

FROM LAB TO LUNCH

SQUASH CHRONIC DISEASE WITH VITAMIN A

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Along with being a popular holiday food, making appearances everywhere from Halloween doorsteps to Thanksgiving feasts, squashes are a great source of vitamin A.

But don't run out and chug down a bottle of vitamin A tablets. Vitamin A toxicities can be just as hazardous as deficiencies.

VITAMIN A: A REAL TURN-ON FOR OUR GENES

For complex organisms to develop and survive, cells must differentiate by changing their structure and function. Vitamin A plays a central role in this process by triggering genetic expression and the production of essential proteins in the body. Without this essential nutrient, many important organs – such as our eyes, skin, and digestive tracts – would deteriorate.

When we don't get enough vitamin A, cell differentiation is stunted, and the body produces a hard protein called keratin. Keratin proteins gradually replace mucus-secreting cells in the outer layer of our skin and gastrointestinal tracts, and the tissues eventually dry out, harden, and crack as they accumulate keratin (a nasty process called keratinization).

Similarly, a lack of vitamin A can cause cloudiness in our eyes (xerosis), followed by a hardening and thickening (xerophthalmia) of the corneal tissues. Left untreated, this condition can lead to blindness. The same dreary fate will befall us if we don't produce rhodopsin, a pigment dependent on vitamin A. We need rhodopsin for night vision and the perception of light. It truly might be "lights out" without enough of rhodopsin.

We also need vitamin A for our immune system – for both differentiation of the immune cells as well as for maintaining the protective integrity of outer tissues. The immune system can be enhanced through antioxidants (which some forms of vitamin A possess). These antioxidant properties protect tissue cells against oxidative damage, delay aging, and ward off the onset of certain diseases, such as cancer.

But don't run out and chug down a bottle of vitamin A tablets. Vitamin A toxicities can be just as hazardous as deficiencies. Vitamin A can be carcinogenic at high levels, meaning it can cause or accelerate the process of cancer growth or act as a teratogen and cause birth defects. Excess vitamin A has also been suggested to cause decrease bone mineral density, potentially accelerating osteoporosis.

RETINOIDS AND CAROTENOIDS: ALL FORMS ARE NOT CREATED EQUAL

"Vitamin A" sounds so simple, doesn't it? It's a deceptively basic name for such a diverse substance. The nutrient is plentiful in nature, and can be obtained from foods of both animal and plant origin.

However, there is a catch: not all types of the various compounds

generally known as "vitamin A" can be converted to active forms in the body. This is where retinoids come in, the chemical compounds derived from vitamin A. There are about a dozen retinoids, but you should only be concerned with three of them – retinol, retinal, and retinoic acid. Retinoic acid, for example, influences stem cells and the development of healthy embryos. Make sure you're getting enough retinoic acid if you're thinking about having a child.

Readily bioavailable retinoids are found in foods of animal origin, such as dairy products. Milk and butter are usually fortified with vitamin A (and vitamin D) since grassfed dairy will get vitamin A and D from the pasture feed that cows consume. Retinoids can also be found in egg yolks (it's what makes them yellow). Beef liver is a particularly rich source, as excess vitamin A is stored there. Stay away from exotic animals, however: Some polar explorers have met an untimely end via retinoid-saturated liver meat.

Unlike animal products, plant sources of vitamin A provide inactive precursors called carotenoids. These may or may not be converted to active vitamin A in the body. All carotenoids have health benefits, but only four have vitamin A activity: alpha-carot-

tene, beta-carotene, gamma-carotene, and beta-cryptoxanthin. Pumpkins and squash are plentiful in beta-carotene.

Foods high in beta-carotene generally appear orange-yellow; however, plants that contain a large amount of chlorophyll will appear green since chlorophyll masks beta-carotene pigment. Along with squash, several items in the produce section of your local grocery store are high in beta-carotene. In fact, Popeye's famous campaign for spinach was launched in an effort to promote vitamin A consumption, not iron (as is popularly believed). So it's actually all that vitamin A power that provides the necessary "oomph" to fight the bad guys!

VITAMIN A AND CHRONIC DISEASE

Beta-carotene has taken the spotlight as an antioxidant that can bind to compounds and prevent them from reacting with oxygen – a process known as oxidation. Oxidation can cause cellular damage, accelerate the aging process, and lead to diseases such as cardiovascular disease or cancer. When an antioxidant prevents oxidation, it is destroyed in the process. As a result, the beta-carotene is no longer available as a precursor for nutrient requirements.

