Robogals Science Challenge

Minor Challenge Set #4
STEM Field: Food Science
Level: Junior
Challenge Name: Science of Apple Browning
Project Cost: 0-20 USD
Materials Required:

- 1 apple, sliced into 4 equal pieces
- 4 containers / bowls / cups / ziploc sandwich bags
- Permanent marker, or pen and paper to label the containers
- Knife
- Water
- Vinegar, or lemon juice
- Milk
- Clock, or timer
- Teaspoon
- Paper, or notebook to record observations and results. Alternatively, print out the table on page 4 to record results.

Safety:

- Adult supervision and assistance are required when handling knife to cut the apple into 4 equal pieces

Duration:

- The challenge take approximately 3 hours to finish, however, the time guideline is an estimation only, and students and mentors can complete the tasks around their schedules

Introduction:

As a food scientist, you apply your science knowledge to study the nature of food. In this project, we will focus on an area in food science called **food preservation**. Food preservation is the process of handling food in such a way to stop, or slow down the spoilage of food. In this process, we also aim to maintain nutritional value, texture, and flavour.

Have you ever seen fresh slices cut from an apple? After a few hours, if those slices are not **preserved** well, these apple slices change to a brown colour.

Why do apples turn brown a few hours after being cut?

Oxygen is present in the air. You can't see, smell, or taste oxygen. But this gas is what keeps us alive! After being cut, these apple slices react with oxygen in the air, which causes the apple to turn brown. In science, this is called a **chemical reaction**. A chemical reaction is a process in which substances are changed into other different substances. In this case, the substances inside the apple slices react to oxygen, and are changed to other substances that create the colour brown.

In this project, our goal is to find the best way to preserve these apple slices! We will test if the following ingredients help to preserve the apple slices: water; milk; and vinegar, or lemon juice.

Instructions:

Part A: Preparing for the experiment

1. Gather 4 small containers, cups, bowls, or ziploc bags.

2. You will use one container as the **controlled variable**. This means you will not add any ingredients to the apple slice being stored in this container.

3. Decide on 3 ingredients to use to preserve the apple slices. We recommend using milk, water, and vinegar (or lemon juice). You will need approximately 1 teaspoon of each ingredient.

4. Create 3 labels to show the ingredients you are using to preserve the apple. Create 1 label as “Control”, for the control variable. Put the labels near each container you will use for the experiment.

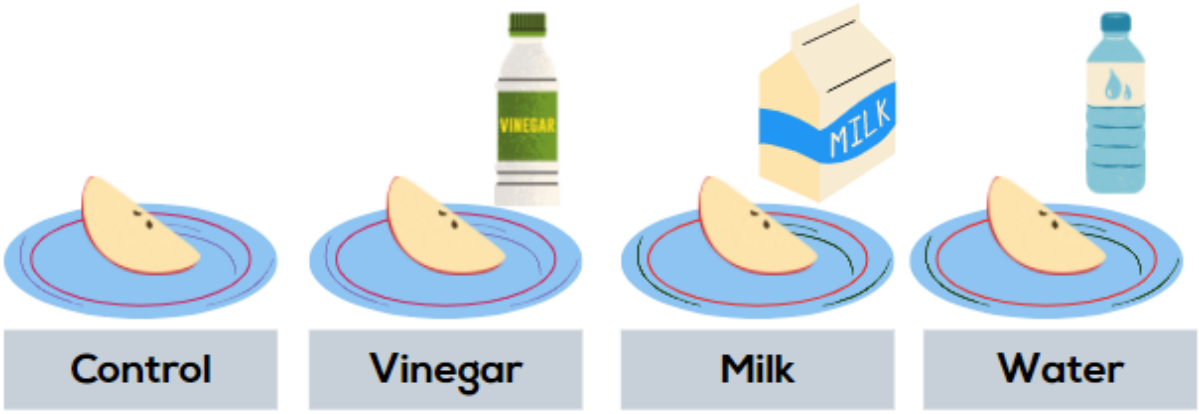
Part B: Conducting the experiment

Note: From this step onwards, it is recommended that you carry out the experiment in one go.

