



January/February 2012: Safe, Reliable Sources of Vitamin D...in Winter and Throughout the Year

"If I had to give you a single secret ingredient that could apply to the prevention—treatment, in many cases—of heart disease, common cancers, stroke, infectious diseases from influenza to tuberculosis, type 1 and 2 diabetes, dementia, depression, insomnia, muscle weakness, joint pain, fibromyalgia, osteoarthritis, rheumatoid arthritis, osteoporosis, psoriasis, multiple sclerosis, and hypertension, it would be... vitamin D." ...Michael F. Holick, Ph.D, M.D.

"Vitamin D may be one of the most fundamentally important building blocks available to us for creating and sustaining vibrant health...Yet vitamin D is also considered to be 'the most toxic of all vitamins.'" ...Chris Masterjohn, April, 2011, Weston A. Price Foundation

Vitamin D is essential for good health, not only for the bones and teeth, but also for metabolism, genetic expression, and to support the body's other non-skeletal systems—cardiovascular, respiratory, digestive, nervous, muscular, immune, reproductive and endocrine. Given this breadth, vitamin D is linked to the prevention of a host of chronic diseases including cancer, diabetes and obesity, heart disease, autoimmune disorders, and, of course, rickets and osteoporosis. Science now appreciates that the cells of the body are equipped with vitamin D receptors. This helps to explain the far-reaching roles of vitamin D in maintaining good health. Yet, according to Michael F. Holick, Ph.D., M.D., who has spent his life researching vitamin D, it is "the most common nutritional deficiency in the world."¹

Rather than a vitamin, science presently recognizes vitamin D as a hormone that works synergistically with other hormones within a complex matrix of body chemistry to affect metabolic and cellular function, as well as genetic expression. To be effective, vitamin D must act in tandem with vitamin A, as well as vitamin K. Vitamin D depletes vitamin A, so even modest amounts of vitamin D without sufficient A can lead to vitamin D toxicity.² Likewise, vitamin A can become toxic without adequate levels of vitamin D.³

For good health, therefore, while we need to be aware of safe, reliable sources of vitamin D, we must also consider vitamin D within the context of our intake of the right kinds of vitamin A and K. Science is just beginning to unravel the vitamin D story. It appears that there may be many more forms of vitamin

¹ Michael Holick, Ph.D., M.D., *The Vitamin D Solution*, xviii.

² F. Thoenes, qtd. in Chris Masterjohn, "From Seafood to Sunshine," 12, April 08, 2011.

³ Sally Fallon, "No Proof that Vitamin A is Toxic," Weston A. Price Foundation, June 15, 2010.

D than just D2 and D3. Vitamin D research promises to be one of the more exciting health fields of the future.

Sources of Vitamin D

How we obtain vitamin D—through sunshine, supplements, or food—is a personal decision. Sunshine and supplements have advantages, but, as you might guess, they also come with their own limitations and risks. Food presents limits, too, since few foods are rich in vitamin D. How we obtain vitamin D is a choice that depends upon health and life style, diet and personal tastes, geographic location, skin type, and age.

Sunshine

Throughout time, plants, animals, and people have been drawn to the sun. Plants bend to catch its rays. Animals, especially those that are vitamin D deficient, know to bask in its light. We are no different—after a bone-chilling winter, nothing feels better than to spread a blanket and stretch out in the sun. Given that our cells and hence our tissues, and arteries are equipped with receptors for vitamin D, it is not surprising that we are naturally and intuitively drawn to the sun's warmth and healing powers.

Thanks to the benevolence and good planning of Mother Nature, it is possible for us to get in warmer seasons enough vitamin D from sunshine to last all winter. We do this by taking in UVB radiation through the skin, transforming it via the liver to calcidiol, known as 25(OH)D, the water-soluble, storage form of vitamin D that can be deposited in our fat cells for future use.⁴ For enough UVB radiation to store sufficient vitamin D to sustain us through the year, we generally need 15-30 minutes of unprotected exposure several times a week between the hours of 10 a.m. and 3 p.m., April through October. Exposure should be over much of the body since a specific surface of skin produces only a finite amount of vitamin D, no matter the length of time in the sun.

