POTENTIAL OF DAYAK ONION SKIN (ELEUTHERINE PALMIFOLIA) EXTRACT AS AN ALTERNATIVE INDICATOR FOR ACID BASE TITRATION PRACTICUM

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Abstract. Synthetic indicators such as phenolphthalein are used during acid-base titrations to determine the end point of the titration. These indicators are not environmentally friendly and the price is high. To overcome this, it is necessary to study the potential of natural indicators available in the environment, one of which was Dayak onion skin which has not been utilized after the tubers have been taken as an anti-cancer herbal medicine. The aim of this research was to determine the potential of Dayak onion skin (*Eleutherine Palmifolia*) as a natural indicator in acid-base titrations. The sampling collection of Dayak onions was done randomly in the city of Palangka Raya, Central Kalimantan. The method used in this study employed experimental techniques in the chemistry laboratory of FKIP ULM with the following steps: 1) Maceration of smoothed Dayak onion skin with 96% ethanol for 1, 2 and 3 days 2) Qualitative test of anthocyanin, color test with buffer pH 1-14, 3) Absorption measurement with a UV-Vis spectrophotometer at a wavelength of 200 - 400 nm, 4) Application of the extract as an indicator in acid-base titrations. The results showed that the optimum maceration time was on day 3 with an absorption of 4,520 at a wavelength of 380 nm. The application on the HCl – NaOH titration with a titration end point volume of 9.11 mL showed a color change from yellow to straw yellow, while the comparison indicator PP had a volume change of 8.57 mL with a color change from colorless to pink. The CH_3COOH – NaOH titration gave a result of 11.43 mL and the PP indicator was 11.01 mL. For the $NaHCO_3$ – HCl titration, the end point volume of the titration was 9.93 mL with a straw yellow – yellow color change and the MO indicator comparison was 10.27 mL with an orange – red color change. From the results of this research, there was a significant color change at the end point of the titration, so it can be stated that Dayak onion skin extract had the potential to be an alternative indicator in acid-base titration practice so that it can be a solution in reducing chemical pollution in the environment.

Keywords: acid-base titration, dayak onion skin, indicator, maceration

INTRODUCTION

Acid-base titration experiments often use synthetic indicators such as phenolphthalein as the endpoint determiner. These indicators are environmentally unfriendly and expensive. Research studies need to be conducted using local plants as alternative indicators from natural materials o address this. Dayak onion (*Eleutherine Palmifolia*) is used as an herbal medicine to treat cancer, tumors, diabetes mellitus, hypertension, reduce cholesterol levels, treat boils, and more (Ekawati, 2020). Dayak onion bulbs contain compounds such as flavonoids, saponins, polyphenols, alkaloids, glycosides, steroids, phenolics, tannins, triterpenoids, and quinones (Hardarani, 2019;

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Kumalasari et al., 2020). The processing of Dayak onion as an herbal medicine often leaves waste in the form of Dayak onion skin.

Research is conducted on the potential use of Dayak onion skin extract as an alternative indicator in acid-base titration experiments to utilize Dayak onion skin waste. Acid-base titration generally uses synthetic indicators such as phenolphthalein and methyl orange as endpoint determiners by providing a change in color. Acids contain H+ ions, while bases contain OH- ions when dissolved. Virliantari, et al. (2018) researched red onion skin as a natural acid-base indicator with an optimal concentration of 50% in ethanol and an optimal maceration time of 3 days with the largest absorbance value of 1.277 at a wavelength of 520 nm and a pH range of 8 - 9. According to Mulyanti (2021), an indicator is a substance that will give a different color in acidic or basic conditions, and hibiscus used as a natural indicator in acid or base identification provides a color degradation change. Jati leaves used as a natural acid-base indicator with the best absorbance at an extraction temperature of 30 °C with an extraction time of 3 hours amounted to 3.669, and the highest titration value with HCl was obtained at an extraction temperature of 60 °C with an extraction time of 4 hours, i.e., 1.2 mL, while titration with NaOH obtained extraction at 60 °C with an extraction time of 4 hours amounted to 10.8 mL (Maulina, Jalaluddin & Bahri, 2022). This study aims to determine the potential effectiveness of Dayak onion skin extract as an alternative indicator for acid-base titration.

METHOD

This research employed an experimental method in the chemistry laboratory of FKIP ULM (Virliantari et al., 2018). According to Virliantari et al., (2018), red onion skin can be used as a natural acid-base indicator. Given that Dayak onion has long been used as an alternative medicine, researching Dayak onion skin samples as an alternative indicator in acid-base titration is an innovation in wetland plant utilization. The materials used in this study include Ulin wood sawdust, 96% ethanol (Merck), distilled water, HCl (Merck), NaOH (Merck), pH 1-14 buffer, phenolphthalein indicator (Merck), and methyl orange indicator (Merck). The tools used include a digital balance (Metler Toledo), UV-Vis spectrophotometer (Biosan), vacuum pump (Aldo), hotplate and stirrer (Thermo), burette (Pyrex), volumetric pipette (Pyrex), dropper pipette, Erlenmeyer flask (Pyrex), beaker (Pyrex), measuring glass (Pyrex), and funnel.

