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PRODUCE NUTRIENTS' STABILITY: Shelf-life, Preservation, and Preparation

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Bottom Line at the Top: Food nutrient retention is dependent on the specific food, nutrient of interest, packaging, storage conditions, food preparation method, temperature and time. All these conditions are good reasons to not assume that the food that enters your body has the exact nutrient content described on the label or in food nutrient lists and books. To maximize nutrient content as much as possible, consume fresh food prepared with the least heat necessary.

Food storage:

Vitamin C, with its unstable chemical structure, is to my understanding the nutrient most negatively impacted by food storage and preparation, as it is easily oxidized in air and under heat, and is dispersed into liquid. Depending on temperature, prolonged exposed to air in a supermarket may oxidize a considerable portion of the vitamin C of vegetables. At home, storage in a sealed container in the refrigerator slows vitamin C loss.

Folate is necessary for brain, nerve and blood cell health. Good food sources are green, leafy vegetables and whole grains. It, too, is degraded easily during canning, freezing and home cooking.

In General, The healthiest vegetables are those consumed shortly after harvesting. Even as water soluble nutrients may disperse in liquid during cooking, beneficial polyphenol bioflavonoids remain intact. The assumption that fresh vegetables are healthiest was upended when the DOGE bros eliminated many of the food safety inspector jobs, enabling cyclospora, an organism that causes explosive diarrhea and death, to enter the food chain, killing more than eleven hundred people.

Most left-over food remains safe in the refrigerator for about three or four days, assuming it was well-cooked to eliminate bacterial contamination beforehand. The FDA Food Code suggests freezing or storing perishable foods for a maximum of seven days at 40 degrees or lower. Cool temperature slows but does not completely prevent growth of mold (the spores of which may have been impervious to cooking heat). Wash fresh produce under running water before eating and discard produce that is visibly moldy or spoiled.

Preservation: Frozen food maintained at a stable low temperature retains its nutrition for up to twelve months. Canning preserves most nutrients, including fiber and minerals, but high heat processing may destroy a variable amount of the vitamin C and folate. Pickled vegetables retain their fiber, antioxidants, and sugars, but water-soluble C and B vitamins often filter out into the juice. Pickled eggs and meat retain their protein, albeit denatured (a different biochemical shape), which doesn't impair intestinal absorption of its amino acids during digestion, and the acetic acid (vinegar) of pickling might enhance digestibility. A pickling

process that includes fermentation that retains some of the fermenting organisms, such as kefir, kimchi and unheated sauerkraut, may improve gut health. Salt brine, used for millennia to preserve foods, slows bacterial growth. I enthusiastically recommend Mark Kurlansky's book, SALT: A History of the World. (All you ever wanted to know about the history of only rock we eat, except for its chemistry and impact on human physiology.)

The fat-soluble vitamins (dissolving in oil rather than water), A, plant carotenoids, D, E and K, have a different, more stable, story. They don't disperse into water, as water-soluble vitamins do, though heat, light and oxygen may accelerate their degradation. Canning and preserving food with high heat may destroy a considerable portion of vitamin A content. Vitamin D_3 is relatively stable under some cooking methods, but losses can occur, depending on the food and cooking method.

Water used to cook vegetables often contains nutrients dissolved in it. Borscht (beet broth) contains varying amounts of vitamin C, depending on other vegetables in the recipe.

Food Preparation: In general, cooking with heat breaks down foods' fibrous structures, altering (increasing or decreasing) nutrients' availability for absorption. Boiling food often depletes water-soluble vitamins and minerals as they are released into water. Dry-heat roasting, steaming or microwaving foods preserve nutritional content better than most other food preparation methods.

Most amino acids of meat are stable during cooking at moderate temperatures, however high temperatures may oxidize lysine and methionine, both important amino acids for normal human organ function. Charring meats with high heat creates heterocyclic amines and polycyclic aromatic hydrocarbons associated with mutations which may lead to cancers of the breast, prostate or pancreas. Marinating, cooking and serving meat with Asiatic herbs and sauces rich in natural polyphenols and antioxidants reduce formation of the above-named compounds in grilled meat. (Puangsombant K, et al, 2011; J. Food Science). Similarly, Asian sauces like soy sauce inhibit vegetables' and their nutrients' oxidation. Submerging them in brine protects them somewhat from oxidation by creating an anaerobic environment.