

# The Effect of Ammonia on Flowers with Anthocyanin Pigment

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## ABSTRACT

**A**nthocyanins are a group of pigments found in flowers, fruits and vegetables, and it is an unstable combination which changes color under the influence of factors such as pH, temperature and other parameters. In this research the tests were designed based on the hypothesis and the results show the change in color of flowers with anthocyanin pigment due to alkaline environment which is more than acidic environment and their color are wither when placed in ammonia gas environment.

**Keywords :** Anthocyanin, Alkaline, Environment, Color

## ARTICLE INFO

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## 1. Introduction

Anthocyanins are secondary metabolites and water-soluble pigments belonging to the phenolic group, with important functions in nature such as seed dispersal, pollination and development of plant organs. In addition to these important roles in plant life, anthocyanins are also used as natural pigments in various industries, due to the color palette they can produce from red to blue and purple. In addition, recent research has reported that anthocyanins have important antioxidant, anticancer, anti-inflammatory and antimicrobial properties, which can be used in the chemoprevention of various diseases such as diabetes, obesity and even cancer. However, anthocyanins have a major disadvantage, namely their low stability. Thus, their stability is influenced by a number of factors such as pH, light, temperature, co-pigmentation, sulfites, ascorbic acid, oxygen and enzymes. It is very important to be precisely aware of the impact that each parameter has on the stability of anthocyanins, in order to minimize their negative action and subsequently potentiate their beneficial health effects.

Anthocyanins are a class of natural water-soluble pigments that are part of the flavonoid family. They are very widespread in nature, found not only in the colored petals of flowers but also in the roots, stems, tubers, leaves, fruits and seeds . This type of pigment has a strong absorption in the UV-visible region of the electromagnetic spectrum and is the main determinant of red-blue colors and their derivatives in the plant kingdom. These characteristics place them second in importance, immediately following chlorophyll pigments. Anthocyanins play an important role in seed dispersal, pollination, development of plant organs, but also in their adaptation to various changes in biotic (pathogenic attacks) and abiotic (drought, lack of nutrients, high intensity light) factors. Due to their chemical structure, with a central core in the form of 2-phenylbenzopyrylium or flavylium cation, anthocyanins can be classified as polyphenols and secondary metabolites .

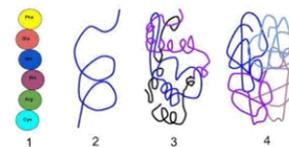
When the viola flower is exposed to ammonia, it changes color and withers, during this phenomenon, chemical and biological reactions occur, which are fully explained in this issue . It was assumed that this phenomenon occurs due to osmotic swelling and cell tissue destruction as a

biological process and PH changing as a chemical change . pH, of the acidity or basicity of aqueous or other liquid solutions, was investigated as one of the cases in this experiment. Denaturation involves the breaking of many of the weak linkages, or bonds (e.g., hydrogen bonds), within a protein molecule that are responsible for the highly ordered structure of the protein in its natural state. It is one of the biological processes that happened in this experiment for flowers due to the ammonia gas. Deprotonation is the removal of a proton (hydrogen ion) from a molecule to form a conjugate base and in biological molecule means the loss of its three-dimensional structure. It happens in the process of changing the color of anthocyanins. There are three type of denaturation :

1. Denaturation by changing pH
2. Chemical Denaturation
3. Denaturation with heat or radiation

### Denaturation by changing pH

Changes in the pH of the environment affect the total molecular charge, the interaction of amino acids with each other and the three-dimensional structure of the protein which happens in this experiment (Fig. 1).



**Fig .1 :** Denaturation- biology dictionary,  
<https://biologydictionary.net/denature/>

Cell swelling can have several effects: Organelles in the cell may become compressed if cell swelling becomes severe. Changes in cell pH can lead to the degradation of internal cellular organs. In this experiment, it happens due to the exposure to ammonia gas for the flower and causes the flower to be wither which changes the PH .

## 2. Materials and Methods

To test different viola flower – carnation flower – rose flower – miniature rose flower – petunia -ammonia(NH<sub>3</sub>) – vinegar – beaker – graduated cylinder- test chamber are used.

Test 1 and 2 were designed and conducted to investigate the effect of pH change on anthocyanins. Test 3 and 4 were designed and carried out to investigate the effect of ammonia on viola flower and its effect on other plant species.

### 3. Experiments

Test 1 :

1. Two types of flowers that have anthocyanin pigment (miniature rose and petunia) were exposed to 20 ml of vinegar with pH:3.
2. Observations were made to check the color change.
3. The final results were recorded (Fig. 2).



Fig. 2: The result of Test 1

Test 2 :

1. Two types of flowers that have anthocyanin pigment (miniature rose and petunia) were exposed to 20 ml of ammonia with pH:3.
2. Observations were made to check the color change.
3. The final results were recorded (Fig. 3).



