa</i>) as an indicator of acid-base [12]
5.	Telang Flower	Extract (<i>Clitori Ternatea</i> L.) as an indicator for acid-base titration testing [13]

Effect of solvents

According to Ginanjar *et al.* [14] that in the extraction process there is a withdrawal of the compound from the active ingredient by the solvent used by the nature of polarity between the compound and the solvent. Anthocyanin is a polar compound, so to extract anthocyanin compounds, polar solvents are needed, one of which is by using ethanol as a solvent. Explained by Delazar *et al.* [15] that ethanol, methanol and acetone are the types of solvents that often used to extract phenolic compounds in plants and herbal plants

In a study conducted by Amin and Yuliana [16], natural dyes are very sensitive to changes in physics and chemistry one of the factors is the use of high temperatures because it can cause damage to these natural dyes. Therefore, the choice of ethanol as a solvent is due to anthocyanin which is polar, the solvent is also volatile so that when processing and concentrating does not require too high a temperature, this is to minimize damage to anthocyanin compounds that are not stable to high temperatures. Ethanol is a type of solvent that can attract polar and non-polar compounds [17], due to the presence of OH groups in ethanol so that it can dissolve polar molecules and the presence of alkyl groups, namely CH_3CH_2 - which can bind non-polar molecules.

Statistical data analysis of acid-base titration and indicators of natural ingredients

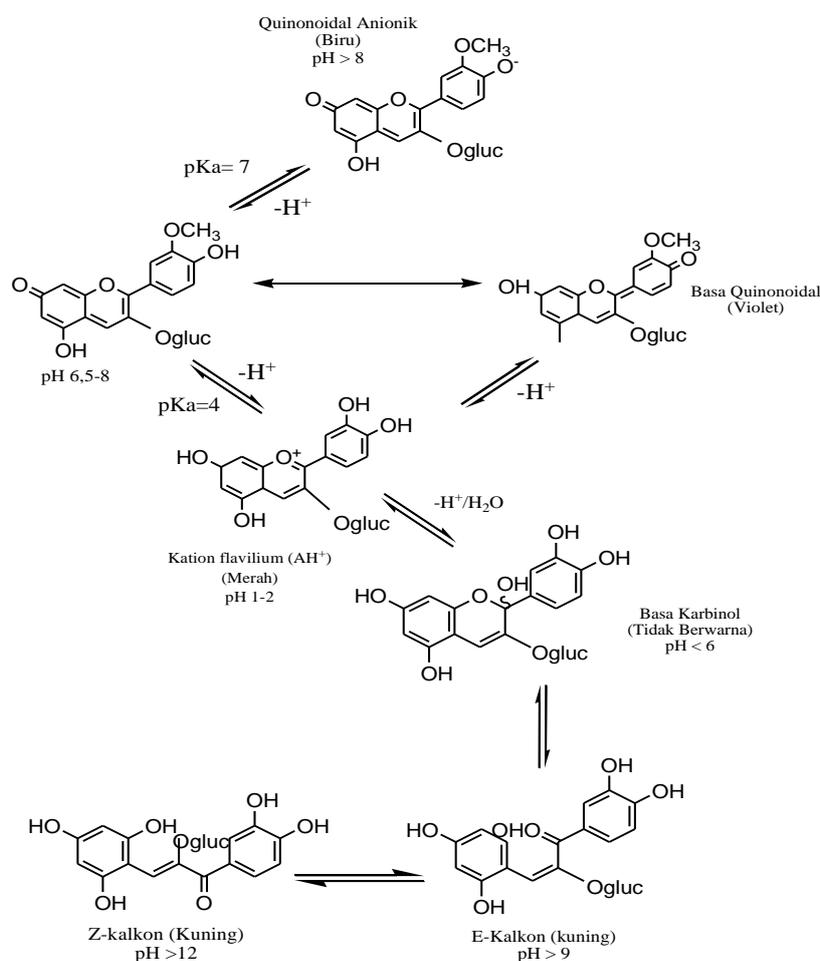
In research conducted by Nining *et al.* [18], it is explained that the color changes that occur from the use of these indicators because they are influenced by the stability of anthocyanin compounds, where one of the factors that influence the stability of anthocyanin compounds is the pH condition.

