Soyun (Ally) Lee
Biology IA Proposal - Mr. Rushton

Research Question

Which fruit produced on Jeju Island - pear(Pyrus nivalis), tangerine(Citrus reticulata), apple(Malus domestica), blueberries(Vaccinium corymbosum), and grapes(Vitis vinifera)- has the highest vitamin C content, measured by DCPIP and how does this correlate with the sugar content of them, measured by refractometer?

Variables

Independent Variable	Fruit species - pear(Pyrus nivalis), tangerine(Citrus reticulata), apple(Malus domestica), blueberries(Vaccinium corymbosum), and grapes(Vitis vinifera)
Dependent Variable	Vitamin C content - Volume of DCPIP to make the fruit juice blue to colourless (cm^3) Sugar Content - Percentage of sucrose and maltose (%)
Control Variables	- Degree of maturation of the fruits (how long they have been since picked from the branch) - Surrounding temperature - Volume of fruit juice used

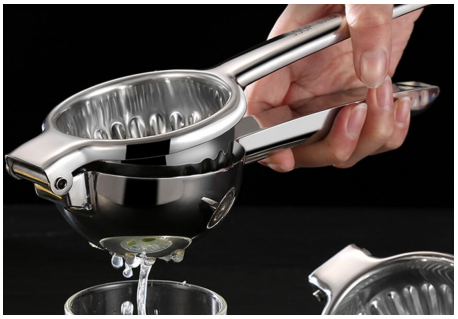
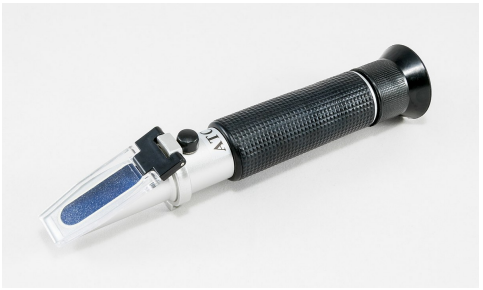
Hypotheses

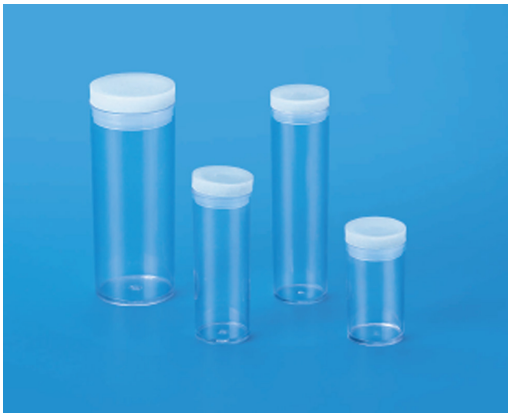
Null Hypothesis (H_0)	Vitamin C content of all members of the fruit will be equal, and the vitamin C content will have no correlation with the sugar content.
Alternative Hypothesis (H_1)	Cheonhyehyang will have the highest vitamin C content per 100 mg and vitamin C content will positively correlate with the sucrose and maltose content.

Methodology

<u>Apparatus</u>

Equipment	Description

Fruits	pear(Pyrus nivalis), tangerine(Citrus reticulata), apple(Malus domestica), blueberries(Vaccinium corymbosum), and grapes(Vitis vinifera) - **2 of each**
Juice extractor	Doesn't need to be machine 
Beaker	50ml x 6
1% DCPIP solution	At least 10 ml
Sugar Refractometer	
White paper	To monitor colour change
5ml Syringe	 including the needle x 6

Specimen tubes	 x6
Pipette	x6

Finding the Concentration of Vitamin C

1. Extract fruit juice from apple by juice extractor into a 50ml beaker.
2. Put 1 ml of 1% DCPIP solution in a specimen tube
3. Fill the 5 ml syringe needle with the juice of apple. Make sure that there isn't any air bubble in the syringe.
4. Place the specimen tube on the white piece of paper to better observe the colour change of the DCPIP solution.
5. Insert the tip of the syringe needle into the specimen tube and drip fruit juice drop by drop into the DCPIP solution while stirring slowly until the blue colour of the DCPIP is unobservable.
6. Repeat the process from 2 to 4 for the same fruit to get the average volume for each different juice.
7. Record the volume of each juice in the results table
8. Repeat the process 1 to 6 for all fruits (pear(Pyrus nivalis), tangerine(Citrus reticulata), apple(Malus domestica), blueberries(Vaccinium corymbosum), and grapes(Vitis vinifera))
9. Calculate the concentration of vitamin C of each fruit using the following formula:

$$Percentage\ of\ vitamin\ C\ =\ \frac{volume\ of\ DCPIP}{volume\ of\ juice\ used}\times\ 0.1\%$$

$$Vitamin\ C\ concentration(mg\ ml^{-1})\ =\ \frac{volume\ of\ DCPIP}{volume\ of\ juice\ used}\times\ 0.1\%$$

Finding the sugar content

1. Prepare the refractometer and make sure it is well calibrated by dropping a couple drops of distilled water on the refractometer and check if it points at 0 brix.
    a. Degrees brix = % sugar by weight
2. Extract fruit juice from the fruit by juice extractor into a 5-ml beaker

3. Using a pipette, drop 2-5 drops of fruit juice on the prism of the refractometer and secure the cover plate. This ensures that the liquid is evenly spread out on the prism.
4. Read the value by pointing the refractometer towards a light source and focusing the eyepiece until the scale is clear and visible. Read the scale value at the point where dark and light portions meet.
5. Repeat this process 1 - 4 for the same fruit to get average reading for each different fruit.
6. Record the concentration of each fruit in the results table
7. Repeat the process 1 - 6 for all members of fruits (pear(Pyrus nivalis), tangerine(Citrus reticulata), apple(Malus domestica), blueberries(Vaccinium corymbosum), and grapes(Vitis vinifera))

Results Table

Finding the Concentration of Vitamin C

Fruits	Volume of juice required to decolourise DCPIP solution (ml)				Vitamin C concentration (%)	Vitamin C concentration (mg ml^{-1})
	1	2	3	Average		
pear						
tangerine						
apple						
blueberries						
grapes						

Finding the Concentration of Sugar Content

Fruits	Volume of juice required to decolourise DCPIP solution (ml)				Sucrose concentration (%)
	1	2	3	Average	
pear					
tangerine					
apple					

blueberries					
grapes					

After collecting these data,

I. Plot a graph between the concentration of vitamin C and concentration of sugar content and explore the relationship between them. Explain the relationship by referring to existing studies https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4911803/
II. Conclude which of the fruits have the highest vitamin C concentration
III. Explain the vitamin C concentration and sugar content by position in the phylogenetic tree(the evolutionary relationship between fruits). Some of the species are artificially made by humans. How does artificially selected species' vitamin C and sugar content differ from natural species?
IV. Explore the real world value of this finding. Refer to scurvy and other diseases that can be caused by vitamin C deficiency. (which fruit is recommended to the patient)