



Utilization of Purple Trumpet Flower Extract (*Ruellia Tuberosa* L.) as an Alternative Acid-Base Titration Indicator

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Abstract

*Anthocyanin-containing plants have potential as environmentally friendly natural acid–base indicators. However, information regarding the suitability of *Ruellia tuberosa* L. flower extract as a titration indicator remains limited. This study aimed to explore the potential of purple trumpet flower extract (*Ruellia tuberosa* L.) as an alternative acid-base titration indicator. The method used for flower extraction was stepwise maceration with n-hexane, ethyl acetate, and 70% ethanol. The extract was tested for anthocyanin content, color response in buffer solutions at pH 1–14, and performance in strong acid–strong base, weak acid–strong base, and weak base–strong acid titrations. The extract exhibited red at pH 1–3, pink at pH 4–5, colorless at pH 6–8, green at pH 9–12, and yellow at pH 13–14. Endpoint detection was comparable to phenolphthalein and methyl orange, with only slight differences in endpoint pH values. Purple trumpet flower extract shows potential as a natural acid-base indicator. It may serve as an alternative for educational and laboratory applications, although further research on stability and quantitative anthocyanin content is still needed.*

Keywords: Acid-base alternative; anthocyanin; indicator; purple trumpet flower

Introduction

Acid-base titration is one of the most widely used chemical analysis methods to determine the level or concentration of an acid or base through a neutralization reaction with a standard solution (Nag et al., 2023). In the titration process, an indicator is required, which is a chemical compound that serves to signal that the reaction has reached or passed the equivalence point (Saja et al., 2020). The equivalence point is the state when the number of moles of acid is equal to the number of moles of base, so that all acids have been neutralized by bases or vice versa, but this point cannot be observed directly visually. Therefore, an indicator is used that will change color when one of the substances is in excess (Kejla et al., 2022). Acid-base indicators that are commonly used are synthetic indicators such as phenolphthalein, methyl blue, methyl orange, methyl red, and phenol red (Alabbsi et al., 2023). However, the use of synthetic indicators has several limitations, including relatively high prices, limited availability in some areas, and the potential for negative environmental impacts if used excessively (Gustriani et al., 2016). Therefore, natural indicators are needed as an alternative in acid-base titration. Natural indicators are materials that have coloring

substances that usually come from plants (roots, leaves, flowers, fruits, or seeds) and can be extracted with appropriate solvents. Natural indicators are easy to obtain, inexpensive, more environmentally friendly, and abundantly available in the surrounding environment. However, not all plants can produce significant color changes in acidic or basic conditions. Some natural indicators can be made from red dadap flowers (*Erythrina crista-galli* L) (Rahmawati et al., 2016), kalpataru flowers (*Hura crepitans* Linn) (Riswanto & Aminah, 2020), red rose flowers (*Rosa hybrida*) (Sulfiani & Sukmawati, 2020), purple sweet potato (*Ipomea batatas*) (Fitriani et al., 2022), purple cabbage (*Brassica oleracea* L) (Gustriani et al., 2016), and dragon fruit peel (*Hylocereus costaricensis*) (Meganingtyas & Alauhdin, 2021) due to their anthocyanin content.

With the development of green chemistry, the use of natural materials as alternative acid-base indicators has become a focus of research. One natural compound with potential as an indicator is anthocyanin. Anthocyanin is a flavonoid compound responsible for giving color to flowers, fruits, and vegetables. Anthocyanins can give plants red, violet, purple, and blue colors (Anggistia et al., 2016). The color change in anthocyanin is due to the presence of phenols or conjugated compounds, such as

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cyanidin, delphinidin, pelargonidin, peonidin, and petunidin, which undergo structural changes when there are variations in pH (Pourjavaher et al., 2017). Anthocyanins are stable at acidic pH levels of around 1-4, orange to blue in color, red at pH 1 as flavilium cations, and colorless at pH 2-4 as a mixture of flavilium and quinoidal cations. The structure of anthocyanins is more stable at pH levels between 1 and 3, while at pH > 4, the structure of anthocyanins is unstable (Kunnaryo & Wikandari, 2021).

Purple trumpet flower (*Ruellia Tuberosa* L.), also known as pletekan flower, is a plant commonly found growing in shrubs and roadsides and can grow wild in grasslands and around rice fields. Purple trumpet flowers are known to contain various phytochemical compounds found in the roots, tubers, stems, and leaves, such as flavonoids, tannins, saponins, alkaloids, steroids, and phenolic compounds (Suandana & Leliqia, 2023). Based on these compounds, especially flavonoids, the flowers of this plant are thought to contain anthocyanins, which act as pigments that give them their purple color. Therefore, researchers are interested in studying the potential of purple trumpet flower (*Ruellia Tuberosa* L.) extract as an alternative acid-base indicator.