Statistical data analysis was performed on the results of a titration between strong acids, 0.1 N HCl, and a strong base, 0.1 N NaOH with phenolphthalein indicator and ethanol extract indicators of various plants. Statistical analysis was performed on the final pH achieved between the 2 indicators in reaching the endpoint of the titration. The results of the data analysis showed that between the 2 data there were no significant differences. The results can be seen from the sig-2 tailed value of > 0.05 between the phenolphthalein indicator and ethanol extracts of Adam's Eve Leaves with a pH range of 8.97 - 10.2 with color changes produced from reddish-orange to brownish green; ethanol extract of white Cambodian flowers with a pH range of 12.55 - 12.56 with color changes from initially colorless to gold; and ethanol extracts of telang flowers with a pH range of 12.67 - 12.69. Data can be seen in the following table:

Table 2 Final pH data in reaching the end point of acid base titration between phenolphthalein indicator and ethanol extract indicator of various plants.

Indicator name	Repeat	Final pH	Sig (2-tailed)	Indicator name for natural materials	Final pH	Sig (2-tailed)
Phenolphthalein	1	9.3	0.351	Adam's Eve Leaves	9.99	0.400
	2	9.25			10.2	
	3	9.4			8.97	
	Average	9.32			9.72	
Phenolphthalein	1	12.56	0.099	White Cambodian Flower	12.55	0.099
	2	12.57			12.56	
	3	12.57			12.56	
	Average	12.56			12.56	
Phenolphthalein	1	12.67	0.197	Telang Flower	12.67	0.197
	2	12.66			12.69	
	3	12.67			12.67	
	Average	12.67			12.67	

Changing pH conditions will cause changes in the structure of anthocyanin compounds and cause changes in color in the solution. In a study conducted by [19], it was explained that the stability of the anthocyanin structure can cause the hydrolysis compounds to undergo hydrolysis, that is the glycosidic bonds and the aglycoty ring become exposed, resulting in the formation of various unstable aglycones, which in the next stage produces carbinol and chalcone groups which are colorless. A following figure is a form of anthocyanin imbalance due to changes in pH.

**Figure 1** Form of anthocyanin balance due to changes in pH [13].

Equality test

This equality test is carried out to determine the suitability of the results of the tests carried out in the same concentration. Equality test can be measured from the value of the resulting standard deviation or relative standard deviation (coefficient of variation), because equality (precision) is a standard deviation or Relative Standard Deviation (% RSD) which is a criterion in this test with acceptable limits. The following are the results of the equality test.

Table 3 Equivalence test uses various indicators of ethanol extract of plants.

Plant extract name	Repeat	HCl concentration (N)	Calculate HCl concentration (N)	Recovery (%)	SD	RSD (%)
Adam's Eve Leaves	1	0.1	0.11	112	1×10^{-4}	0.09
	2	0.1	0.11	117		
	3	0.1	0.11	111		
	Average	0.1	0.11	113.33		
Red Cambodian Flower	1	0.1	0.07	72	39×10^{-4}	0.54
	2	0.1	0.07	72		
	3	0.1	0.07	72		
	Average	0.1	0.07	72		
White Cambodian Flower	1	0.1	0.06	58	8×10^{-4}	1.33
	2	0.1	0.06	58		
	3	0.1	0.06	58		
	Average	0.1	0.06	58		
Butterfly Pea Flower	1	0.1	0.10	98	26×10^{-7}	0.003
	2	0.1	0.10	97		
	3	0.1	0.10	98		
	Average	0.1	0.10	97.66		
Black Sticky Rice	1	0.1	0.10	105.2	5×10^{-5}	0.05
	2	0.1	0.10	105.3		
	3	0.1	0.10	105.2		
	Average	0.1	0.10	105.3		
Telang Flower	1	0.1	0.09	87	5×10^{-5}	0.06
	2	0.1	0.10	97		
	3	0.1	0.09	89		
	Average	0.1	0.09	91		

In the table above can be seen from the SD or standard deviation where for all the data from the ethanol extracts of the various plants show the distribution of data close to each other, and also seen in the % RSD value, the result is $\leq 1\%$ for Adam leaf extract air, red Cambodia flowers, butterfly pea flower, black sticky rice and telang flowers that show the data have a very thorough accuracy, and meticulous for white Cambodia flowers with $\% \text{RSD} \leq 2\%$, so that the data can be said to meet the parameters of good equality.

Conclusions

Based on statistical data processing from this study there was no significant difference between the average pH of the phenolphthalein indicator and the average pH of the ethanol extract of Adam's Eve Leaves, ethanol extracts of white Cambodia flowers and ethanol extracts of telang flowers in producing color changes, and in the test the similarity of SD shows the distribution close to each other and the value of % RSD ≤ 1 % for extracts of Adam's Eve Leaves, red cambodia flowers, butterfly pea flower, black sticky rice and telang flowers and white cambodia flowers with % RSD ≤ 2 %, so that the data can be said to meet the parameters of good equality.

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