While it seems that a higher intake of beta-carotene from vegetables (such as squash) helps lower our rate of cellular oxidation, we don't know whether beta-carotene supplementation can prevent or treat diseases related to oxidation.

For example, in the AT-BC (alpha-tocopherol, beta-carotene) cancer study, researchers investigated whether a supplement of either beta-carotene or alpha-tocopherol (vitamin E) would reduce the incidence of lung cancer in smokers who

were already meeting their vitamin A intake requirements. Surprisingly, lung cancer incidence went up in the beta-carotene supplement group. The beta-carotene and retinol efficacy trial (CARET) found similar results.

These findings suggest that the concentrated levels of beta-carotene commonly found in dietary supplements may act as a pro-oxidant, rather than an antioxidant. In other words, it may increase, rather than prevent, cel-

Foods that get an "A"

For a blast of beta-carotene, try:

Apricots	Dandelion greens
Beets	Kale
Bok choy	Green leaf & Romaine lettuce
Canned tomatoes	Mustard greens
Cantaloupe	Spinach
Collard greens	Turnip greens

lular damage in people whose vitamin A levels are already adequate. On the other hand, epidemiological studies have reported lower incidence of cancer in groups consuming the greatest quantities and varieties of fruit and vegetables high in micro-nutrients and antioxidants such as beta-carotene. Other studies have found that intake of beta-carotene, along with other antioxidants (vitamins C and E), seems to reduce the development of visual impairments, such as cataracts and macular degeneration, in populations who are vitamin A-deficient.

Therefore, beta-carotene may best prevent chronic disease in its natural form, obtained from fresh

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fruits and vegetables such as squash. In these sources, it can interact and perform with other nutrients, just as nature intended.

“SQUASHING” A GLOBAL PUBLIC HEALTH PROBLEM

While vitamin A deficiency may be rare in industrialized nations, such as Canada and the United States, it is a serious health problem in developing countries, where inaccessibility to food with adequate nutrients, or malabsorption from disease, is common. Many of these countries rely on fruits and vegetables that contain vitamin A precursors (sweet potato, pumpkin, winter squash, spinach, apricots), rather than preformed vitamin A (calf liver, milk, egg yolks).

Children are particularly vulnerable to vitamin A deficiencies because they need more vitamin A during stages of growth and to fight childhood infections. Globally, the greatest prevalence of vitamin A deficiency occurs in sub-Saharan Africa and Southeast Asia, where up to 40% of preschool-aged children are vitamin A deficient.

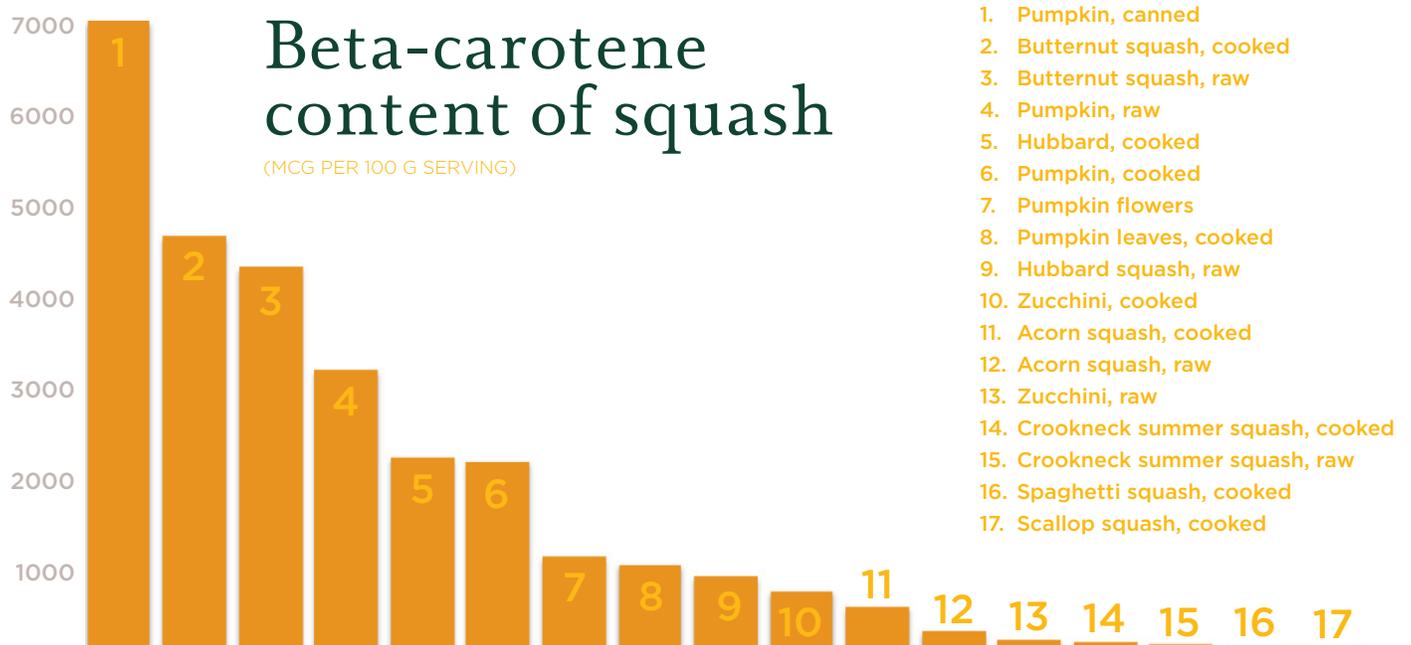
Public health programs to prevent and treat vitamin A deficiency include supplementation, food fortification, and promoting dietary diversity with an emphasis on consuming animal sources of vitamin A, which are more easily absorbed by the body. To date, supplementation is the primary way to combat vitamin A deficiency. Countries that receive supplementation see great improvement: 80% of vitamin A-deficient children between 6 months