Obtaining vitamin D from the sun has several advantages. It is free. It can, by encouraging the body to produce endorphins,⁵ lift our spirits and provide a sense of well-being. Sunshine helps regulate our circadian rhythms to help us sleep. It is a natural source of vitamin D that many experts believe cannot, even with prolonged exposure to the sun, lead to vitamin D toxicity.^{6 7} And, as noted, if enough sun is taken in during the summer months, it can be stored by the body in sufficient quantity to last all winter.

⁴ The skin takes in UVB rays and transforms previtamin D3 via the liver to calcidiol, the storage form of vitamin D which can enter the blood stream to be converted by the kidneys into active vitamin D. This is the form of vitamin D to test, although many experts question the value of vitamin D testing.

⁵ Holick, 219.

⁶ Nature provides two safeguards related to sunshine and vitamin D toxicity. Any skin surface produces a limited amount of vitamin D before it begins to degrade at the same rate that it is synthesized. And, sun exposure leads to the buildup of melanin, which slows the synthesis of vitamin D. Hollis Adams, "Vitamin D: Synthesis, Metabolism and Clinical Measurement," qtd. in Chris Masterjohn, "From Seafood to Sunshine," WAPF, 2011.

Scientists specializing in vitamin D research now believe that “sunshine vitamin D” provides many photonutrients that extend beyond our current understanding of vitamin D. Sunshine is the most natural source of what we might think of as “full spectrum” vitamin D. Scientists have discovered that the body, taking in UVB radiation through the skin, makes not only vitamin D as we know it but also other vitamin D metabolites with potential health benefits not yet understood. Ancient cultures perhaps knew to use the sun for healing. One of the sun pioneers in more contemporary times was Arnold Rikli (1823-1906), known as the “sun doctor” and regarded as the founder of heliotherapy. Rikli used natural sunlight in many drugless institutions in Europe to cure tuberculosis, bone and skin diseases, and to accelerate wound healing.⁸

Another aspect of sunshine and health relates to UVB radiation’s positive effect on body chemistry by entering the iris of the eye. John Ott, best known in the 1950s-60s for his work in the early days of time-lapse photography of plant life, was a pioneer in this field. Ott discovered that sunshine entering the unprotected iris of the eye affects the pineal and pituitary glands to aid in the proper chemistry and hormone balance of the body. As an arthritis sufferer, he discovered this by accident. Ott had long observed the positive benefits that sunshine held for plants and animals, and he extrapolated this to his own improved health when he broke his glasses and began to notice a great improvement in his arthritis condition (glass screens out 99% of the sun’s UVB radiation, but none of the UVA radiation that causes wrinkles). He was one of the first to link sunlight and the retinal-hypothalamic-endocrine system and its role in the body’s chemistry and hormonal balance.⁹ [This same principle is used with laying hens to boost egg production in the shorter days of fall and winter, since artificial light entering the eye stimulates a hen’s pituitary gland for an increased yield.]

While we do not understand all the benefits of ultra violet exposure, the fact that Nature provided melatonin in our skin and yet few vitamin D-rich foods suggests that we are supposed to get at least some vitamin D through sunshine. Given the broad spectrum of ultra violet wave lengths, we might think of sunshine much like we do a whole food, with factors that work synergistically and in ways that cannot be fully appreciated with a microscope.

Of course, sunshine is not a trouble-free source of vitamin D. While sunshine may help prevent specific types of cancers such as breast, prostate, and colon, among its well-publicized drawbacks are the risks of cataracts and non-melanoma skin cancer, as well as wrinkles, the cosmetic price of UVA exposure.¹⁰

⁷ It is true that safeguards built into the skin, including melatonin, provide protection against vitamin D toxicity, but this must also be viewed within the context of a nutrient-rich diet with sufficient vitamin A and K2 (see discussion, that follows).

