IS HIGH C ALL IT CLAIMS TO BE?

Purpose

- To investigate the vitamin C content of fruit juice.
- To develop practical skills.

Schoolgirls expose false vitamin C claims

Fruit juice is recommended as a good source of the antioxidant vitamin C and large volumes are sold every day. In 2004, two high school students in New Zealand conducting an experiment to determine the vitamin C levels of their favourite fruit drinks found that the levels in one well-known blackcurrant juice drink were much lower than those claimed by the manufacturer. The manufacturer dismissed the concerns, saying the claim related only to the blackcurrant fruit and not the product. However, the case was taken up by a television consumer affairs show and after further testing it was found that statements about the levels of vitamin C had been misleading. Fifteen charges were brought under the Fair Trading Act. In March 2007, the manufacturer pleaded guilty to all 15 charges and was fined NZ$217,500. The manufacturer maintains that the issue only affected juice in Australia and New Zealand.

Which juice contains the most vitamin C?

The quantity of vitamin C in food and drink can be determined using a simple colour test. Vitamin C decolourises the blue dye DCPIP (dichlorophenolindolphenol). Vitamin C is an antioxidant and reduces the DCPIP. DCPIP changes from blue to colourless (or slightly pink) as it becomes reduced.

Use the method described below to investigate the amount of vitamin C in fruit juice.

Read the procedure below carefully and decide if it will validly answer the question posed. Complete a risk assessment before you start.

You need

- 1% DCPIP solution
- 1% vitamin C solution
- A range of fruit juices
- Test tubes
- Pipette to accurately measure 1 cm^3
- Pipette or burette.

Procedure

1 Pipette 1 cm^3 of 1% DCPIP solution into a test tube.

2 Record the start volume of 1% vitamin C solution in a pipette or burette. Add 1% vitamin C solution drop by drop to the DCPIP solution. After adding each drop, shake the tube gently. Continue to add drops of the vitamin C solution until the blue colour of the DCPIP has just disappeared. Record the end volume. Calculate the exact volume of 1% vitamin C solution needed to decolourise the DCPIP by subtracting the start volume from the end volume. Repeat the procedure and average the result.

3 Repeat this procedure with the fruit juices provided. If only one or two drops of the fruit juice decolourises the DCPIP, dilute the juice and repeat the test.

4 The 1% vitamin C solution contains 10 mg of vitamin C in 1.0 cm^3. Calculate the mass of vitamin C that is required to decolourise 1 cm^3 of the DCPIP solution. Use this value to work out how much vitamin C each of the fruit juices contain, in mg cm^{-3}.

Safety checked, but not trialled by CLEAPSS. Users may need to adapt the risk assessment information to local circumstances.
© 2015 University of York, developed by University of York Science Education Group.
This sheet may have been altered from the original.

Analysis and interpretation of data

5 Present your results in the most appropriate way.

Conclusion and evaluation

6 Discuss your findings with reference to your question or problem. State a clear conclusion to your work, summarising what you have found. Support your statements with evidence from your results and relevant biological knowledge.

7 Comment on any systematic or random errors in the data.

8 Comment on the accuracy and precision of your results.

9 Propose any changes to the procedure that would improve the quality of the results.

Safety checked, but not trialled by CLEAPSS. Users may need to adapt the risk assessment information to local circumstances.
© 2015 University of York, developed by University of York Science Education Group.
This sheet may have been altered from the original.

IS HIGH C ALL IT CLAIMS TO BE?

Purpose

- To investigate the vitamin C content of fruit juice.
- To develop practical skills.

Investigating vitamin C content in fruit juice

The student activity sheet presents a case that appeared in the news and this could be used to put the practical work in context. Students use the procedure provided to investigate the amount of vitamin C in fruit juice. Students could plan their own investigation using the planning sheet provided in these notes, although support on the method would need to be provided first. They might investigate the story on the activity sheet, testing the vitamin C levels in juice and comparing their values with the quantity stated on the product. Alternatively, they may investigate the vitamin C content of a range of different juices to determine which contain the highest level of the vitamin, or whether drinking fruit juice from a carton is just as good as eating fresh fruit to maintain high levels of antioxidant vitamin C in your diet. Note that heat treated fruit juice often has vitamin C added. The effect of heat treatment could be investigated; see CLEAPSS guidance leaflet GL146 for additional details.

Note that the Edexcel GCE Biology (Salters-Nuffield) specification requires that students know how to investigate the vitamin C content of food and drink. Even if students only test juices, they also need to know how they might test foods.

Notes on the procedure

The Student Sheet includes a procedure for the experiment. It would help in the development of students' practical skills if the procedure was reviewed before starting the practical work. This can be done using the Developing Practical Skills Framework that can be found in the Practical Skills Support materials in the SNAB Online resources. Alternatively students could plan the investigation themselves using the planning sheet provided with these notes. Students will not necessarily have addressed all of the practical skills in every practical activity, for example, this activity could focus on suitability of method, accuracy, precision and risk assessment. Students can be directed to CLEAPSS student safety sheets which can be downloaded free from the CLEAPSS website.

