

VITAMIN C IN ORANGE JUICE

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PURPOSE

Vitamin C is important for the human body because it is needed in the production of collagen to make connective tissue. Vitamin C also helps the body to absorb iron, helps wounds to heal, helps red blood cell formation and helps to fight infections. Some studies say that vitamin C prevents cancer. A lack of vitamin C can cause a disease called scurvy, iron deficiency and poor wound healing. The healthy diet should include high amounts of vitamin C because the human body cannot make its own vitamin C. Oranges are an excellent source of vitamin C. (Gordon, 1995-2005, p.1)(Larsen,1997-2005, p. 1)(General Health Encyclopedia, 1998, p. 1)(Royston, 2003, p.19) Orange juice and drinks are common in our diet and some people think they are receiving vitamins in any type of orange drink. I conducted two experiments to compare the content of vitamin C in different kinds of orange juice and drinks.

HYPOTHESIS

My hypothesis is that freshly squeezed orange juice will have the most vitamin C compared to the other types of orange juice and drinks, because the fruit is picked fresh, and it is not stored, preserved or exposed to oxygen.

BACKGROUND

Vitamins help to speed up important reactions in the body. Vitamin C, also known as ascorbic acid, is water soluble, meaning it will dissolve in water and is not stored in the body. We need to get vitamin C from the foods we eat. (Gordon, 1995-2005, p.1) (Silverstein, 1992, p.8) Vitamin C is found in fruits such as oranges, limes, and grapefruit, and vegetables including

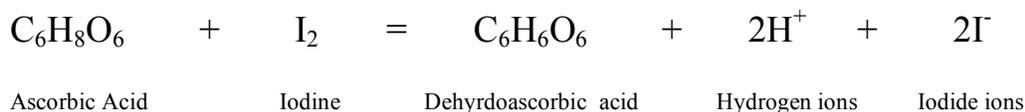
tomatoes, green peppers, and potatoes. The recommended amount of vitamin C is 60 to 90 milligrams per day. (Gordon, 1995-2005, p. 2) People who smoke need more vitamin C in their diet, because they lose 25 mg. of vitamin C every time they smoke a cigarette. People who are stressed, have infections, take antibiotics, drink lots of alcohol or have been injured need more vitamin C in their diet. (Sullivan, 1997, p. 30)

Factors that Affect Vitamin C in Orange Juice

Vitamin C is sensitive to light, heat and air. (Alpert, 1997-2004, p. 1) Vitamin C is the most easily destroyed vitamin and it is easily harmed during food preparation. This can happen during chopping, exposure to air, cooking, and boiling. (Joanne Larsen, 1995-2003, p. 1 and 2) There are many factors that will affect how much vitamin C is in orange juice. Townsend (1999) summarized some of these factors. For example, freezing preserves vitamin C. Exposure to oxygen will destroy vitamin C. Oranges will have more vitamin C if they are picked when they are less ripe, if they are early maturing like Navel oranges, if they are grown in soil with low levels of nitrogen or if they are exposed to cooler temperatures while growing. How the juice is made will also affect the amount of vitamin C in it. For instance, frozen orange juice is made from a mix of early ripening and late ripening oranges, so it tends to have higher concentrations of vitamin C. The type of container that the juice is stored in can affect vitamin C levels. For instance, enamel lined cans lose more vitamin C than tin cans. Orange juice in glass jars or cardboard cartons have less. Today cartons have oxygen and light barriers to protect the vitamin C and frozen juices are stored in cardboard cans lined with foil to help keep vitamin C. For the best vitamin C levels, orange juice must be stored at cool temperatures with oxygen barriers. (Townsend, 1999, p. 1 and 2)

The Chemical Reaction

The vitamin C content of a drink can be tested using an indicator solution made of cornstarch, iodine and water. When the iodine is added to a starch solution, the solution turns blue. When a drink containing ascorbic acid is added to this indicator solution, the iodine reacts with the ascorbic acid. The result is the colourless chemical called dehydroascorbic acid, and hydrogen ions and iodide ions. The ascorbic acid loses 2 hydrogen atoms to the iodine and dehydroascorbic acid is formed:



When all of the ascorbic acid is used up, that is the end point of the reaction. If there is so much vitamin C that all of the iodine in the starch solution is used up, the solution will become clear because of the dehydroascorbic acid. If there is very little vitamin C, less iodine will be used up and more blue colour will remain. (Thomas, 1999, p. 1)

METHOD

Materials

- Vitamin C Indicator Solution (2% Iodine solution, cornstarch and water)
- Medicine droppers, Test tubes, Test tube holder
- Beverages -12 different kinds of orange juices and drinks:

Indicator Solution

Mix one tablespoon of cornstarch and water to make a paste, add 250 millilitres of water and boil. Add 10 drops of this solution to 75 millilitres of hot water, stirring. To this solution, add 12 drops of 2% iodine solution. (USDA Agricultural Research Service, 2005, p. 1)

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Experiment One

Add 10 drops of one juice to 5 ml. of indicator solution in a test tube. Stir. Repeat for each beverage. Line the tubes up from lightest to darkest. Record the rank of each beverage from '12' being the lightest (with the most vitamin C) to '1' being the darkest colour (with the least vitamin C). (USDA Agricultural Research Service, 2005, p. 1)

Experiment Two

Add juice one drop at a time to 5 ml. of indicator solution in the test tube until the indicator solution changes from blue to colourless or until the solution no longer changes colour. This is the endpoint. Repeat for each beverage. Observe and count the numbers of drops of orange beverage added to the indicator to cause it to lose its colour or to stop changing colour. Record the number of drops. (Dipaolo, 2002, p. 1)

RESULTS

Both experiments showed that freshly squeezed orange juice had the most vitamin C and that C-plus and Kool-aid had no vitamin C, while the orange drink had very little vitamin C in it. Other juices that were processed in various ways had less vitamin C content than freshly squeezed but more than the orange 'drinks' and pop.