5. Ask an adult to help cut the apple into 4 equal slices.

6. Place 1 slice into the container labelled as “Control”. Do **not** put any liquid in this container.

7. Place 3 other slices into the other 3 containers. Sprinkle about 1 teaspoon of each liquid onto each apple slice. Make sure to cover the apple slice completely with liquid. An example of the experimental set up is shown in the figure below.



8. Start the timer when you have finished step 7. You will time the experiment for 2 hours.

Part C: Record your observations and results

Note: You can draw the table below in your notebook, or print out the table, to record your results.

9. Record your results and observations in the table below. You will record your results at the 1 hour mark, and again at the 2 hours mark.

10. Write your choice of vinegar, or lemon juice in the treatment column, bottom row.

Treatment	After 1 hour		After 2 hours	
	Observation of the apple slice	Rate how brown the apple appears (0 = not brown at all; 5 = very brown)	Observation of the apple slice	Rate how brown the apple appears (0 = not brown at all; 5 = very brown)
Control				
Milk				
Water				

So, what happened?

Previous experiments showed vinegar, or lemon juice should be the best ingredient in preserving apple slices! This is because vinegar, and lemon juice are very acidic. They react to the substances in the apple slices, before these substances react to oxygen in the air. The substances inside vinegar, and lemon juice eliminate oxygen, and so, keep your apple slices looking fresh, even after a few hours.

In the food industry, a common technique to prevent browning of fruits is to dry fruits. When drying fruits, you are removing moisture from the fruits, which stops other very small organisms from growing in these fruits. This ensures these fruits are still safe to eat after a long time. The shapes of these fruits also become more compact, and can be stored in packages more easily.

Extension - Experimenting with other treatments

You can complete any part below as the extension task!

Part A: Fruit juices, such as lemon juice, or vinegar, can be used to slow down the browning of apples. This is because they are acidic, and help eliminate oxygen, before the oxygen causes the substances in apples to turn brown. **What other fruit juices, or acidic products, can help prevent apple browning?**

Part B: In other experiments, it is shown that sugar, or syrup, puts a layer between the apple and oxygen in the air. This layer reduces the amount of oxygen reaching the substances inside the apple slices. **Does sugar actually prevent apple browning?**

Reflection Questions:

- Are there any improvements you would make to this challenge?
- What real world application/s can you apply this challenge to?
- Why do you think food scientists research techniques to preserve food?

- Is it better to use other treatment ingredients to preserve the apple slices? If so, which treatment ingredient preserves the apple slice the best? Which ingredient did not preserve the apple slice at all?
- Does your result match with other experiments' results in the **So, what happened** section?

If you attempted any part in the extension task:

- What did you learn from the extension experiment?

Submission Guidelines:

- Submit photos of the experiment setup, with the results table from page 4. If you attempted the extension task, include photos of your experiment and observations.
- Include a short summary that addresses the reflection questions.

> Note: Remember, if you want to upload pictures of your Minor Challenge that also include you, please check if it is OK with your parent or guardian first.

- The submission form is on the Minor Challenges page: https://sciencechallenge.org.au/index.php/minor-challenges/ Fill out the details and make sure you upload your submission.

Learn More! Resources:

- If you are interested in learning more about what food scientists do in their job, read more here: https://careerdiscovery.sciencebuddies.org/science-engineering-careers/earth-physical-sciences/food-scientist-or-technologist

Bibliography:

- Lohner, S., 2021. *Why Does Fruit Turn Brown?* | *Science Project*. [online] Science Buddies. Available at: <https://www.sciencebuddies.org/science-fair-projects/project-ideas/FoodSci_p082/cooking-food-science/enzymatic-browning> [Accessed 2 April 2022].