Despite the growing number of studies on natural indicators derived from anthocyanin-rich plants, limited information is available regarding the indicator performance of *Ruellia tuberosa* L. flower extract, particularly its pH transition range and suitability for different acid–base titration systems. Previous studies have reported the use of anthocyanin-rich materials such as red cabbage, dragon fruit peel, purple sweet potato, and kalpataru flowers as natural acid-base indicators (Gustriani et al., 2016; Meganingtyas & Alauhdin, 2021; Fitriani et al., 2022; Riswanto & Aminah, 2020). However, systematic evaluation of *Ruellia tuberosa* L. flower extract as a titration indicator remains limited.

Therefore, the knowledge gap addressed in this study is the lack of experimental evidence concerning the effectiveness of *Ruellia tuberosa* L. extract as an alternative titration indicator. The novelty of this work lies in evaluating the color transition characteristics, pH response, and endpoint detection capability of purple trumpet flower extract in three common acid–base titration systems and comparing its performance with standard synthetic indicators.

Based on this, this study was conducted with the aim of utilizing purple trumpet flower extract (*Ruellia Tuberosa* L.), which contains anthocyanins, as an alternative indicator for acid-base titration by examining the characteristics of color changes in the extract at various pH variations, determining the pH range of color changes, and evaluating its effectiveness in indicating the end point of titration compared to synthetic indicators commonly used in laboratories, namely phenolphthalein and methyl orange indicators.

Methods

The equipment used in this study included standard chemical laboratory glassware, as well as several auxiliary tools such as a magnetic stirrer, pH meters, ovens, shakers, centrifuges, measuring cups, spatulas, scissors, measuring flasks, Erlenmeyer flasks, measuring pipettes, dropper pipettes, 10 mL vials, glass funnels, spray bottles, suction rubber, drop plates, digital narracas, stands, and clamps.

The materials used in this study were purple trumpet flowers, pH 1-14 buffer solution, distilled water, 70% ethanol, 0.1 M HCl solution, 0.1 M NaOH, 0.1 M NH₄OH, 0.1 M CH₃COOH, methyl orange indicator, phenolphthalein, filter paper, tissue, and aluminum foil.

Extraction of purple trumpet flowers

Extraction was carried out using a stepwise maceration method with three types of solvents. The first extraction used n-hexane solvent by weighing 10 grams of Purple Trumpet flower powder. It was then placed in a 500 mL Erlenmeyer flask. Next, 250 mL of n-hexane was added. The mixture was shaken for 10 minutes, then stored for 24 hours, and then filtered using filter paper and a funnel. For the second extraction, the residue obtained from the first extraction was then placed in a 500 mL Erlenmeyer flask, and 250 mL of ethyl acetate solvent was added. The mixture was then filtered for 10 minutes, stored for 24 hours, and filtered again using filter paper and a funnel. Third extraction: the residue produced from the second extraction process is placed in a 500 mL Erlenmeyer flask, and 70% ethanol is added. The mixture is filtered for 10 minutes and left to stand for 24 hours, then filtered again using filter paper and a funnel. The result is filtered, and the filtrate is evaporated using an evaporator so that it is ready to be used as an acid-base indicator.

Qualitative test for anthocyanins

2 mL of purple trumpet flower extract (Ex.TU) was added to each of the different test tubes. Then, 20 drops of 0.1 M HCl solution were added to test tube I. A positive anthocyanin result was indicated by a change in the color of the extract from yellowish brown to red. Meanwhile, in test tube II, 20 drops of 0.1 M NaOH solution were added while observing the color change that occurred. A positive result, when the color changed to green, indicated the presence of anthocyanin. (Bria et al., 2021)

Testing of purple trumpet flower extract indicators in acid-base solutions

Two drops of the purple trumpet flower extract obtained were placed on a drop plate and tested with each of the following solutions: 0.1 M HCl, 0.1 M NaOH, 0.1 M CH₃COOH, and 0.1 M NH₄OH. The color change produced by the natural indicator extract from the purple trumpet flower was observed.

Testing of purple trumpet flower extract indicator in pH 1-14 buffer solution

Buffer solutions were added to 10 mL vials, 5 mL each, with different pH levels, namely pH 1-14. Then, 0.5 mL of purple trumpet flower extract was added to each buffer solution. The color changes that occurred were observed.

Testing in acid-base titration

Titration of strong acid and strong base

10 mL of 0.1 M HCl solution was placed in an Erlenmeyer flask, then 3 drops of purple trumpet flower extract were added, followed by titration with 0.1 M NaOH solution until a color change occurred. For each 1 mL addition of titrant, the pH of the mixture was measured using a pH meter until a color change occurred. This was repeated 3 times. Next, this titration was replaced by substituting the purple trumpet flower extract with phenolphthalein indicator for comparison.

Titration of a weak acid and a strong acid

10 mL of 0.1 M NH_4OH solution was placed in an Erlenmeyer flask, then 3 drops of purple trumpet flower extract were added, followed by titration with 0.1 M HCl solution until a color change occurred. For each 1 mL addition of titrant, the pH of the mixture was measured using a pH meter until a color change occurred. This was repeated 3 times. Next, this titration was replaced by substituting the purple trumpet flower extract with methyl orange indicator as a comparison.