and 5 years old are getting closer to meeting international dietary goals.

IS GMO THE WAY TO GO?

Many biotechnicians suggest that we shouldn't stop at supplementation. They look to genetic engineering of foods, rather than supplementation or fortification, to control costs and provide vulnerable populations the nutrients they need. For instance, “golden rice” has been genetically engineered to contain beta-carotene in an effort to alleviate the global public health burden of vitamin A deficiency in developing countries.

While genetic engineering may provide additional nutrients, this approach may not address the underlying causes of nutrient deficiencies. For instance, many cases of malabsorption



are due to disease. Other cases of mal-absorption occur because daily diets in low-income regions are low in protein, zinc, and fat – nutrients we need to absorb vitamin A properly. In these cases, although vegetable staples such as squash (which is common across Africa, South America, and parts of Asia) are high in vitamin A precursors, the carotenoids cannot be properly converted into usable forms.

HOW TO GET ALL AS

Here's how to plan your next vitamin A-packed meal. First, some technical details: The recommended dietary allowance (RDA) for vitamin A is 700µg/d or 2333 international units (IU) for adult women and 900µg/d or 3000 IU for adult men. The RDA for vitamin A is measured in retinol activity equivalents, since retinol and carotenoids do not have the same bio-availability. 1fhg retinol equals 12fhg beta-carotene or 24µg of other vitamin A precursor carotenoids.

For maximum beta-carotene content, choose squashes that are highest in carotenoids (see chart) and be sure to cook them. Cooking increases the bioavailability of beta-carotene. Uncooked summer squash, for instance, only contains 136µg beta-carotene per cup. In contrast, all varieties of cooked summer squash contain 229µg per cup and all varieties of cooked winter squash have the highest content at 5,726µg.

While vitamin A is stable when heated, it may be affected by light or oxygen. Modern-day milk cartons are usually opaque in an effort to preserve vitamins A & D. Be sure to eat your squash soon after it's cooked!

Keep in mind that too much of anything can cause problems for your body. Hypercarotenemia can occur from consumption of exces-

sive carotenoids, usually from carrots. Carotenoids provide the bright pink pigment of flamingos, and while you won't turn pink, you may turn orange. Keep your vitamin A sources varied to avoid looking like an Oompa-Loompa.

Now that you're armed with plenty of information about vitamin A, you'll probably see it everywhere in the aisles of your local grocery store, especially if you're stocking up on seasonal squash. Fall and winter are the perfect times to supplement your favourite dishes with something new, adding all those convenient, natural, and tasty sources of vitamin A to your culinary repertoire.

Keep your vitamin A sources varied to avoid looking like an Oompa-Loompa.

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