CONCLUSIONS

The results support my hypothesis that freshly squeezed orange juice would have the most amount of vitamin C because the fruit is picked fresh and it is not stored, preserved or exposed to oxygen. The 'boiled McCain juice' might have had more vitamin C because it was boiled for two minutes. The water evaporated and maybe the juice became more concentrated.

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'McCain Old South from frozen concentrate' ranked third in both experiments probably because freezing preserves the vitamin C and possibly early maturing oranges were used. For various reasons as I reviewed in the background information, the other juices ranked lower in vitamin C content than these top three. C-plus and Kool-aid, which are orange flavoured obviously had no vitamin C in them. These results were as expected.

APPLICATIONS

My project is important because it shows that orange juice that has not been processed, such as freshly squeezed orange juice, has the most vitamin C. Drinks that have orange flavour and colour, like Koolaid, pop and orange 'drinks', may not have any vitamin C in them. In order to get enough vitamin C to help to make healthy connective tissue, healthy people should always make sure they buy 100% pure orange juice. For instance, juice made from frozen concentrate or juice that is squeezed then processed, will provide adequate amounts of vitamin C. Although these juices that are processed may have enough vitamin C in them for healthy people, it may not be enough for smokers or people who are ill. For these people, it is even more important to use fresh oranges and read the labels to make sure they are buying 100% pure orange juice.

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APPENDIX A

BIBLIOGRAPHY

Microsoft Encarta Encyclopedia Standard 2001. *Ascorbic Acid*. Microsoft Works Suite.

BOOKS

Royston, Angela (2003). *Vitamins and Minerals for a Healthy Body*. Chicago, Illinois: Heinemann Library.

Silverstein, Dr. Alvin, Virginia and Robert (1992). *Vitamins and Minerals*. Brookfield, Connecticut: The Millbrook Press.

Sullivan, Karen (1997). *Vitamins and Minerals: A Step-by-step Guide*. Rockport, Massachusetts: Element Books Limited.

Tocci, Salvatore (1997). *How to do a Science Fair Project*. New York City: Grolier Publishing.

WEBSITES

Alpert, Howard. (1997-2004). *Cforyourself - Vitamin C Tests -- A Summary*. Retrieved January 10, 2005, from http://www.cforyourself.com/Overview/Primer/Chemistry/c_tests.html.

BOAST Hands-on Science Lessons. (no date). *Testing Vitamin C*, Retrieved January 9, 2005, from <http://www.life.uiuc.edu/hughes/boast/sciencelessons/vitaminc.htm>

DiPaolo, Natalie. (2002) *Do Different Types of Orange Juice Contain the Same Amounts of Vitamin C?* Retrieved January 10, 2005, from <http://www.scienceteacherprogram.org/biology/DiPaolo02.html>

Ganong, Barry. (2003). *Determination of Vitamin C in Orange Juice* Retrieved January 8, 2005, from <http://faculty.mansfield.edu/bganong/biochemistry/vitaminc.htm>

General Health Encyclopedia . (1998). *Vitamin C*. Retrieved January 8, 2005, from <http://www.healthcentral.com/mhc/top/002404.cfm>.

Gordon, Dr. Jerry, (1995-2005). *How Vitamin C Works*. Retrieved January 8, 2005, from <http://home.howstuffworks.com/vitamin-c.htm>.

Larsen, Hans R. (August 1997). *Vitamin C: Your Ultimate Health Insurance*, Retrieved January 10, 2005, from *International Health News* (1997-2005) http://www.yourhealthbase.com/vitamin_C.htm.

Larsen, Joanne. (1999-2003) *Ask the Dietitian* SM . Retrieved January 10, 2005, from <http://www.dietitian.com/vitaminc.html>.

NASA Explores. (no date). *Where Is The Antioxidant, Vitamin C?* Retrieved January 30, 2005, from <http://media.nasaexplores.com/lessons>.

Talbot, Jonathan. (March 2003). *The Daily Press – Boston University, Fresh or frozen: orange juice and vitamin C*. Retrieved January 11, 2005, from <http://www.dailyfreepress.com/news/2003/03/04/Science/Fresh.Or.Frozen.Orange.Juice.And.Vitamin.C-385495.shtml>.

Thomas, Martin. (1999) *Re: What is the formula of Ascorbic Acid when it has been oxidized?* Retrieved February 25, 2005, from <http://www.madsci.org/posts/archives/dec99/944415476.Ch.r.html>.

Townsend, Chet. (1999). *Vitamin C and Citrus Juices*. Retrieved January 9, 2005, from <http://www.ultimatecitrus.com/vitaminc.html>.

United States Department of Agriculture Agricultural Research Service. (no date). *Comparing Vitamin C Content*. Retrieved January 11, 2005, <http://www.ars.usda.gov/is/kids/fair/method.htm> .