Data analysis

All analytical procedures and measurements in this study referred to previous scientific studies and standard analytical chemistry methods. The extraction procedure using stepwise maceration followed methods described by [Arrofiqi et al. \(2024\)](#). Anthocyanin qualitative analysis referred to [Bria et al. \(2021\)](#), while acid-base titration procedures followed quantitative analytical chemistry methods described by [Day & Underwood \(2002\)](#). The pH measurements were conducted using a calibrated digital pH meter.

The data analysis was conducted using qualitative descriptive analysis, which included sensory data on changes in the color of the extract and testing of strong acid (HCl), weak acid (CH_3COOH), strong base (NaOH), weak base (NH_4OH), and buffer solutions, as well as titration curves using the titration method.

Results and Discussion

Extraction of purple trumpet flowers

The extraction process, using the maceration method, is carried out in stages using three types of solvents, namely n-hexane, ethyl acetate, and 70% ethanol. This is done to remove impurities from the sample in order to produce a higher anthocyanin content. Extraction is the process of separating soluble active compounds using certain liquid

solvents from simplisia materials. Simplisia are natural materials that come from nature and have not undergone any processing except drying ([Samsuar et al., 2025](#)). Extraction methods can be divided into two types based on the heating temperature, namely cold and hot methods. Cold extraction methods include maceration and percolation, while hot methods include reflux and Soxhlet extraction. Maceration methods commonly used in the extraction of active compounds from natural materials include simple maceration, stepwise maceration, and maceration with stirring.

The advantages of the maceration method offer benefits in terms of simplicity of application and flexibility in extracting various compounds without the need for heating, which reduces the risk of degradation of natural materials. This makes maceration suitable for thermolabile compounds such as flavonoids and enzymes. The selection of solvents based on their solubility and polarity facilitates the separation of natural materials in samples ([Arrofiqi et al., 2024](#)). Polar solvents can bind phenolic compounds, including flavonoids. Anthocyanins are polar flavonoids that are soluble in polar solvents. The extraction process to obtain anthocyanin compounds requires a suitable solvent. Ethanol is a polar solvent, and n-hexane is a nonpolar solvent that is often used in the extraction process. Differences in polarity in solvents can affect the total content of bioactive compounds in the extract ([Sulistiani & Isworo, 2022](#)).

Flavonoid content can be extracted using ethanol solvent, which has polar properties, so that flavonoids will dissolve in this solvent ([Bangun et al., 2021](#)). In addition, the fractionation process can also be applied to isolate secondary metabolite compounds. Fractionation is a process of separating compounds using two different solvents based on their polarity levels. The purpose of the fractionation process is to obtain a purer extract fraction with higher activity ([Suhaenah et al., 2021](#)).

The results obtained were filtered to separate the filtrate and residue, then the filtrate was evaporated using an evaporator, and the extract obtained was yellowish brown. This may indicate that purple trumpet flowers contain anthocyanins ([Virliantari et al., 2018](#)). Anthocyanins are the basic pigments that form colors in plants.

Extraction of purple trumpet flowers

Qualitative test results for anthocyanin in purple trumpet flower extract (Ex.TU) in test tube I: 2 mL of extract was placed in a test tube, then 20 drops of 0.1 M HCl were added, resulting in a dark red solution. Meanwhile, in test tube II, 2 mL of extract was placed in a test tube, then 20 drops of 0.1 M NaOH solution were added, resulting in a dark green solution. The test results showed positive results, as stated by [Bria et al. \(2021\)](#), that anthocyanins are characterized by a change in the color of the extract from yellowish brown to red in an acidic solution and green in a basic solution. The

reactions that occur in anthocyanins with the addition of HCl and NaOH can be seen in **Figure 1** and **Figure 2**.

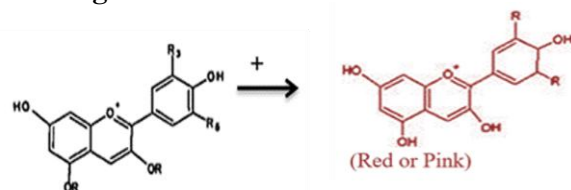


Figure 1. Reaction of anthocyanins with hydrochloric acid (HCl)

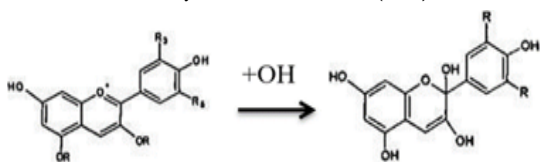


Figure 2. Reaction of anthocyanins with sodium hydroxide (NaOH)

Extraction of purple trumpet flowers

The results of testing purple trumpet flower extract (Ex.TU) in acid-base solutions are presented in **Figure 3** and **Table 1**.

