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Vitamin C

Have you ever wondered why you need a serving of citrus fruit or juice or other source of vitamin C each day? Have you ever wondered what distinguishes vitamin C from vitamins A or B?

Perhaps you have even wondered how vitamin C got its name. Letters were assigned to vitamins as they were discovered: A was the first one discovered, B the second, etc. Vitamin C has been given another name: ascorbic acid, which means "not scorbutic" or without scurvy. This scurvy-preventing action was the first observed feature of vitamin C. The British Navy was hard hit by scurvy in the 1700's, but officials observed that those ships carrying fresh lemons and limes had no scurvy problems. So in 1795 the British Navy ordered all its ships to carry citrus provisions. This, incidentally, is the origin of the nickname "Limey" for British seamen. However, vitamin C, or the anti-scurvy vitamin, was not identified for another 100 years.

What Vitamin C Does

How does vitamin C work in your body? It makes it possible for your body to form the cementing substance which binds the cells in tissues together in an orderly fashion. This cementing substance (intercellular material) forms a network of supporting tissue onto which the minerals, calcium and phosphorus, are deposited to form bones and teeth. Thus, this supporting tissue is one of the basic building materials for bones and teeth. When ascorbic acid is absent from the diet for a long period of time, bones and teeth may form improperly because the intercellular cementing substance is missing. Even though minerals are available, they are not properly arranged and cannot form normal bones and teeth when vitamin C is lacking.

The cementing material is also necessary for wound healing. Two doctors designed an interesting experiment to find out more about the body's need for vitamin C. One of them consumed a diet free of vitamin C for 6 months. After 3 months on the diet a wound was made in the mid-region of his back. The wound showed good healing within 10 days. A second wound made after he had been on the diet for 6 months showed good healing of the skin but no healing at deeper levels. He then received large amounts of vitamin C, and after 10 days the wound showed excellent healing.

Vitamin C also is believed to be involved in the formation of red blood cells and to aid the body in resisting damage from bacterial toxins or infections.

Scurvy once was common during famines, wars, or on long journeys when little food except bread and salt meat was available. Fortunately, it is seldom seen in this country today. When seen, it is most common in infants 6 to 12 months of age.

Growing bones show the most marked signs of a deficiency of vitamin C in infants. Without the cementing substance needed as supporting tissue, bones do not form properly. Areas at the ends of the long bone shafts are especially affected. The soft tissue around the joints swells and is tender. Walking and sitting become painful and the child lies on his back to avoid the pain involved in moving his legs. The front ends of the ribs are sore and breathing may be difficult and painful. The child cries when handled or even approached because he expects pain. If there are teeth, the gums may bleed.

In adults, the soft tissues show the most noticeable signs of a vitamin C deficiency. The cementing material is missing and the cells seem just to fall apart. The gums become sore, swollen, spongy, bleed readily, and are easily infected. In extreme cases the teeth may loosen.

Protecting Vitamin C

Vitamin C is a rather simple chemical compound, quite similar to glucose, one of the simple sugars. Glucose and other hexoses, (or simple sugars) have a backbone of 6 carbon (C) atoms firmly joined to each other like the vertebrae in your backbone.

On the side these carbons are joined to oxygen (O) and hydrogen (H). Vitamin C has this form, too, but between the second and third carbons there is a double bond which means

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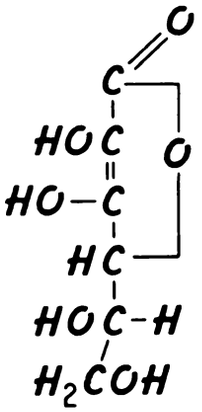

chemically that the backbone is not as firm as that of the hexose sugars. This means that these 2 carbons in vitamin C are free to make changes. The hydrogen ions (groups of atoms) especially can wander off and combine with oxygen in the air. Even without the 2 hydrogens, vitamin C is still active in the body. However, this form can easily change to another which cannot be used by the body nor change back to either of the active forms.

Since vitamin C is so easily changed, foods that contain it should be handled with extra care.