⁸ Kirshfeld and Boyle, *Nature Doctors*.

⁹ John Ott, *Health and Light* and *Light, Radiation, and You*.

¹⁰ Early sunscreens blocked UVB radiation that causes sunburn, but not UVA rays that affect the deeper layers of skin to cause wrinkles. These sunscreens lent a false sense of comfort—no sunburn did not mean that the skin was safe. Today, most sunscreens are “full-spectrum” to also protect against UVA radiation.

Another problem is that some people cannot convert enough sunshine to vitamin D to meet their needs. Included are:

- *People living in the mid- and high-latitudes (above 35 degrees latitude, which comprises the northern two-thirds of the United States), where in winter the need for cold weather clothing and the low arc of the winter sun prevent acquiring sufficient sun-based vitamin D;*
- *Darker-skinned people, because they have more melanin in the outer layers skin which curtails their ability to make vitamin D from sunlight;¹¹*
- *Babies who are breast-fed because breast milk lacks vitamin D;*
- *Older adults because with time the skin is less able to efficiently synthesize vitamin D;*
- *People who are obese because fat cells retain vitamin D and resist releasing it into the blood stream when needed;*
- *Individuals with celiac or other conditions that make it difficult to digest fats;*
- *People who live and work indoors through the midday hours; and*
- *All who generously apply sunscreens or try to avoid the sun-related risks listed above.*

Well, that is just about all of us! With such a long list, it is not hard to see why Michael Holick, a pioneer in vitamin D research, believes Vitamin D to be the most pervasive nutritional deficiency in the world. While figures concerning vitamin D deficiency vary, at perhaps the upper end, a 2009 Harvard study suggests that 70% of Caucasians, 90% of Hispanics, and 97% of African-Americans have deficient blood levels of vitamin D.¹² [These statistics may cast doubt on the accuracy of vitamin D testing.]

Allow me to stop for a moment to make a side comment about the sun. Leaving out concerns about the ozone layer, I believe that a large part of the present-day problem with sun exposure is rooted in our indoor lifestyle and our modern nutrient-deficient diet, particularly with respect to vitamin A and K2. Traditional cultures consumed ten times the vitamin A¹³ (and I suspect a similar or even greater multiple of vitamin K2) that we do. These two vitamins are important because they are vital working partners with vitamin D and, as such, important antidotes to relatively excessive levels of vitamin D. In addition, until the industrial revolution that brought city life and with it rickets as a major health problem, people spent time outside without sunscreens and could adjust to the sun, gradually building up melatonin.

¹¹ Fortunately, African Americans appear to have greater genetic protection from osteoporosis and broken bones than those who are more fair-skinned.

¹² AA Ginde, MC Liu, and CA Camargo, Jr, "Demographic differences and trends of vitamin D insufficiency in the US population, 1988-2004." *Archives of Internal Medicine* 2009 Mar 23; 169 (6): 626-32.

¹³ Sally Fallon and Mary G. Enig, Ph.D., "Vitamin A Saga." Weston A. Price Foundation.

Regarding diet, modern processed foods lack antioxidants to diffuse free-radical damage. They also lack the vital *animal based*, fat-soluble forms of vitamins A (retinol) and K that are essential partners to work alongside vitamin D in the body. *Preformed* vitamin A is different from plant-based *provitamin A*—beta-carotene and the carotenoid group—little of which may be converted in the body to vitamin A. And, vitamin K2 is different from plant-based vitamin K1 of which is associated with blood clotting.

Foods that supply vitamin A and K2 include liver and other organ meats, fish eggs, and eggs and butter/animal fats from grass-fed animals. Vitamin K2 is also found in lacto-fermented vegetables (the kind made without vinegar and that need refrigeration) like sauerkraut, pickles, and fermented fruits (see July/August 2009 newsletter). None of these foods, which were staples in the diet of traditional cultures, would be high on our list of favorites today. If we get a lot of sun, we need to consume some of these foods. Given our modern lifestyle and contemporary diet, it is only logical that stretching out on a sandy beach for a week or two of summer sun can invite trouble.