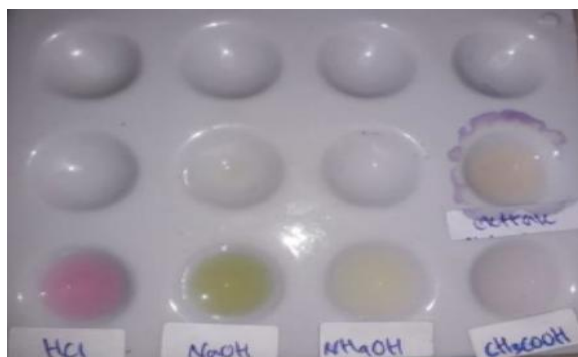


Figure 3. Color of purple trumpet flower extract

Based on **Figure 3** and **Table 1**, the color of the purple trumpet flower extract (Ex.TU) tested with a strong acid solution (0.1 M HCl) is red, a strong base (0.1 M NaOH) is green, a weak acid (0.1 M CH₃COOH) is pink, and a weak base (0.1 M NH₄OH) is greenish yellow. This indicates that the ability of purple trumpet flower extract to produce color in acidic and basic conditions may be due to the presence of anthocyanins. This is in line with the statement made by [Jusnita et al. \(2025\)](#) that anthocyanins are red or purple at acidic pH, while at basic pH, the color changes to green or yellow.

Anthocyanins are flavonoid compounds responsible for giving color to flowers, fruits, and vegetables. Anthocyanins can give red, violet, purple, and blue colors to plants ([Anggistia et al., 2016](#)). Color changes in anthocyanins are due to the presence of phenols or conjugated compounds, such as cyanidin, delphinidin, pelargonidin, peonidin, and petunidin, which undergo structural

changes when there are variations in pH ([Pourjavaheer et al., 2017](#)).

Table 1. Test results for purple trumpet flower extract indicators in acid-base solutions

Solution	Color of Purple Trumpet Flower Extract Solution
Sampel	Brownish Yellow
HCl 0.1 M	Red
NaCl 0.1 M	Green
CH ₃ COOH 0.1 M	Pink
NH ₄ OH 0.1 M	Greenish Yellow

Testing of purple trumpet flower extract indicator in pH 1-14 buffer solution

Testing the indicator extract from purple trumpet flowers in buffer solutions with a pH range of 1-14, with the aim of determining the pH range of the indicator by dripping the purple trumpet flower indicator extract into buffer solutions 1-14. The results of testing the purple trumpet flower extract in buffer solutions with a pH of 1-14 are presented in **Figure 4** and **Table 2**.



Figure 4. Results of Ex.TU color change at pH 1 - pH 14

Table 2. Test results of purple trumpet flower extract indicator in pH 1-14 buffer solution

pH	Color change of the extract at pH
1	Red
2	Red
3	Red
4	Pink
5	Pink
6	Colorless
7	Colorless
8	Colorless
9	Green
10	Green
11	Green
12	Green
13	Yellow
14	Yellow

Based on **Figure 4** and **Table 2**, testing the extract at pH 1-14 showed consistent color changes, from red at acidic pH to green-yellow at alkaline pH. These results indicate that the pH range is wide enough to be used as an effective indicator—the color of Ex.TU changes as follows: red at pH 1-2, pink at pH 3-5, colorless at pH 6-7, green at pH 8-12, and yellow at pH 13-14. This is because anthocyanins are mostly in the form of stable flavilium cations, which appear red in an acidic environment. With increasing pH, the system changes to green/yellow, which is caused by the

formation of a quinone base and its anionic partner after further deprotonation of the flavilium cation (Wang & Liu, 2024).

Testing testing on acid-base titration

Titration of strong acid and strong base

The results of titration with strong acid (0.1 M CH_3COOH) and strong base (0.1 M NaOH) using purple trumpet flower extract and phenolphthalein indicator as a reference are presented in **Table 3**.

Table 2. Data results of strong acid (0.1 M HCl) and strong base (0.1 M NaOH) titration

Volume NaOH	pH Ex.TU	Color	pH Phenolphthalein	Color
0	1.51	Red	1.53	Colorless
1	1.59	Red	1.66	Colorless
2	1.67	Red	1.75	Colorless
3	1.77	Red	1.85	Colorless
4	1.85	Red	1.96	Colorless
5	2	Red	2.13	Colorless
6	2.32	Red	2.37	Colorless
7	2.86	Red	2.94	Colorless
8	3.15	Pink	3.12	Colorless
9	3.48	Pink	3.55	Colorless
9.4	8.47	Yellowish green	8.5	Pink
10	10.52	Yellowish green	10.48	Pink

Based on the results of this study, the use of purple trumpet flower extract as an indicator shows that the endpoint of titration is reached after the addition of 9.5 mL of 0.1 M NaOH at a pH of 8.47, as well as a color change from red to yellowish green at that point. Phenolphthalein was used as a comparison indicator, which showed the endpoint

of titration upon the addition of 9.4 mL of 0.1 M NaOH at pH 8.5 and a color change from colorless to pink. The results of the study on the use of purple trumpet flower extract and phenolphthalein as indicators for comparison are shown in the curve in **Figure 5**.

