Learning activity 3

Test for reduction of browning reaction on apple

**Objective**

To observe browning reaction on apple and to investigate ways to reduce the reaction.

**Principle**

On some fruits and vegetables, particularly apples, avocado, pear, bananas, potatoes, and lettuce, turn brown when the fruit or vegetable has been cut, damaged, or bruised.

When plant cells are damaged and the plant tissue browns, the colour change is due to the oxidation of phenolic compounds into a brown pigment. These phenolic compounds are part of the plant’s chemical defences. When the plant tissue is damaged, the brown pigments form barriers and have antimicrobial properties that prevent the spread of infection or bruising in plant tissues. Polyphenol oxidase is the enzyme responsible for the browning reaction.

One of nature’s strategies to fight oxidative damage is to use antioxidant molecules to prevent damage to proteins and other cellular components.

**Equipment & materials**

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| --- | --- |
| **Equipment** | **Materials** |
| Non-metal container x 4Measuring spoonMeasuring cupChopping boardKnifePeelerFood wrapRefrigerator | Apples 2Sample A empty containerSample B empty container + food wrap + refrigerationSample C cold distilled water (250ml)Sample D salt (1 tsp)Sample E lemon juice (1 tsp) |

**Procedure**

1. Prepare and label the containers.
2. Peel and core the apple. Cut it into quarters.
3. Put apple pieces into containers and add corresponding materials. For Sample D and E, rub the salt and lemon juice on the surface of apple respectively.
4. Observe colour change immediately and 15 minutes later.

**Results**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **A**empty container | **B**empty container + food wrap + refrigeration | **C**cold distilled water | **D**salt | **E**lemon juice |
| Colour of apple (immediately) |  |  |  |  |  |
| Colour of apple (15 minutes later) |  |  |  |  |  |

**Questions**

1. Which sample undergoes most browning reaction? Why?
2. Which sample undergoes least browning reaction? Why?
3. What causes the reduction of browning when apple is immersed in cold distilled water (sample C)?
4. What causes the reduction of browning when apple is kept in refrigerator (sample B)?

**Answers**

1. Sample A. The colour change is due to the oxidation of phenolic compounds into a brown pigment when apple cells are damaged.
2. Sample E. Vitamin C in lemon juice blocks the oxidation reactions to produce the brown pigments. Vitamin C is an antioxidant found in citrus fruits. A solution of vitamin C will slow the appearance of browning in cut fruit. But vitamin C also rapidly reacts with oxygen in the air and is destroyed by heat.
3. Immersing the cut pieces in cold water limits oxygen to cause browning reaction.
4. Refrigeration slows down the enzyme polyphenol oxidase, and hence browning reaction.