Finally, while sunshine may provide a potential array of photonutrients to support health (many in ways that we do not understand), by the same token, the erosion of the ozone layer poses new risks. We can only assume that sunshine may bestow untold benefits *and* untold risks not faced by prior generations.

Vitamin D Supplements

Because vitamin D is naturally present in few foods, vitamin D supplements are often recommended by doctors for people who want to avoid sun exposure and/or who may not be able to convert sunshine into a sufficient quantity of active vitamin D. For most of us who are indoors spending long hours at a desk, vitamin D supplements may seem to be the answer. They are convenient, reasonably priced, and easy to take. In addition, unlike sunshine, their potency does not decline as we age—a fact that is also true of foods rich in vitamin D. On the negative side, the quality of supplements, in terms of their ingredients and processing, may vary and the dosage stated on labels may not be reliable. In addition, vitamin D from supplements is quickly dissipated in the body (its half-life is just two-three weeks) compared to the long-lasting effects of vitamin D from sunshine. And, supplements do not impart the sun's "feel-good-feeling," nor do they help to regulate circadian rhythms.¹⁴

Above all, the greatest strike against supplements is that they are the most likely of the three vitamin D options...sunshine, supplements and food...to cause vitamin D toxicity. It is easy to overdose when taking supplements because of the toxicity risk inherent in even modest doses of vitamin D when the other essential fat-soluble partners of vitamin D, vitamins A, possibly E (vitamin E's role with D is not yet understood), and K2, are lacking in the diet. In addition, synthetic supplements, either vitamin D or A, are far more likely to build to toxic levels than these vitamins in their natural forms.¹⁵

¹⁴ Holick, 147,219.

¹⁵ Sally Fallon and Mary Enig, "Vitamin A Saga," 8.

Vitamin D in Foods

Foods that naturally contain vitamin D are not common to the American diet. Yet, the few good sources (mostly fatty fish, such as salmon) do present certain advantages—they can be assimilated equally by young and old; they incorporate other nutritional cofactors; and, (unless rich sources like cod liver oil or lard are used with abandon) their low levels of vitamin D pose little risk of vitamin D toxicity. Some foods, such as cow's milk, nut and seed milks, yogurt, orange juice, and boxed cereals are now fortified with vitamin D. Milk was first fortified in response to a major outbreak of rickets in the 1930s, a result of city living. It is important to read food labels since not all milk, yogurt, juice, and cereal are fortified with vitamin D.

Vitamin D3 and D2. Vitamin D3 is synthesized by our skin, as well as the skin and oils of the fur of animals. As a second stage, the liver converts it to 25(OH)D, or calcidiol, the more water-soluble storage form that can be deposited in fat cells and carried in the blood to be bound to the vitamin D binding protein DBP. This is activated as 1,25(OH)₂D, or calcitriol, when needed. How vitamin D is stored and carried in the body is instructive because it suggests what kinds of foods are rich in vitamin D, as shown in Table 1, page 7.

How vitamin D3 is synthesized is also important to appreciate a difference between some forms of D3 and D2. Vitamin D2 used to fortify foods is produced commercially by irradiating yeast. The fact that both D2 and D3 resolve rickets has led some to believe that they are equivalent, but there appear to be subtle differences. Unlike D3, vitamin D2 does not bind well to DBP and therefore only fractionally raises calcidiol levels.¹⁶ [As mentioned, there may be other forms of vitamin D yet to be discovered.]

As an introductory comment to Table 1, I used two measures of daily vitamin D requirements—400 IUs, the official government guideline; and 1000 IUs, which is still a conservative level and perhaps a better intake for optimal health. I included pork blood in italics, not as a food source for us in modern times, but to illustrate the high vitamin D content of blood. Blood is consumed as source of vitamin D by the Masai of Africa and also by animals that eat insects or animals of prey.