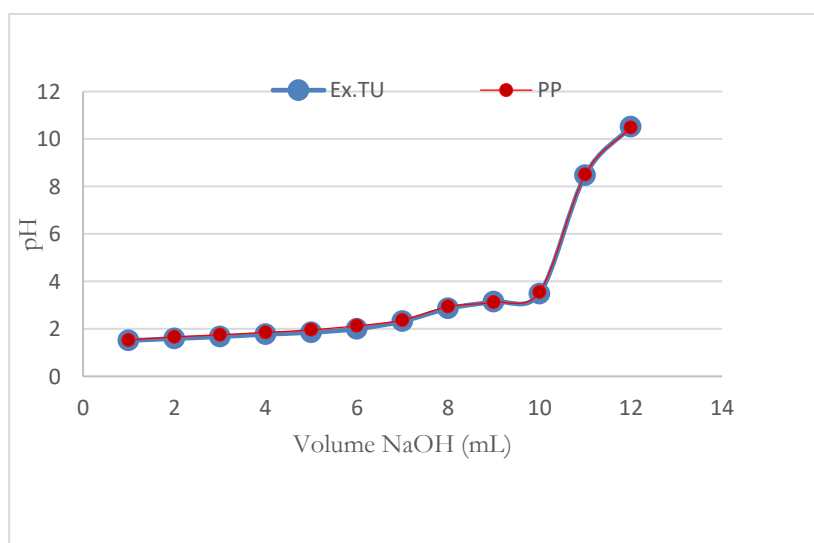


Figure 5. Titration curve of strong acid (HCl) – strong base (NaOH)

Based on the titration curve of strong acids and strong bases using purple trumpet flower extract as an indicator and phenolphthalein as a comparison, it is known that when adding NaOH

solution from 1 mL to 10 mL, the two curves tend to be above each other or overlap, indicating that the pH values obtained from the two types of indicators are not too different. This shows that

purple trumpet flower extract can be used as an indicator in strong acid-strong base titration, replacing phenolphthalein (Riswanto & Aminah, 2020).

Titration of a weak acid and a strong base

The results of titration with strong acid (0.1 M CH_3COOH) and strong base (0.1 M NaOH) using purple trumpet flower extract and phenolphthalein indicator as a reference are presented in Table 4. Based on the results presented in Table 4, the use of purple trumpet

flower extract as an indicator shows that the endpoint of titration is reached after the addition of 9.4 mL of 0.1 M NaOH at a pH of 8.37, as well as a color change from pink to colorless at that point. Phenolphthalein was used as a comparison indicator, which showed the endpoint of titration upon the addition of 9.2 mL of 0.1 M NaOH at a pH of 8.44 and a color change from colorless to pink. The results of the study using purple trumpet flower extract and phenolphthalein as indicators for comparison are shown in Figure 6.

Table 3. Titration results for 10 mL of 0.1 M CH_3COOH solution with 0.1 M NaOH

Volume NaOH	pH Ex.TU	Color	pH Phenolphthalein	Color
0	3.19	Pink	3.5	Colorless
1	3.91	Pink	3.96	Colorless
2	4.25	Pink	4.35	Colorless
3	4.48	Pink	4.65	Colorless
4	4.68	Pink	4.85	Colorless
5	4.85	Pink	5.08	Colorless
6	5.01	Pink	5.35	Colorless
7	5.26	Pink	5.72	Colorless
8	5.37	Pink	5.91	Colorless
9	6.85	Red	6.89	Colorless
9.4	8.37	Colorless	8.44	Pink
10	10.92	Greenish yellow	11.4	Pink

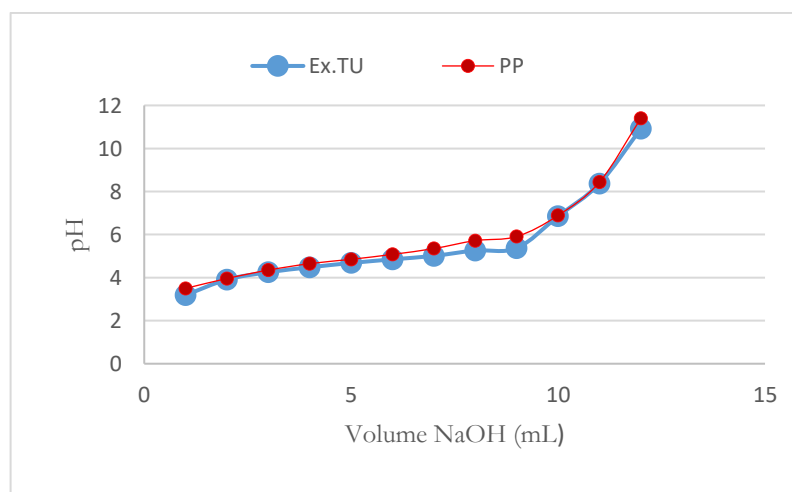


Figure 6. Titration curve of weak acid (CH_3COOH) – strong base (NaOH)

Based on the titration curve of weak acids and strong bases using purple trumpet flower extract as a natural indicator and phenolphthalein as a comparison, it is known that when adding NaOH solution from 1 mL to 10 mL, the two curves tend to be above each other or overlap, indicating that the pH values obtained from the two types of indicators are not too different. This shows that purple trumpet flower extract can be used as an indicator in weak acid-strong base titration, replacing phenolphthalein. The results of this study are in line with the theory that the pH range at which phenolphthalein changes is between 8.0 and 9.60 (Day & Underwood, 2002). According to Riswanto & Aminah (2020), if the pH values obtained from

both types of indicators are not too different in a weak acid-strong base titration, then they can replace the phenolphthalein indicator.