The chief enemies are:

1) *Water* – Vitamin C is soluble in water and leaches out of food into water.
2) *Oxygen* – Vitamin C combines with oxygen when exposed to air.
3) *Temperature* – Vitamin C combines with oxygen more rapidly at high temperatures.
4) *Light* – Exposure to light speeds up vitamin C loss.
5) *Enzymes* – These natural substances accompany vitamin C in food and can start its destruction when the product is cut, chopped, or bruised.

Most fruits and vegetables are fairly well protected against vitamin C loss as long as they are not peeled, cut, or bruised. When the peel is removed or the fruit or vegetable is cut or chopped, loss of vitamin C begins. To minimize its loss, peeling or cutting should be done as near the time of serving as possible. If the peeled or cut products must stand before serving, refrigeration in a covered container will slow down the loss of vitamin C. Vegetables such as cabbage, broccoli, and turnip greens which contain sizable amounts of vitamin C should be cooked in a small amount of water for as short a time as possible to preserve the vitamin C.

Acid foods such as tomatoes or citrus fruits retain most of their vitamin C during the canning process, but turnip greens and other non-acid foods may lose much during processing.

Amounts of Vitamin C Needed

Studies have shown that vitamin C is one nutrient most often lacking or in short supply in the diets of children, teenagers, and adults in this country. How much vitamin C do we need each day? The amount varies with age which reflects rate of growth and body size.

The recommended daily nutrient allowances of the National Research Council are designed to maintain good nutrition of healthy persons in this country and are used as a standard for evaluating diets. The unit of measure used for the vitamin C allowance is milligrams.

Daily Recommended Allowances as suggested by the National Research Council

Age	*Milligrams*
Infants, 0-12 months	35
Children, 1-10 years	40
Children, 11-19 years	45
Adults	45
Women, pregnant	60
Women, lactating	80

Infants are born with enough vitamin C stored to last through the first few months of life if the mother's intake was abundant during pregnancy. If the mother's intake is adequate, human milk is a good source of vitamin C. Breast-fed babies usually get more than the suggested 35 milligrams daily. Pasteurized cow's milk is an extremely poor source; hence, bottle-fed babies need an additional source of vitamin C early in life. Orange juice is often used, since 4 tablespoonfuls (one-fourth cup) supply the needed 35 milligrams.

If orange juice is not well tolerated by the infant, strained apple juice, fortified with ascorbic acid may be used. Another alternative is to give ascorbic acid in a vitamin supplement.

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Although small amounts (approximately 3 months' supply) are stored in the body tissues, vitamin C is water-soluble so any which is not needed by the body is excreted in the urine. This means that if you eat several foods high in vitamin C in any one day, or take a vitamin pill containing vitamin C in addition to eating a good diet, part of the vitamin C may be wasted.

Where is vitamin C found? Many foods supply it but some have more than others. The table below indicates the milligrams of vitamin C supplied by an average size serving of each of the selected foods.

Mg of Vitamin C supplied by one serving of selected foods

Juice	*Serving Size*	*Mg of Vitamin C*
Orange, fresh	1 cup (8 oz.)	124
Orange, frozen	1 cup	120
Orange, canned	1 cup	100
Grapefruit, canned	1 cup	84
Tomato, canned	1 cup	39
Pineapple, canned	1 cup	22
Fruits		
Orange	1 medium	66
Grapefruit	½ medium	44
Cantaloupe, raw	½ medium	63
Strawberries, fresh	1 cup	88
Lemons	1 medium	39
Vegetables		
Tomatoes, raw	1 medium	42
Tomatoes, canned or cooked	1 cup	41
Cabbage, raw	1 cup	42
Broccoli, cooked	1 cup	140
Green pepper, raw	1 pepper	94
Potatoes, white boiled or baked	1 medium	22
Potatoes, sweet boiled or baked	1 medium	17
Turnip greens, cooked in small amount of water	1 cup	68
Spinach	1 cup	50
Kale	1 cup	68
Collards	1 cup	87

Citrus fruits and juices are excellent sources of vitamin C, but there are many other sources. Turnip greens are an especially good source; one large serving supplies all of the vitamin C needed in a day, plus vitamin A. Other greens such as spinach, kale, and collards are good sources too. Notice, too, the important contributions of potatoes. White potatoes are a favorite vegetable and can contribute significant amounts of vitamin C. Sweet potatoes have lots of vitamin A as well as vitamin C and may be a real nutrition bargain. Note that many of the sources of vitamin C can be grown in the home garden.