Lard. Lard deserves a special comment. My parents each grew up on rural Midwest farms in the 1930s and 1940s where lard from free-range pigs was used as a staple in daily cooking and baking. Surviving as they did to the cholesterol/fat-phobic decades of more recent times, my mother and father often bemoaned the large amounts of lard that they ingested as children. My parents (with no access to cod liver oil's vitamins D and A), stayed active well into their 90s, and I wonder if lard was, in fact, their true saving grace. Lard provided a rich source of vitamin D and, because vitamin D works to prevent obesity and diabetes, lard may have helped them stay warm, trim and happy in their active outdoor life. And, sources of vitamin A to complement this D were just beyond their doorstep in the eggs from their barnyard chickens and butter from their grass-fed cows—a homemade formula for their vibrant health.

¹⁶ Masterjohn, "Seafood to Sunshine," 9, 10.

Fatty Fish. The more appetizing source of vitamin D3 for many people is oily fish like salmon, mackerel, herring, and sardines. How do fish, living underwater and away from the sun make vitamin D? Not so much from sun exposure to their oily skin since they spend most of their life deep underwater. Instead, most of the vitamin D3 in fatty fish is a by-product of the plankton that they eat. Plankton contains

Table 1: Selected Food Sources of Vitamin D Relative to Daily Values¹⁷

Food	IUs	% DV	
		400 IUs	1000 IUs
High-Vitamin Cod Liver Oil, 1 t.	1150	287	115
<i>Summer Pork Blood</i> , ¼ cup	1,000	250	100
Regular Cod Liver Oil, 2 t.	907	227	91
Lard, Free-Range Pigs, 1 t.	500	125	50
Wild Sockeye Salmon, 3 oz.	447	112	45
Mackerel, 3 oz.	388	97	39
Tuna, canned, water, 3 oz.	154	39	15
Orange Juice, Fortified, 1 cup	~137	34	14
Shiitake Mushrooms, Sundried, ½ oz. dried, 1 cup reconstituted	130	33	13
Milk, Vitamin-D Fortified, 1 cup	120	30	12
Beef Liver, cooked, 3.5 oz.	49	12	5
Sardines, 2, Drained	46	12	5
Egg, with Yolk	41	10	4
Fortified Cereal, 1 cup	~40	10	4

Source: USDA; Weston A. Price Foundation.org; Green Pasture.org; Pathways4Health.org

¹⁷ Recommended DV ranges from 400 IUs, the official government figure too as high as 4,000 IUs/day.

vitamin D precursors that fish are able to synthesize. Many oily fish, if eaten with the skin and bones, provide a healthy array of oils, including EPA and DHA, as well as calcium.

Mushrooms. The skin of mushrooms acts much like our own, taking in UVB radiation to synthesize vitamin D. Mushrooms are the only plant-based food with natural vitamin D. Several companies market sun-dried mushrooms with significantly higher vitamin D content than fresh mushrooms. More recently, Monterey Mushrooms of California developed with the USDA fresh mushrooms sold under the Sun Bella label that are grown with ultra violet light. The company advertizes that just 3 ounces, or about four or five mushrooms, provide 100 percent of the daily requirement (based on 400 IUs).

Fermented Cod Liver Oil—You need very little; it is easy to store; and it needs no cooking.

“There is hardly a disease in the books that does not respond well to cod liver oil, and not just infectious diseases but also chronic modern diseases like heart disease and cancer.”¹⁸

This is my favorite source of vitamin D because, unlike the foods listed above, it is naturally balanced with vitamin D’s vital partner, preformed vitamin A. Cod liver oil also contains health-supporting quinines, EPA (for inflammatory response) and DHA (for brain and neurological function), and omega-3,-6,-7, and -9 oils. A teaspoon or two over breakfast along with X-Factor butter oil (which provides vitamin K2) works well for me. Also, for people with an aversion to its taste, fermented cod liver oil comes both in flavors and capsule form and can be taken with orange juice to blunt any aftertaste.