Titration of a weak base and a strong acid

The results of the weak base (0.1 M NH_4OH) and strong acid (0.1 M HCl) titration studies are presented in Table 5.

Based on the results presented in Table 5, the use of purple trumpet flower extract as an indicator shows that the endpoint of titration was reached after the addition of 9.2 mL of 0.1 M HCl at a pH of 2.68, as well as a color change from yellowish green to red at that point. Methyl orange was used as a comparison indicator, which showed the

endpoint of titration after the addition of 9.5 mL of 0.1 M HCl at a pH of 3.18 and a color change from yellow to red.

Based on the pH range theory, methyl orange indicator is in the range of 3.1–4.4 (Day & Underwood, 2002). This shows that the pH range

for color change in purple trumpet flower extract is still within the pH change range of the methyl orange indicator. The results of the study comparing the use of purple trumpet flower extract and methyl orange as indicators are shown in **Figure 7**.

Table 4. Titration results for 10 mL of 0.1 M NH_4OH solution with 0.1 M HCl solution

Volume NaOH	pH Ex.TU	Color	pH Phenolphthalein	Color
0	10.2	Yellowish green	10.4	Yellow
1	9.93	Yellowish green	9.98	Yellow
2	9.54	Yellowish green	9.67	Yellow
3	9.38	Yellowish green	9.41	Yellow
4	9.26	Yellowish green	9.29	Yellow
5	9.12	Yellowish green	9.16	Yellow
6	8.61	Yellowish green	8.84	Yellow
7	8.52	Yellowish green	8.24	Yellow
8	8.42	Yellowish green	7.93	Yellow
9	8.04	Yellowish green	7.67	Yellow
9.4	2.68	Red	3.18	Red
10	2.64	Color	2.58	Red

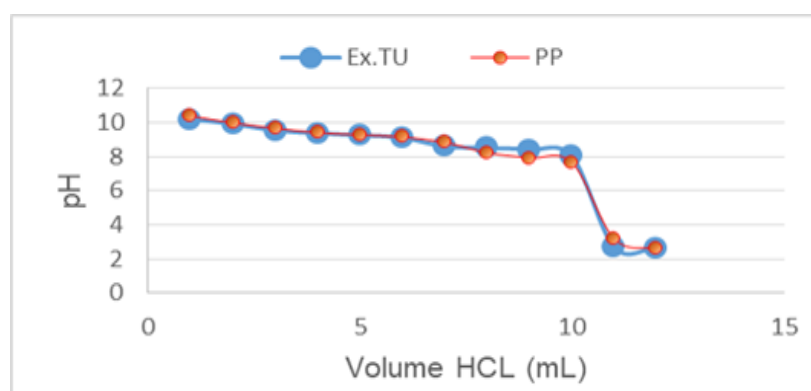


Figure 7. Titration of weak base (NH_4OH) – strong acid (HCl)

Titration curve of weak base and strong acid using purple trumpet flower extract as a natural indicator and methyl orange as a reference. Methyl orange is used as a reference indicator in weak base–strong acid titration because its pH color change range is in the acidic region corresponding to the pH of the reaction's equivalence point. Thus, when adding HCl solution from 1 mL to 10 mL, the two curves tend to overlap, indicating that the pH values obtained from the two types of indicators are not significantly different. This shows that the purple trumpet flower extract indicator can be used as an indicator in weak base–strong acid titration to replace the methyl orange indicator.

The similarity between titration curves obtained using purple trumpet flower extract and synthetic indicators demonstrated that the natural extract had adequate sensitivity in detecting equivalence points. Slight differences in endpoint pH values may have been caused by anthocyanin instability under strong alkaline conditions and differences in extract concentration (He & Giusti, 2010).

The disappearance of color at pH 6–8 indicated the formation of colorless carbinol pseudobase structures due to hydration of anthocyanin molecules (Castañeda-Ovando et al., 2009). This observation was similar to previous findings reported by Pourjavaher et al. (2017) and Castañeda-Ovando et al. (2009). The green and yellow coloration observed at alkaline pH values suggested the formation of quinoidal base structures after deprotonation (He & Giusti, 2010).

The brownish-yellow extract obtained after evaporation indicated the successful extraction of flavonoid compounds, particularly anthocyanins (Giusti & Wrolstad, 2001; Khoo et al., 2017). The final extract color may have been influenced by solvent polarity, oxidation during extraction, and the presence of other phytochemical compounds such as tannins and phenolics (Khoo et al., 2017). Compared with previous studies using red cabbage and dragon fruit peel extracts, purple trumpet flower extract demonstrated a broader visible color transition range.