Fig. 3: The result of Test 2

Test 3 :

1. 15 ml of ammonia was poured into the beaker.
2. Then it was placed under the test chamber.
3. Viola flower was exposed to ammonia gas for 2.5 hours.
4. Then the results were recorded.

Test 4 :

1. 15 ml of ammonia was poured into the beaker.
2. Then it was placed under the test chamber.
3. Roses and carnations were exposed to ammonia gas for 7 and 5 hours, respectively.
4. Then the results were recorded.

### 4. Results

Test 1 : Investigating the effect of acidic substances on anthocyanins by exposing miniature petunia and rose to vinegar (Fig. 4).

The procedure:

- 1) Exposure to vinegar
- 2) Start of changing in color

3)Fading and changing in color happen

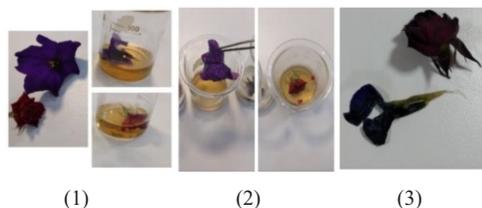


Fig. 4 : Data from Test 1

Test 2: 1 Investigating the effect of alkaline substances on anthocyanin by exposing petunias and miniature roses to ammonia.

The procedure:

- 1) Exposure to ammonia
- 2) Start of changing in color
- 3)Fading and changing in color happen (Fig. 5)



Fig. 5 : Data from Test 2

Test 3: Investigating the effect of ammonia on viola flowers by exposing viola flowers to ammonia gas.

The Procedure:

- 1) Exposure to ammonia
- 2) Start of changing in color
- Change from purple to yellow
- 3)Fading and changing color to dark yellow and brown (Fig. 6).

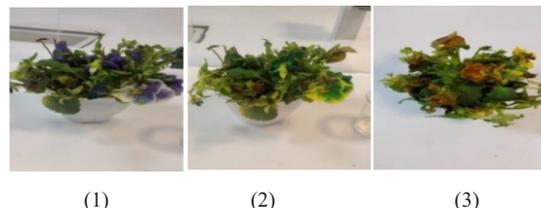


Fig. 6 : Data from Test 3

Test 4 : Investigating the effect of ammonia on other plant species by exposing roses and cloves to ammonia gas.

The procedure

- 1) Exposure to ammonia
- 2) Changing the color of carnation and rose to dark brown and black respectively
- 3) Final color , withering of rose and carnation and changing the color of rose to black and carnation to dark yellow (Fig. 7).

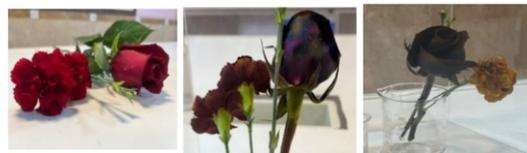


Fig. 7 : Data from Test 4

### 5. Data Analysis

The color changes observed in the experiments are shown as follows:

Anthocyanin color changes in alkaline environment faster than in acidic environment.

About 80% of the cell space is the vacuole of the cell

has an acidic atmosphere.

Ammonia is an alkaline substance; ammonia gas molecules are the same size as air molecules, they can easily penetrate the cell and when combined with the acidic atmosphere of the cell, it changes the pH of the cell.

The change in pH of the cell due to exposure to ammonia gas, the anthocyanin present in the flower changes color and causes the color of the flower to change. As mentioned in the theories, denaturation is a process during which the proteins of the cell were changed and various reasons such as changing the pH of the cell are among the reasons for this phenomenon. In this test, due to the change in the pH of the cell, denaturation occurs in the cell and affects the proteins and nucleic acids, causing the plant cells to no longer have the ability to perform their activities.

When ammonia gas enters the cell and combines with the water inside the vacuole, it causes the production of ammonium ions and hydroxide, and the production of these ions causes the destruction of cellular tissue and disrupts cellular respiration, causing the flower to wither and lose its freshness.

## 6. Results and Discussion

Ammonia has chemical and biological effects on flowers, causing discoloration and wilting of flowers.

A) Chemical :

1- PH changes in cell

2- Ammonium and hydroxide production by ammonia and water reaction

B) Biological : as a result of chemical process

1- Osmotic swelling

2- Disrupting the basic hydrogen bonding of DNA (denaturation) that cause Blocking oxygen transmission and breathing

Ammonia is one of the gases in air pollution.

The largest amount of ammonia is produced by agriculture globally and nationally from sources such as animal manure, but vehicles with internal combustion engines also contribute to ammonia emissions because their catalytic converters reduce nitrogen oxides and create ammonia.

This ammonia gas can cause the problems mentioned in the laboratory simulation test and in the long run it can cause the loss of vegetation.

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