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Testing The Viability Of Vitamin C Supplements

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I. Introduction

Vitamin C deficiency has become one of the most common problems in the world with more than 1 in 20 people having it across all demographics.[1] Vitamin C is a key requirement for humans due to its many functions. Vitamin C plays a role in the formation of collagen, the absorption of iron in humans, wound healing and helps maintain cartilage, bones as well as teeth. Individuals with Vitamin C deficiency could face many side effects such as Scurvy, slow wound healing and change in hair structure. [2]

Due to the vast amount of people having this deficiency the need for Vitamin C supplements has become more common. Post the pandemic more and more people have started taking supplements in hopes to not face the side effects of the deficiency and have an overall healthy anatomy. Vitamin C supplements generally contain a stated amount of ascorbic acid (vitamin C) and other components however this varies from company to company.[3]

Being from a family where many people are Vitamin C deficient I was curious to know how effective these supplements are and how viable they are at providing vitamin C. Seeing a dispute between two members in my family whether to have powdered or tablet form Vitamin C supplements I became more intrigued into which medium is actually more beneficial. Due to these reasons and the prevalence of Vitamin C deficiency I decided to scribe a paper on how effective Vitamin C supplements are.

Requirements

Table 1: List of requirements used with quantities.

Name	Quantity
Ascorbic Acid	400mg
Water	1000ml
Starch Solution	Roughly 60 drops
Vitamin C supplement 1	5 tablets (each tablet states 80mg of ascorbic acid)
Vitamin C supplement 2	5 sachets (each sachet states 80mg of ascorbic acid)
Vitamin C supplement 3	5 servings using complementary scooper (each serving states 80mg of ascorbic acid)

Apparatus:
1. Weighing Balance
2. 100ml Burette
3. White Tile
4. 50ml Conical Flask x 20
5. Burette Stand
6. 50ml Beaker
7. Funnell
8. 25ml pipette
9. Filter paper
10. Glass rod

Variables

Independent:

Type of vitamin C supplement used in each setup is varied.
- Vitamin C supplement 1 (tablet)
- Vitamin C supplement 2 (sachet)
- Vitamin C supplement 3 (powder)

Dependent:

Volume of Iodine required to neutralize the solutions, if volume required to neutralize ascorbic acid solution (control) and volume required to neutralize the supplements is around the same, the supplements are as effective as they state.

Controlled:

Controlled Variable	Method to control it
Total amount of water used for each titration	50ml was used
Starch solution added to each setup	3 drops in each
Contents in each conical flask	50ml water+supplement/ascorbic acid+starch solution
Temperature	Each experiment was carried out in same environment at room temperature

II. Methodology

Preparing ascorbic acid solutions (control):

1. Measure a total of 50ml of water using a 25ml pipette twice and transfer to a 50ml conical flask.
2. Measure 80mg of ascorbic acid using a weighing balance.
3. Transfer the weighed amount of ascorbic acid into the conical flask with 50ml of water using filter paper.
4. Mix the solution using a glass rod.
5. Repeat this 4 more times.

Preparing Vitamin C supplement 1 solutions (tablet):

1. Measure a total of 50ml of water using a 25ml pipette twice and transfer to a 50ml conical flask.
2. Take 1 tablet and place it in the conical flask and wait for it to completely dissolve.
3. Once dissolves mix the solutions using a glass rod.
4. Repeat this 4 more times.

Preparing Vitamin C supplement 2 solutions (sachet):

1. Measure a total of 50ml of water using a 25ml pipette twice and transfer to a 50ml conical flask.
2. Tear one sachet and empty its contents into the conical flask.
3. Keep on stirring using a glass rod to mix it.
4. Repeat this 4 more times.

Preparing Vitamin C supplement 3 solutions (powder):

1. Measure a total of 50ml of water using a 25ml pipette twice and transfer to a 50ml conical flask.
2. Measure one scoop of the supplement with the complementary scoop given.
3. Empty it into the conical flask.
4. Keep on stirring using a glass rod to mix it.
5. Repeat this 4 more times.

Titration Setup:

1. Clamp the burette onto the stand in a position where the volume readings can be measured clearly.
2. Using a funnel fill the burette with 100ml of iodine solution.
3. Any excess can be removed using the 50ml beaker.
4. Add or remove iodine solution until exact 100ml mark is reached.
5. Place a clean white tile onto the stands base so the colour change can be observed clearly.