Conclusions

Purple trumpet flower extract (*Ruellia Purple* trumpet flower extract (*Ruellia tuberosa* L.) exhibited clear pH-dependent color changes. It was capable of indicating endpoint transitions in strong acid–strong base, weak acid–strong base, and weak base–strong acid titrations. The extract showed a color transition pattern of red, pink, colorless, green, and yellow. Endpoint pH values obtained using the extract were comparable to those obtained using phenolphthalein and methyl orange, suggesting that the extract has potential for use as an alternative natural indicator, particularly in educational and laboratory-scale applications. However, the findings should be interpreted within the limitations of this study, which did not evaluate long-term storage stability, environmental effects, or quantitative anthocyanin content. Further research is recommended to investigate extract stability, anthocyanin quantification, and shelf-life characteristics.

Conflict of Interest

The authors declare that there are no financial or commercial conflicts of interest associated with this study.

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References

- Alabbsi, A., Alassad, D. A., Abdalsamed, I., & Ahmida, K. (2023). A Study into using plant extracts as indicators for the endpoint in the acid-base titrations. *Scientific Journal for Faculty of Science-Sirte University*, 3(1), 109–114. <https://doi.org/10.37375/sjfssu.v3i1.149>
- Anggisti, M. D., Widiyandari, H., & Anam, K. (2016). Identifikasi dan kuantifikasi antosianin dari fraksi bunga rosela (*hibiscus sabdariffa* l) dan pemanfaatannya sebagai zat warna dye-sensitized solar cell (DSSC). *Jurnal Sains dan Aplikasi*, 19(2), 50–57. <https://doi.org/10.14710/jksa.19.2.50-57>
- Arrofiqi, M. R., Sakti, A. S., & Mayangsari, F. D. (2024). Kajian literatur : aplikasi sejumlah metode ekstraksi konvensional untuk mengekstraksi senyawa fenolik dari bahan alam. *Jurnal Penelitian Farmasi & Herbal*, 7(1), 8–24. <https://doi.org/10.36656/jpjh.v7i1.1972>
- Bangun, P. P. A. (2021). Analisis kadar total flavonoid pada daun dan biji pepaya (*carica papaya* l.) Menggunakan metode spektrofotometer Uv-Vis. *JIFA: Jurnal Ilmiah Farmasi attamru*, 2(1), 1–5. <https://doi.org/10.31102/attamru.v2i1.1263>
- Bria, H. R., Leba, M. A. U., & Kopon, A. M. (2021). Penggunaan ekstrak umbi ubi jalar ungu (*ipomoea batatas* l.) sebagai indikator asam-basa alami. *Jurnal Beta Kimia*, 1(2), 35–41. <https://doi.org/10.35508/jbk.v1i2.5579>
- Castañeda-Ovando, A., Pacheco-Hernández, M. D. L., Páez-Hernández, M. E., Rodríguez, J. A., Galán-Vidal, C. A. (2009). Chemical studies of anthocyanins: A review. *Food Chemistry*, 113(4), 859–871. <https://doi.org/10.1016/j.foodchem.2008.09.001>
- Day, R. A., & Underwood, A. L. (2002). *Analisis Kimia Kuantitatif*. Jakarta: Erlangga
- Fitriani, D., Trihadi, B., & Widiyati, E. (2022). Sosialisasi pemanfaatan ekstrak ubi jalar ungu dan bunga terompet ungu sebagai indikator alami untuk mendeteksi boraks dan formalin pada makanan. *Martabe: Jurnal Pengabdian Masyarakat*, 5(3), 1018–1023. <https://doi.org/10.31604/jpm.v5i3.1018-1023>
- Giusti, M. M., & Wrolstad, R. E. (2001). Characterization and measurement of anthocyanins by UV-visible spectroscopy. *Current Protocols in Food Analytical Chemistry*, 00(1), 1–13. <https://doi.org/10.1002/0471142913.faf0102s00>
- Gustriani, N., Novitriani, K., & Mardiana, U. (2016). Penentuan trayek pH ekstrak kubis ungu (*brassica oleracea* l) sebagai indikator asam basa dengan variasi konsentrasi pelarut etanol. *Jurnal Kesehatan Bakti Tunas Husadaa: Jurnal Ilmu-Ilmu Keperawatan, Analis Kesehatan Dan Farmasi*, 16(1), 94–100. <https://doi.org/10.36465/jkbth.v16i1.171>
- He, J., & Giusti, M. M. (2010). Anthocyanins: natural colorants with health-promoting properties. *Annual Review of Food Science and Technology*, 1(November), 163–187. <https://doi.org/10.1146/annurev.food.080708.100754>
- Jusnita, N., Sugiyono, Yuliana, N. D., & Suyatma, N. E. (2025). Exploring pH-responsive color changes of anthocyanin extracts from four selected plants as potential natural food deterioration indicators. *Indonesian Food Science and Technology Journal*, 9(1), 61–70. <https://doi.org/10.22437/ifstj.v9i1.46450>
- Saja, K. A., Anoobkumar, K. I., & Rasa, O. K. (2020). pH Indicators: A valuable gift for analytical chemistry. *Saudi Journal of Medical and Pharmaceutical Sciences*, 6(05), 393–400. <https://doi.org/10.36348/sjmps.2020.v06i05.001>
- Kejla, L., Svoboda, P., Sedláček, J., Šimáček, P. (2022). Gravimetric titrations in a modern analytical laboratory: evaluation of performance and practicality in everyday use. *Chemical Papers*, 76(3-4), 2051–2058. <https://doi.org/10.1007/s11696-021-02004-z>

