Investigating Ways to Prevent Enzymatic Browning

Objective

To compare the effectiveness of various methods for preventing enzymatic browning in apples.

Principles

Some fruits (e.g. apples and bananas) and vegetables (e.g. potatoes) turn brown when they have been cut and left exposed to air. This enzymatic browning involves the oxidation of polyphenol (a substrate that occurs naturally in the fruits and vegetables) which is catalysed by polyphenol oxidase (an enzyme found in plant cells).

Unlike caramelisation and Maillard browning, this enzymatic browning is not considered to improve the food, as it does not result in any aroma molecules. In fact, it is desirable to prevent enzymatic browning as it makes the food unattractive in appearance. To prevent enzymatic browning, little can be done about the substrate. The prevention mainly depends on exclusion of oxygen or inhibition of the enzyme.

Part I – Experimental Work

Apparatus and Materials

Apparatus		Materials	
small white plate / tile	× 5	apple	× 1
small bowl/small glass	× 5	lemon / lemon juice	1 pc /1 tbsp
lemon squeezer	× 1	salt	¼ tsp
sieve	× 1	sugar	1 tbsp
knife / apple cutter	× 1	water	100 ml
chopping board	× 1	cold distilled water	100 ml
ruler***	× 1	distilled water	300 ml
measuring cup	× 1	labels	
measuring spoons	× 1 set		
stop watch / timer	× 1		
chopsticks	× 1 pair		
small saucepan	× 1		
stove / electric or induction cooker	× 1		

Procedure

1. Label the white plates and small bowls as Sample A (lemon juice), B (salt), C (sugar), D (blanched) and E (control).
2. Fill bowls A, B and C each with 100 ml distilled water and bowl D with 100 ml iced distilled water.
3. Cut the lemon crosswise into halves. Squeeze to get 1tbsp lemon juice. Add the juice to bowl A and stir well.
4. Dissolve ¼ tsp of salt in the distilled water of bowl B, and dissolve 1 tbsp of sugar in the distilled water of bowl C.
5. Fill a small saucepan with water to about ⅓ way up. Bring the water to boil.
6. Cut the apple into 6 equal segments (8 segments if an apple cutter is used).
7. Fully immerse 1 piece of apple into each of the bowls A, B and C. Let the pieces of apple be immersed in these liquid for 3 minutes. Place another piece of apple into the boiling water for 30 seconds, remove it and cool it in cols distilled water in bowl D for 2 minutes (i.e. blanching).
8. Remove the apple from each of bowls A, B, C and the boiling water and place them onto the corresponding plates A, B, C and D. Put another piece of apple onto the plate labelled E (the control).
9. Using the following scale, assess and record the degree of browning of the apple on each plate every 5 minutes for 30 minutes. Tabulate the results.

–	:	no browning
+	:	very slight browning; the appearance is very acceptable
++	:	slight browning; the appearance is acceptable
+++	:	moderate browning; the appearance is still acceptable
++++	:	significant browning; the appearance is barely acceptable / almost unacceptable
+++++	:	severe browning; the appearance is unacceptable

Results

Part II - Report Writing

Discussion

1. Based on the results of this experiment, comment on the effectiveness of the four treatments in preventing enzymatic browning.

2. Explain why the treatments can help prevent enzymatic browning.

3. Discuss the applications of your findings in preparing dishes which involve using apples.

4. Suggest another method to prevent enzymatic browning of apples. Explain the scientific principle of the method. Briefly describe how the effectiveness of the suggested method can be investigated.

Conclusion