Titration Procedure:

1. Take a conical flask with ascorbic acid (control) and add 3 drops od starch solution using a dropper.
2. Place the conical flask directly under the burettes opening and on top of the glass tile.
3. Twist the knob of the burette and set it in a way where iodine solution is falling in drops to minimise any error.
4. Keep swirling the conical flask and observe the colour change by looking at the flask from the top.
5. The solution will keep turning a blue colour, but keep swirling to get rid of it.
6. Continue adding the drops until the solution permanently becomes the blue colour and twist the knob to stop the drops from falling.
7. Not down the volume of iodine solution used.
8. Fill the burette back to the 100ml mark with iodine solution.
9. Repeat this procedure 4 more with ascorbic acid (control).

10. After this repeat this entire procedure 5 times each for Vitamin C supplement 1, 2 and 3.

III. Results & Data Processing

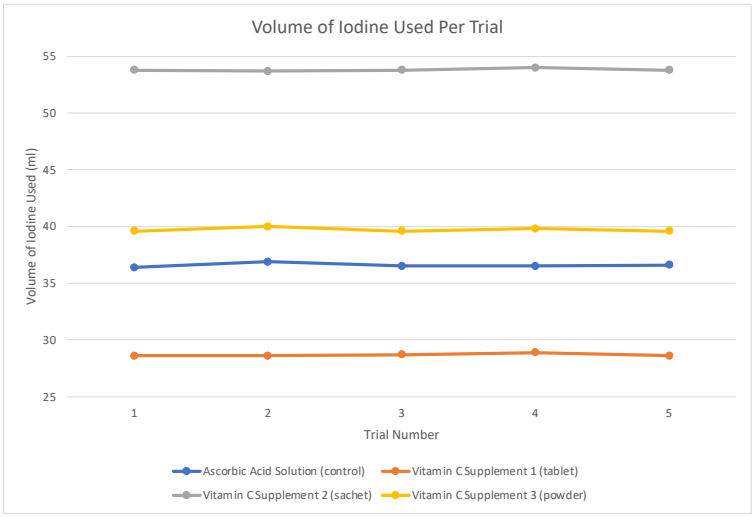
Qualitative Results

1. Permanent colour change to a blue solution was observed when titration point reached.
2. Each Vitamin C supplement had a different colour, supplement 1 was transparent but a little cloudy, supplement 2 was a yellow colour and supplement 3 was an orange colour, due to this the colour change observed where different with supplement 3 turning a dark purple instead of blue.

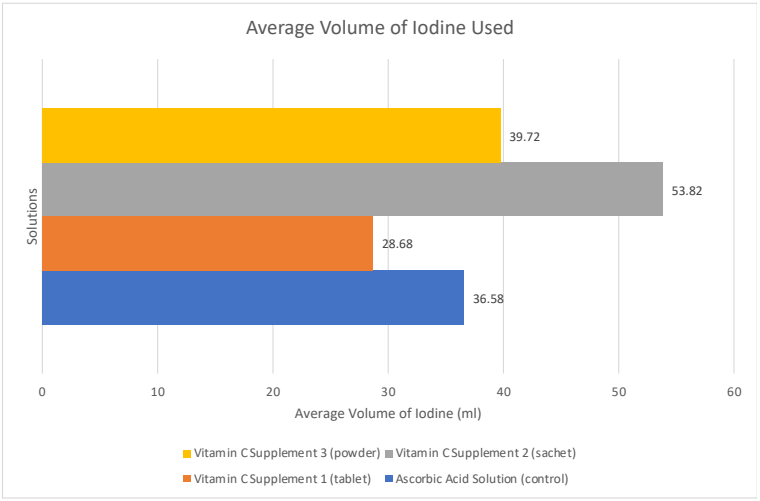
Quantitative Results

Trial	Volume of Iodine Used (ml)			
	Ascorbic Acid Solution (control)	Vitamin C Supplement 1 (tablet)	Vitamin C Supplement 2 (sachet)	Vitamin C Supplement 3 (powder)
1	36.4	28.6	53.8	39.6
2	36.9	28.6	53.7	40
3	36.5	28.7	53.8	39.6
4	36.5	28.9	54	39.8
5	36.6	28.6	53.8	39.6
Average	36.58	28.68	53.82	39.72
Standard Deviation	0.172046505	0.116619038	0.09797959	0.16