Unfortunately, using blackcurrant fruit drink can be problematic due to the dark colour of the juice. It would need to be diluted to give a pale colour that would not affect the viewing of the DCPIP decolourisation.

On completion of the practical investigation students could use the Self-evaluation Sheet to reflect on what they have done in this practical. This can be found with the Practical Skills Support materials.

Sample results

The table below gives the volume of various carton fruit juices that decolourised 1 cm^3 of 0.1% DCPIP solution. The end point was when the blue tinge had completely disappeared.

0.6 cm^3 of 1% vitamin C solution decolourised 1 cm^3 of 0.1% DCPIP solution. 1 cm^3 of the 1% vitamin C contains 10 mg of vitamin C, so it takes 6 mg of vitamin C to decolourise 1 cm^3 of DCPIP.

Juice tested	Volume of juice required to decolourise 1 cm^3 of 0.1% DCPIP solution/cm^3			Average volume of juice required/cm^3	Vitamin C content of juice/mg cm^{-3}
Grapefruit juice	1.50	1.70	1.65	1.61	3.8
Pineapple juice	12.00	11.20	11.50	11.56	0.5
Orange juice	2.00	2.25	2.10	2.12	2.8
Orange drink	1.40	1.50	1.45	1.45	4.1
Fresh lemon juice	1.90	1.70	1.60	1.73	3.5
Bottled lemon juice	24.00	23.50	24.50	24.00	0.25

Safety checked, but not trialled by CLEAPSS. Users may need to adapt the risk assessment information to local circumstances.
© 2015 University of York, developed by University of York Science Education Group.
This sheet may have been altered from the original.

Student Planning Sheet

Purpose

- To investigate the vitamin C content of fruit juice.
- To develop practical skills.

Investigating vitamin C content in fruit juice

1 Scientific questions and information research

- *State what you are going to investigate* – you should express this as a question to answer, a problem to investigate or a hypothesis to test. You might be interested in which type of fruit juice provides the most vitamin C, or if drinking fruit juice from a carton is just as good as eating fresh fruit to maintain high levels of vitamin C in your diet, or does 'long life' heat-treated juice in a carton provide as much vitamin C as freshly squeezed juice in cartons.
- *Research relevant information* – to help you decide on what you are going to investigate and how you will carry out the practical work, you might need to research the background science and methods people have used to investigate similar problems. When you write up your plan remember to give full details of any information sources you use and comment on their reliability.

2 Planning and experimental design

The quantity of vitamin C in food and drink can be determined using a simple colour test. Vitamin C decolourises the blue dye DCPIP (dichlorophenolindolphenol). Vitamin C is an antioxidant and reduces the DCPIP. DCPIP changes from blue to colourless (or slightly pink) as it becomes reduced.

- *Design an experiment that you can use to complete your investigation* – the Developing Practical Skills Framework on SNAB Online will help you plan your investigation.

You will be provided with the following equipment:

- Range of fruit and/or fruit juices
- Standard 1% vitamin C solution
- DCPIP 0.1%
- Pipette, syringe or burette to measure volumes accurately
- Standard laboratory glassware and apparatus.

Make sure your plan:

- includes a question, problem or hypothesis that you are testing
- identifies the independent and dependent variables
- identifies any other variables that may affect the outcome of the experiment and, where possible, controls or allows for them
- includes a procedure that uses suitable apparatus to test your question or problem
- has a control, if appropriate, and this control is fully explained
- includes replicates and an explanation of why this is necessary
- says what measurements you will make, how they will be made and the level of accuracy that you can expect in your measurements
- identifies any potential sources of error (systematic or random) and how errors can be minimised
- includes a risk assessment that identifies potential safety issues and how they can be minimised.

Have your plan checked by your teacher/lecturer before you start the experiment.

Safety checked, but not trialled by CLEAPSS. Users may need to adapt the risk assessment information to local circumstances.
© 2015 University of York, developed by University of York Science Education Group.
This sheet may have been altered from the original.

IS HIGH C ALL IT CLAIMS TO BE?

Purpose

- To investigate the vitamin C content of fruit juice.
- To develop practical skills.

The requirements will depend on the hypothesis being tested and whether the students first plan the investigation themselves. The requirements below are for an experiment to compare the vitamin C content of a range of fruit juices.

Requirements per student or group of students	Notes
For each solution students test they will need:	
1 cm^3 0.1% DCPIP solution	0.1% in aqueous solution freshly made up.
Fruit juice to test or standard 1% vitamin C solution	The volume of fruit juice required will depend on the concentration of vitamin C it contains; see the sample results on the teacher sheet. The 1% vitamin C solution contains 10 mg per cm^3.
Test tube	
Pipette	To accurately measure 1 cm^3 of DCPIP solution.
Pipette, syringe or burette	To add the test solution drop-wise to the DCPIP solution.

Notes

Safety checked, but not trialled by CLEAPSS. Users may need to adapt the risk assessment information to local circumstances.

© 2015 University of York, developed by University of York Science Education Group.
This sheet may have been altered from the original.