Fermented cod liver oil that is made in accordance with tradition often contains ten times the vitamin A relative to vitamin D, but the amount of A to D is inconsistent; these amounts vary according to the diet of the specific catch and the season (summer cod livers have more oil than those taken in winter and are less potent—the less oil in a liver, the more potent the oil).

Fermented cod liver oil should not be confused with commercial brands that are cleaned and deodorized using alkali refining, bleaching, and deodorization. Because people often buy cod liver as a source of EPA and DHA, some deodorized brands do not bother to add back lost vitamins, and hence have low levels of vitamin A and no vitamin D. Such a product can lead to vitamin A toxicity if over-consumed. Other brands—the majority of cod liver oils sold—are cleaned and deodorized, and synthetic vitamins A and D are added back after processing. When labels contain exact levels of vitamins A and D, it is a sign that they fit this latter category. Read labels carefully. Traditional cod liver oils, such as Green Pastures; Radiant Life; and Dr. Ron’s UltraPure, may not list vitamin A and D levels. This can be a good sign, indicating that it is a natural product created without commercial processing and the addition of synthetic, measureable forms of vitamins A and D.

¹⁸ Krispin Sullivan, “Cod Liver Oil: Number One Super Food.” Weston A Price Foundation.org.

While dosage recommendations can vary, a dose of high-vitamin fermented cod liver oil is generally half that of regular cod liver oil. Guidelines provided by Sally Fallon and Mary Enig of the Weston A. Price Foundation are as follows:

- Children aged 3 months to 12 years: ½ teaspoon, providing approximately 4,650 IU vitamin A and 975 IU vitamin D;
- Children over 12 years and adults: 1 teaspoon or 10 capsules, providing 9,500 IU vitamin A and 1,950 IU vitamin D;
- Pregnant and nursing women: 2 teaspoons or 20 capsules, providing 19,000 IU of vitamin A and 3,900 IU vitamin D.¹⁹

All cod liver oils in the United States are tested for contaminants like mercury, cadmium, lead, and PCBs by the Association of Analytical Communities. Mercury, which is water soluble, is not a concern. It may be present in the flesh of fish but it is not contained in fish oils.²⁰

Why don't we hear more about cod liver oil? Per capita cod liver oil consumption is less than one-twentieth that of our parents' or grandparents' generation.²¹ Cod liver oil has gone out of style, perhaps because we can now purchase vitamin D supplements, and perhaps, too, because we eat food more for pleasure than for health—with broad-based medical coverage, it is easy to leave the rest to doctors and drugs. Another very important reason that cod liver oil has fallen from favor is that it has no large constituency of support. Unlike synthetic drugs that can be patented and sold for multiples of their production costs, cod liver oil is a food, with little profit-generating power.

While naturally-produced cod liver oil has no broad constituency, its cause has been taken up by the Weston A. Price Foundation (WAPF), a not-for-profit organization, to further the pioneering work of Weston Price. In addition, cod liver oil has devoted people like David Wetzel who, through his non-profit company Green Pastures.org, produces traditional fermented cod liver oil and X-Factor butter oils. These are nutrient-dense products for optimal health that provide the important vitamins D, A, and Activator-X (vitamin K2) dietary factors discovered by Dr. Weston A. Price in his surveys of healthy, robust traditional cultures around the globe during the 1920s and 1930s (see *Nutrition and Physical Degeneration*). It is hard to think of anything that delivers so much for so little.

Important Summary Points About Vitamin D and Its Partners, Vitamin A and K2.

- *Vitamins A and D combine to affect gene expression, which carries important implications for cancer and a host of other chronic diseases.* In the words of Chris Masterjohn, "Vitamins A and

¹⁹ Sally Fallon and Mary Enig, "Cod Liver Oil Basics and Recommendations." WAPF.