Data Processing



Graph 1: Volume of Iodine used across the 5 trials



Graph 2: Average volume of iodine used

ANOVA Test

Single Factor ANOVA test conducted through Microsoft Excel Extension called Microsoft ToolPak

Anova: Single Factor						
SUMMARY						
Groups	*Count*	*Sum*	*Average*	*Variance*		
Ascorbic Acid Solution (control)	5	182.9	36.58	0.037		
Vitamin C Supplement 1 (tablet)	5	143.4	28.68	0.017		
Vitamin C Supplement 2 (sachet)	5	269.1	53.82	0.012		
Vitamin C Supplement 3 (powder)	5	198.6	39.72	0.032		
ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	1652.748	3	550.916	22486.36735	3.33667E-29	3.238871517
Within Groups	0.392	16	0.0245			
Total	1653.14	19				

IV. Discussion

By using graph 1 and 2 and comparing the readings of each supplement with that of the ascorbic acid conclusions can be drawn. The higher the amount of iodine required to neutralize the ascorbic acid the greater the amount of Vitamin C in each supplement.

The average volume of iodine required to neutralize 80mg of ascorbic acid was 36.58ml, using graph 2 we can see that Vitamin C Supplement 3 (powder) is the most similar to the ascorbic acid control readings, through this we can state that the supplement has little more than the stated amount of Vitamin C, average volume of iodine used was 39.72ml little more than the control, and hence it can be deemed as a viable supplement.

Supplement 1 (tablet) required much less iodine to neutralize with the average being 28.68ml, this is 7.9ml less than the control and hence it can be said that supplement 1 has lesser than 80mg of Vitamin C per tablet, this could mean that an individual may have to take more than 1 tablet to ensure the correct dosage is consumed. It claim can be made that this supplement is the weakest source of Vitamin C in this study and has less than the stated amount of Vitamin C.

Vitamin C supplement 2 (sachet) required the greatest amount of Iodine to neutralize it (53.82ml average volume), through this it can be said that supplement 2 has much more than stated amount of Vitamin C making it an overperforming supplement as it required 17.24ml of Iodine to neutralize it than the control (averages used). This can be viewed as good and bad. To begin with since it has more than the stated amount of vitamin C it means that individuals consume more vitamin C which is a good thing, however since it has much more vitamin C it may lead to overconsumption which can lead to problems like Nausea and Diarrhoea, hence to meet the stated amount of vitamin C the full sachet cannot be used.[4]

The relatively low standard deviations of the study could suggest that the readings and values obtained are significant and closely related with no anomalies making the study viable. This can increase the accuracy of the comparisons made thereby deeming the conclusions more accurate.

The ANOVA test used also shows that the data obtained is significant. For the values to be significant the F value has to be greater than the F crit value and the P value must be less than 0.05. It can be seen that the F value is much greater than the F crit value making the data very significant. Furthermore since the P value is less than 0.05 the study can be deemed significant and viable.

Future Scope

- More supplements can be used to see the effectiveness of different kinds of supplements.
- Exact amounts of Vitamin C can be calculated to see how much the dosages exactly vary from the stated amount.
- Clinical trials may be conducted to see how

Evaluation

Strengths

- Experiment is easy to conduct and does not require a lot of assistance making it a resource and time effective study.
- The ANOVA test results state the experiments values and data are significant.
- This experiment can be repeated very easily.

- Experiment has a wide range of applications.

Limitations

- Other substances in each supplement could have affected the results obtained as the supplements were not purely ascorbic acid.
- Exact change in pH could not be measured which could have given more significant data.

Errors and Improvements

- Exact titration point not determined: Improvement for this could be lowering the rate at which Iodine is dispensed.
- Weighing balance zero error: Balance can be calibrated before using.

V. Conclusion

Through the course of this experiment the research question "***Do Vitamin C supplements contain the amount of ascorbic acid as stated? Does this vary depending on the medium of supplement consumption?"*** has been successfully answered. Vitamin C Supplement 2 (sachet) had more than the stated amount of Vitamin C, Supplement 3 (powder) had roughly the same amount of Vitamin C as stated and Supplement 1 (tablet) had less than the amount of Vitamin C stated.

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