- Khoo, H. E., Azlan, Tang, S. T., & Lim, S. M. (2017). Anthocyanidins and anthocyanins: colored pigments as food, pharmaceutical ingredients, and the potential health benefits. *Food & Nutrition Research*, 61(1), 1–21. <https://doi.org/10.1080/16546628.2017.1361779>
- Kunnaryo, H. J. B., & Wikandari, P. R. (2021). Antosianin dalam produksi fermentasi dan perannya sebagai antioksidan. *UNESA Journal of Chemistry*, 10(1), 1–108. <https://doi.org/10.26740/ujc.v10n1.p24-36>
- Meganingtyas, W., & Alauhdin, M. (2021). Ekstraksi antosianin dari kulit buah naga (*hylocereus costaricensis*) dan pemanfaatannya sebagai indikator alami titrasi asam-basa. *AgriTECH*, 41(3), 278–284. <https://doi.org/10.22146/agritech.52197>
- Nag, M., Paul, R. K., Biswas, S., Dasgupta, D., Roy, D., Bhattacharjee, P., Chattopadhyay, S., & Mallick, A. (2023). A review on application of natural indicators in acid-base titration. *Pharmacognosy Reviews*, 17(34), 308–319. [10.5530/phrev.2023.17.10](https://doi.org/10.5530/phrev.2023.17.10)
- Pourjavaher, S., Almasi, H., Meshkini, S., Pirsa, S., & Parandi, E. (2017). Development of a colorimetric pH indicator based on bacterial cellulose nanofibers and red cabbage (*brassica oleraceae*) extract. *Carbohydrate Polymers*, 156(January), 193–201. <https://doi.org/10.1016/j.carbpol.2016.09.027>
- Rahmawati, Nuryanti, S., & Ratman. (2016). Indikator asam-basa dari bunga dadap merah (*erythrina crista-galli* l.). *Jurnal Akademika Kimia*, 5(1), 29–36. <https://doi.org/10.22487/j24775185.2016.v5.i1.7997>
- Riswanto, B., & Aminah, S. (2020). Utilization of kalpataru flower extract (*hura crepitans* linn) as an alternative acid base indicator. *Jurnal Akademika Kimia*, 9(3), 148–157. <https://doi.org/10.22487/j24775185.2020.v9.i3.pp148-157>
- Samsuar, Pratiwi, I., Susanti, L., Widodo, S., & Ariawan, M. W. (2025). Standarisasi bahan alam sebagai bahan obat tradisional. *Jurnal Media Pengabdian Kepada Masyarakat*, 4(2), 94–102. <https://doi.org/10.37090/jm-pkm.v4i2.3053>
- Suandana, I. K. A. P., & Leliqia, N. P. E. (2023). Review: studi kandungan fitokimia dan aktivitas antibakteri kencana ungu (*ruellia tuberosa* l.). *Prosiding Workshop dan Seminar Nasional Farmasi*, (pp. 209–217). Bali: Universitas Udayana.
- Suhaenah, A., Pratama, M., Wulandasari, A. H., & Amir. (2021). Penetapan kadar flavonoid fraksi etil asetat daun karet kebo (*ficus elastica*) dengan metode spektrofotometri UV-Vis. *As-Syifaa Jurnal Farmasi*, 13(1), 48–49. <https://doi.org/10.56711/jifa.v13i1.767>
- Sulfiani & Sukmawati. (2020). Pemanfaatan ekstrak bunga mawar merah (*rosa hybrida*) asal Desa Bonto Majannang Kabupaten Bantaeng sebagai indikator formalin pada ikan asin. *Jurnal Abdidas*, 1(5), 478–486. <https://doi.org/10.31004/abdidas.v1i5.99>
- Sulistiani, R. P., & Isworo, J. T. (2022). Efektivitas jenis pelarut dan metode ekstraksi dari daun talas (*colocasia esculenta* l. schoot). *Jurnal Gizi*, 11(2), 68–76. <https://doi.org/10.26714/jg.11.2.2022.68-76>
- Virliantari, D. A., Maharani, A., Lestari, U., & Ismiyati, I. (2018). Pembuatan indikator alami asam-basa dari ekstrak kulit bawang merah (*allium ascalonicum* l.). *Prosiding Seminar Nasional Sains dan Teknoogi 2018*, (pp. 1–6). Jakarta: Universitas Muhammadiyah Jakarta.
- Wang, C., & Liu, C. (2024). A pH-sensitive intelligent packaging film harnessing anthocyanin for food freshness monitoring. *Food Bioprocess Technology*, 17(12), 5312–5323. <https://doi.org/10.1007/s11947-024-03431y>