Flavonoid Extract with Maceration

The extract is made by weighing 50 g of Dayak onion skin that has been blended and macerating it using 96% ethanol as much as 200 mL (1:4) with variations in maceration time for 1, 2, and 3 days, then filtered using filter paper. The reddish-brown extract is stored in dark glass bottles (Virliantari et al., 2018).

Qualitative Anthocyanin Test on Sample Extract

The qualitative anthocyanin test on the sample extract is done using Harbone's method (1986) with 3 mL of extract added to 2 M HCl and then heated at 100 °C for 5 minutes. The characteristic of anthocyanin is that the red color will not fade. Another qualitative test involves adding 3 mL of extract to 2 M NaOH drop by drop, resulting in a color change from greenish-blue that gradually fades to yellow.

Color Test on Sample Extract with pH 1-14 Buffer Solution

The color test on the extract with pH 1-14 buffer solution is performed by preparing each buffer solution as much as 2 mL and adding 5 - 6 drops of extract to each buffer, observing the color changes that occur.

Determination of Optimal Maceration Time of Extract with UV-Vis Spectrophotometer

The determination of the optimal maceration time for the extract with maceration times of 1, 2, and 3 days is carried out with a UV-Vis spectrophotometer at a wavelength of 200–400 nm. This determination is to find the maximum absorbance (Maulina et al., 2022).

Application of Natural Indicator in Acid-Base Titration

The results of optimum absorbance measurements on the extract that provides optimal absorption will be used as a natural indicator in HCl–NaOH titration; CH_3COOH–NaOH; and $NaHCO_3$–HCl with a comparison of phenolphthalein and methyl orange indicators.

RESEARCH RESULTS AND DISCUSSION

The extract from maceration for 1, 2, and 3 days provides a reddish-brown extract as shown in Figure 1. This extract is then subjected to qualitative tests, color tests, spectrophotometer testing, and application in acid-base titration.

Figure 1. Dayak Onion Skin Extract

Qualitative Anthocyanin Test on Sample Extract

The qualitative anthocyanin test on the sample extract was conducted using the Harbone method, where 3 ml of the extract was added to 2 M HCl and then heated at a temperature of 100 °C for 5 minutes. The characteristic of anthocyanin is that the red color will not fade. The test results at this stage can be seen in Figure 2.

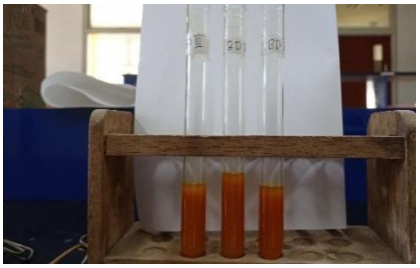

Figure 2a

Figure 2b

Figure 2. Changes in Qualitative Test of Sample Extract

Information:
Figure 2A = sample extract + HCl (yellowish cloudy solution)
Figure 2B = sample extract after heating (brownish cloudy solution)

Another qualitative test involved adding NaOH 2 M drop by drop to the extracts from maceration on days 1, 2, and 3, respectively, into reaction tubes. Changes can be observed in Figure 3.

Figure 3a **Figure 3b**

Figure 3. Changes in Qualitative Test of Sample Extract

Information:
Figure 3A = sample extract (clear brown solution)
Figure 3B = sample extract + NaOH (dark brown solution with sediment)

Figures 2 and 3 show unexpected color results, where the red color persists upon heating with HCl, and the brown color turns into dark brown with sediment when NaOH is added. Therefore, it is suspected that the Dayak onion extract contains tannins instead of anthocyanins. Tannins, as a coloring substance, give a brown color (Putri & Ridho, 2020). Dayak onion contains alkaloids, flavonoids, quinones, polyphenols, saponins, steroids, monoterpenoids, and tannins.

Color Test on Sample Extract with pH 1 - 14 Buffer Solution

The color test on the sample extract was conducted by preparing pH 1-14 buffer solutions (2 ml each) in reaction tubes and then adding 5-6 drops of sample extract. The test results can be seen in Figure 4.

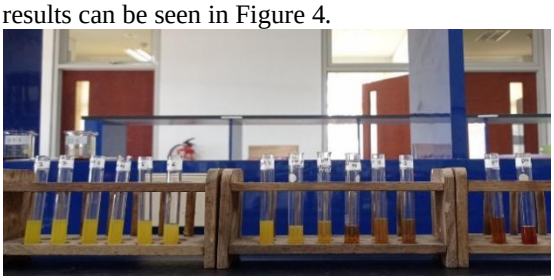

Figure 4. Color changes of extract in pH 1- 14 Buffer Solution

Figure 4 illustrates significant color changes in pH 1-8 buffers, appearing cloudy yellow upon the addition of extract. Furthermore, when adding pH 9-14 buffers, the solution's color changes to clear brown. The more basic the solution, the more reddish-brown it becomes. This color transformation occurs through the equilibrium process of molecular and ionic forms of the indicator compound. This is due to the delocalization of phi electrons from the compound's structure by the solvent, shifting reagents, and auxochrome, causing a smaller transition energy and a larger wavelength (Santi, Rahmalia, & Syahbanu, 2020).