²⁰ Krispin Sullivan, "Cod Liver Oil: Number One Super Food." WAPF.

²¹ The United States imported five million gallons of cod liver oil in 1927, but less than half a million gallons in 2000, a figure that must then be adjusted for population growth.

D are both precursors to nuclear hormone, which are molecules that bind to receptors, travel into the nucleus, bind to DNA or specific target genes, and control the expression of those genes...turning them on and off, up and down.”

- *Vitamins A and K2 are needed to offset vitamin D to protect against bone demineralization and soft tissue calcification.* Kidney stones, calcified joints and arteries, cardiovascular disease...all are tied to deficiencies of vitamin A and K2.
- *Vitamins A and K2 protect against vitamin D toxicity. High levels of vitamin D deplete vitamin A, and must be balanced with compensating amounts of vitamin A and K2 to prevent toxicity.*²²
- *Active forms of vitamins A and D together signal cells to make specific, vital proteins for important bodily processes, but once created, these proteins can only function in the presence of vitamin K2.* One example of this relates to proper bone calcification: Only when vitamins A and D are both present can cells produce osteocalcin, a protein that oversees the deposition of calcium and phosphorus salts in teeth and bones, but osteocalcin can only accumulate when it has been activated by vitamin K2.²³ Vitamins A and K2 both assure the proper disposition of calcium in the bones and teeth (K2 actually encourages dentin to re-mineralize, helping to reverse tooth decay).²⁴

In conclusion, taking vitamin D in isolation can create imbalances and health problems: too much vitamin D without adequate levels of vitamin A and K2 can weaken bones and lead to the calcification of soft tissues, including the heart, kidneys, and arteries. Too much vitamin D in isolation can cause vitamin A and vitamin K deficiencies. At the same time, vitamin A and vitamin K work to prevent vitamin D toxicity. Thus, even small amounts of vitamin D can be detrimental if vitamin A and vitamin K2 are deficient.

Designing a Personal Strategy

As mentioned previously, how we choose to obtain vitamin D is a personal decision. My purpose in writing this newsletter has been to try to help you sort through enough information, both about vitamin D and its necessary complementary cofactors...vitamins A and K ...that you may choose your own way to obtain these nutrients—one that fits your lifestyle, personal tastes and eating habits. My own personal strategy for obtaining sufficient vitamin D and A involves taking a modest daily serving of naturally fermented cod liver oil (for vitamins A and D), along with X-Factor butter oil (for K2 and saturated fat to help the body assimilate the highly unsaturated fatty acids of cod liver oil). [Cod liver oil is highly unsaturated and cannot be utilized and stored effectively without adequate amounts of saturated fats from grass-fed animals.] For anyone with an aversion to its taste, fermented cod liver oil (not to be

²² J. Pepping Adams, “Vitamin K in the treatment and prevention of osteoporosis and arterial calcification.” (2005)

²³ Chris Masterjohn, “On the Trail of the Elusive X-Factor,” 5.

²⁴ Masterjohn, X-Factor, 6.

confused with well-known commercial, deodorized brands that lack natural vitamins A and D) comes both in flavors and capsule form.

In springtime as the days lengthen and the weather warms, I cut back on cod liver oil and begin to work into the sun gradually. This is a hedge—I capture what may be other health benefits from the sun's photo-nutrients that reach beyond vitamin D as we know it today. I also take off my glasses for brief periods to let some sun enter my eyes, an approach inspired by the work of John Ott, who discovered in the 1950s-1960s positive hormonal benefits of UVB radiation passing through the iris of the eye to the pineal and pituitary glands. Of course, the risk of using the sun may involve non-melanoma skin cancer and cataracts. These are tradeoffs in any effort to prevent more serious chronic diseases.

