

Title: Study of Leaf Color and Tannin Content Variation in Hawthorn Leaves at Different Developmental Stages.

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Abstract

This research aimed to investigate the color and tannin content in hawthorn leaves at different developmental stages. The research team was interested in studying the physical characteristics of hawthorn leaf color and the tannin content in hawthorn leaves at various developmental stages. The study revealed that the color of hawthorn leaves at each developmental stage in both areas was similar. Additionally, it was found that the tannin content in hawthorn leaves varied across different developmental stages, with ripe leaves having the highest tannin content, followed by young leaves, and mature leaves having the lowest tannin content.

Keywords: Hawthorn leaves, Tannin

Introduction

Tannin is a complex polyphenolic compound with a molecular formula of $C_{75}H_{52}O_{46}$ comprising 9 molecules of gallic acid and 1 molecule of glucose. It is commercially available as tannic acid and imparts astringency and bitterness. Tannins are found in various plant sources such as tea leaves, grape leaves, oak leaves, mushroom caps, and raw fruits like banana peels, mangosteen peels, and young coconut husks. They are also present in fruit seeds like grapes and the kernels of tamarind, as well as in red wine. Hawthorn leaves are among the plant species where tannins are detected, prompting further investigation into this matter.

Research Questions

1. Does the color of hawthorn leaves vary at different developmental stages?
2. Does the extracted tannin content from hawthorn leaves differ across different developmental stages?

Research Hypotheses

1. The color of hawthorn leaves varies across different developmental stages.
2. The extracted tannin content from hawthorn leaves differs across different developmental stages.

Methods and materials

1. Plant Color Guide
2. Mortar and pestle
3. Plum-shaped bottle
4. Weighing scale
5. Shaker or stirrer
6. Distilled water
7. Graduated cylinder
8. Funnel
9. Filter paper
10. Beaker
11. Tweezers
12. Dropper
13. Quartz cuvette
14. UV spectrophotometer

Methodology

1. Study Area



Image 1 shows the study area at Botanical Garden 1.



Image 2 shows the study area at Botanical Garden 2.

2. Data Collection Procedure:

Color Measurement of Hawthorn Leaves:

1. Establish sampling points in the botanical garden areas where hawthorn trees are growing.
2. Measure the color of hawthorn leaves at different developmental stages - mature, ripe, young shoots, and tender leaves using the Plant Color Guide.
3. Measure the color of hawthorn leaves once a week and record data twice.

Tannin Extraction Data Collection from Hawthorn Leaves:

Perform tannin extraction from hawthorn leaves following the GLOBE protocol:

1. Collect hawthorn leaves at three different developmental stages: mature, ripe, and tender.
2. Once collected, tear the hawthorn leaves into small pieces and weigh them to ensure equal weights.

3. After obtaining equal weights, grind the leaves into fine particles and add 10 ml of distilled water.

4. After grinding, transfer the mixture into plum-shaped bottles and add an additional 50 ml of distilled water.

5. Place the bottles in a shaker and set the timer for 12 minutes.

6. After the designated time, filter the mixture using filter paper in a funnel and transfer it into beakers.

7. Use a dropper to add the filtered solution into quartz cuvettes and clean the cuvettes with tweezers before placing them into the UV spectrophotometer.

8. Read the tannin content extracted from hawthorn leaves at all three developmental stages.

3. Data Analysis

1. Analysis of Leaf Color: Leaf color of hawthorn leaves at different age stages was analyzed using the values measured from the Plant Color Guide.

2. Analysis of Tannin Content: Tannin content of hawthorn leaves at different age stages was analyzed using the values extracted from the UV spectrophotometer.

Research Findings: The study on leaf color and tannin content of hawthorn leaves at different age stages yielded the following results:

1. Study of the Physical Characteristics of Hawthorn Leaves:

Table 1 presents the physical characteristics of leaf color for each age stage.

	Leaves	Data of plant color	
		Plant Color	Plant Color
Study point 1	Top leaves	dark green color 5GY4/8	dark green /light green color 5GY6/10
	Young leaves	light green color 5GY7/12	light green color 5GY7/12
	Tender leaves	dark green color 5GY4/8	dark green color 5GY4/8
	Ripe leaves	yellow-orange color 2.5Y8/12	yellow-orange color 2.5Y8/12

Based on the table, it is found that mature leaves have a dark green color measured at 5GY4/8, ripe leaves have a yellow-orange color measured at 2.5Y8/12, tender leaves have a light green color measured at 5GY7/12, and young leaves have two colors alternating between dark green measured at 5GY4/8 and dark green alternated with light green color measured at 5GY6/10.

	Leaves	Data of plant color	
		Plant Color	Plant Color
Study point 1	Top leaves	Dark green 5GY4/8	Dark green 5GY4/8
	Young leaves	Light green color 5GY7/12	Light green color 5GY7/12
	Tender leaves	Dark green 5GY4/8	Dark green 5GY4/8
	Ripe leaves	Yellow-orange color 2.5Y8/12	Yellow-orange color 2.5Y8/12

Based on the table, it is observed that mature leaves have a dark green color measured at 5GY4/8, ripe leaves have a yellow-orange color measured at 2.5Y8/12, tender leaves have a light green color measured at 5GY7/12, and young leaves have a dark green color measured at 5GY4/8.

Table 2 shows the tannin content extracted from hawthorn leaves at each age stage.

Leaves	Absorbance vale			Average
Young leaves	0.783	0.822	0.898	0.834
Tender leaves	0.442	0.528	0.563	0.511
Ripe leaves	0.625	0.744	0.861	0.743

Based on the table, it is found that the tannin content extracted from mature leaves is 0.511, from ripe leaves is 0.834, and from tender leaves is 0.743.

Discussion and Conclusion

From the study of the physical characteristics of hawthorn leaf color and tannin content, it was found that the results of leaf color in both areas were similar. In Area 1, the young leaves showed a dark green color of 5GY4/8 and alternated with a dark green and light green color of 5GY6/10. The tender leaves exhibited a light green color of 5GY7/12, while the mature leaves appeared dark green of 5GY4/8, and the ripe leaves were yellow-orange of 2.5Y8/12. Similarly, in Area 2, the young leaves displayed a dark green color of 5GY4/8, tender leaves were light green of 5GY7/12, mature leaves were dark green of 5GY4/8, and ripe leaves were yellow-orange of 2.5Y8/12.

The tannin content varied across different developmental stages of hawthorn leaves. The tannin content measurement results were as follows: young leaves measured at 0.743, mature leaves measured at 0.511, and ripe leaves measured at 0.834.

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