Determination of Optimal Maceration Time for Extract with UV-Vis Spectrophotometer

Samples of extracts from days 1, 2, and 3 were measured using a UV-Vis spectrophotometer at a wavelength of 200-400 nm to determine the optimal maceration time, with absorption results as shown in Table 1.

Table 1. Absorbance Measurement Results

No.	Sample	A at ƛ 200 – 400 nm
1.	Day 1	4,324
2.	Day 2	4,457
3.	Day 3	4,520

Table 1 shows that macerating Dayak onion skin with 96% ethanol provides optimal absorbance absorption in the extract on day 3, with a value of 4.520 at a wavelength of 380 nm. The longer the maceration time, the more colored substances are extracted by the polar ethanol solvent. These results align with Santi et al., (2020), stating that the reddish-brown color in the extract requires less energy and absorbs at a larger wavelength. Compounds that absorb light in the visible region / colored compounds have easily promotable electrons. Based on these results, the day 3 extract will be applied to acid-base titration as a natural indicator.

Application of Natural Indicator in Acid-Base Titration

Comparisons of the end point of strong acid-strong base titration (HCl – NaOH), weak acid-strong base titration (CH_3COOH – NaOH), and weak base-strong acid titration ($NaHCO_3$ – HCl), using the natural indicator from Dayak onion skin extract with comparisons to synthetic indicators phenolphthalein (PP) and methyl orange (MO), were conducted in triplicate. The titration results are presented in Table 2.

Table 2. Acid-Base Titration Results with Natural and Synthetic Indicators

Indicator	Kondisi titrasi dan titik akhir titrasi								
	Titrasi HCl - NaOH			Titrasi CH_3COOH- HCl			Titrasi $NaHCO_3$-HCl		
	Vol. HCl (mL)	Vol. NaOH (mL)	Color at End Point	Vol. CH_3COOH (mL)	Vol .NaOH (mL)	Color at End Point	Vol. $NaHCO_3$ (mL)	Vol. HCl (mL)	Color at End Point
PP	10	8,65	Tidak berwarna – merah muda	10	11,05	Tidak berwarna – merah muda			
	10	8,11		10	10,91				
	10	8,95		10	11,06				
Average		8,57			11,01				
Dayak Onion Skin	10	9,01	Kuning – kuning jerami	10	11,41	Kuning – kuning jerami	10	10,33	Kuning Jerami - kuning
	10	9,01		10	11,29		10	10,05	
	10	9,31		10	11,61		10	10,45	
Average		9,11			11,43			10,27	
MO							10	10,05	Orange - merah
							10	9,76	
							10	10	
Average								9,93	

Table 2 shows the endpoint of titrations, where in the HCl – NaOH titration with PP indicator, it was 8.57 mL with the solution changing color from colorless to pink. The pH indicator PP has a range of 8.0 – 9.6 (Day and Underwood, 2002), and with the natural indicator from Dayak onion skin, it was 9.11 mL, with a color change from yellow to straw yellow, and the pH at the endpoint of titration indicating 9.8. In the CH_3COOH – NaOH titration with PP indicator, it was 11.01 mL with the solution changing color from colorless to pink. With the natural indicator from Dayak onion skin, it was 11.43 mL, with a color change from yellow to straw yellow, and the pH at the endpoint of titration indicating 9.96. The endpoint of titration in the $NaHCO_3$ – HCl titration with MO indicator was 10.27 mL with the solution changing color from orange to red. The pH range of MO is 3.1 – 4.4 (Day and Underwood, 2002), and with the natural indicator from Dayak onion skin, it was 9.93 mL with a color change from straw yellow to yellow, and the pH ranging from 3.12 – 4.19. Therefore, these results suggest that Dayak onion skin can be used as a natural indicator in acid-base titrations. The color changes at the endpoint of titrations can be seen in Figure 4.

Figure 4. Color Changes at the Endpoint of HCl-NaOH; CH3COOH-NaOH Titrations

Figure 5. Color Changes at the Endpoint of NaHCO3-HCl Titrations

From the research stages mentioned above, the extract of Dayak onion skin is highly potential as an alternative indicator in acid-base titrations because it provides clear and noticeable color changes. This serves as a solution to address the environmental unfriendliness and relatively high cost of synthetic indicators.

CONCLUSION

Based on the research results, it can be concluded that the extract of Dayak onion skin (*Eleutherine Palmifolia*) can be applied as a natural indicator in acid-base titrations, displaying color changes at the endpoint of titration from yellow to straw yellow in strong acid-strong base titrations, weak acid-strong base titrations, and color changes in weak base-strong acid titrations from straw yellow to yellow.

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