It would be monotonous to get the needed amount of vitamin C each day from one source only. Fortunately it is possible to choose a variety of foods during the day to supply vitamin C. For example, any of the combinations shown below will supply the recommended daily allowance of 45 milligrams:

1 potato + 1/4 c.frozen strawberries
1/3 c. turnip greens + 1/4 grapefruit

3/4 tomato+1/2 c. pineapple juice+1/2 sweet potato

1 sweet potato + 1/6 c. broccoli
1/2 potato + 2/3 c. cabbage + 1/4 c. canned tomato

Vitamin C Supplements

Of all the biological functions attributed to vitamin C, none has proved to be more controversial than the belief that it is effective in preventing the common cold. The recent increase in interest concerning vitamin C began with the publication of Linus Pauling's book, **Vitamin C and the Common Cold**, in 1970. Pauling feels that a minimum daily intake of 200 to 400 mg of the vitamin is needed for optimal health. This amount should decrease the incidence of colds. If a person does develop a cold, Pauling suggests that the dose be increased up to 10,000 mg per day in order to reduce the cold's severity and duration. Most nutritionists feel that Pauling's conclusions lack scientific proof. In the past four years various studies have been conducted in an attempt to clarify the situation. These studies have examined the effect of large doses of vitamin C (1000 to 4000 mg per day) on the frequency of occurrence and the duration of colds. The results of these studies are non-conclusive. On the basis of present evidence, one cannot say whether vitamin C is useful or useless in preventing or relieving symptoms of the common cold.

Although there is no scientific evidence to support the miracle claims that have been made for vitamin C, millions of Americans consume massive doses in the form of vitamin supplements believing that they are deriving certain benefits. Vitamin C supplements may be expensive. They may prove to be useless. Can they also be harmful? Very little is known about the adverse reactions which could occur with the use of massive doses of vitamin C. However, some studies have indicated that excessive doses of vitamin C may be potentially dangerous.

Excess doses of vitamin C have been shown to cause nausea and diarrhea in some persons. Large doses of the vitamin markedly enhance the absorption of iron. This effect may not be desirable in non-anemic persons. Minerals are mobilized out of bone in the presence of excess vitamin C. The long term consequences of this effect are not known. Overdoses of vitamin C may result in a conditioned deficiency or a relative lack of response to normal doses. This means that if a person becomes accustomed to consuming large doses of vitamin C ($>$ 250 mg per day), he may suffer a temporary case of scurvy when he stops taking these high doses. This "rebound scurvy" may not be a serious problem in the adult. However, there is a danger that pregnant women taking megadoses of vitamin C may give birth to infants suffering from rebound scurvy. There is some evidence that high doses of vitamin C (500 mg per day) destroy substantial amounts of vitamin B_{12} (50-90 percent) in food. A 1972 study provided evidence that high doses of vitamin C interfere with the proper measurement of glucose in the urine of diabetics. Large amounts of the vitamin excreted in the urine produce a false response for sugar in certain urine tests. The diabetic person can be misled by false results into not taking the insulin he may need, or into taking too large a dose. The development of kidney stones has been observed in certain individuals who cannot adequately dispose of megadoses of vitamin C.

According to present evidence, the body uses only the amount of vitamin C that it needs and eliminates the rest through the kidneys. Once the body tissues are saturated with vitamin C, additional intake should be excreted in the urine. Only if the body tissues are depleted will a high intake of vitamin C be absorbed and retained. Therefore, is it useful to take excess doses? Vitamin C in the amount of 45 mg per day is sufficient to maintain the body pool at or near maximum. Much smaller amounts (10 mg per day) will prevent scurvy. These amounts can be obtained from the many sources of vitamin C in the diet. At the present time, then, there is no conclusive evidence that vitamin C has a protective effect against the common cold in healthy individuals not depleted of vitamin C. Until further evidence is available, the safest course of action is to make certain that the daily diet provides vitamin C in the amounts recommended by the National Research Council as sufficient to prevent disease and maintain health.