My research and my own personal experience lead me to believe that the judicious use of traditionally fermented cod liver oil and X-Factor butter oil is an effective, balanced, convenient strategy for acquiring vitamin D and A. Cod liver oil comes with far-reaching benefits, from the reversal of tooth decay to improved behavior and mood. I have taken a modest daily serving of fermented cod liver oil along with X-Factor butter oil for several years; I have not had a cavity and I have never felt better. If you decide to try these, be patient—it may take about six weeks to feel a difference.

Good Sources of Cod Liver Oil and X-Factor Butter Oil

Green Pasture (402-858-4818), www.greenpasture.org

Dr. Ron's Ultra-Pure, Additive Free Products (877-472-8701), www.drjons.com

Radiant Life (888-593-8333), www.radiantlifecatalog.com

Reading Resources:

Sunshine, Health, and Vitamin D:

Michael Holick, Ph.D., M.D., *The Vitamin D Solution*.

Chris Masterjohn, "From Seafood to Sunshine: A New Understanding of Vitamin D Safety," WAPF.

John N. Ott, *Health and Light; Light, Radiation and You*.

Weston A. Price, *Nutrition and Physical Degeneration*.

NIH Office of Dietary Supplements, "Vitamin D," <http://ods.od.nih.gov/factsheets/VitaminD>

Vitamin A:

Sally Fallon and Mary Enig, Ph.D., "Vitamin A Saga," WAPF.

Sally Fallon, "Update 2 on Cod Liver Oil/Vitamin A," WAPF.

Elson Haas, *Staying Healthy with Nutrition*.

Vitamin K2 and X-Factor Butter Oil:

Chris Masterjohn, "On the Trail of the Elusive X-Factor: A Sixty-Year Mystery and Vitamin K," WAPF.

Cod Liver Oil:

Sally Fallon Morell and Mary Enig, Ph.D., "Cod Liver Oil Basics and Recommendations," WAPF.

Sally Fallon Morell, "Cod Liver Oil: Setting the Record Straight," WAPF.

Chris Masterjohn, "Science Validates the Benefits of Our Number One Super Food," WAPF.

Krispin Sullivan, "Cod Liver Oil: Number One Super Food," WAPF.

David Wetzel, "Cod Liver Oil Manufacturing," WAPF.

David Wetzel, "Update on Cod Liver Oil Manufacture," WAPF.

Additional Reading: The voluminous journal articles cited in the WAPF readings listed above.

Appendix: A Technical Reference to Vitamins D, A, and K

These vitamins work in partnership and must be balanced to achieve the maximum benefit and to avoid vitamin D and/or vitamin A toxicity.

"Most ...[vitamin D] recommendations, like most of the research on vitamin toxicity, fail to take into account the interaction between vitamins A, D and K, which may be the most critical point to address in a discussion of vitamin D's toxicity...*there is compelling evidence to support the premise that vitamin D toxicity results from a relative deficiency of vitamins A and K.*"²⁵

"Vitamin A is an essential factor in vitamin D's hormonal function and vitamin K is necessary to activate the proteins made in response to vitamins A and D. Vitamin D toxicity appears to result from a depletion of vitamin K, and animal evidence suggests that even small amounts of vitamin D increase the need for vitamin A. Therefore, we must ask a most important question when we consider the various studies on vitamin D requirements and vitamin D toxicity: what was the dietary context in which the vitamin D was consumed?"²⁶

"What is clear is that the protective and synergistic context of a nutrient-rich diet [especially in relation to vitamins A and K2] is not only underappreciated, but is essential to consuming vitamin D in a way that provides optimal benefit and maximum safety."²⁷

Vitamin D:

Vitamin D and the Prevention of Disease. Vitamin D deficiency was originally associated with rickets, since vitamin D is required for proper calcium absorption. Now we believe that vitamin D plays a vital role not only for strong bones and teeth but also for the prevention of chronic disease. Vitamin D deficiency is linked to many forms of cancer—breast, prostate, colon, ovarian, lung—and even melanoma; heart disease, hypertension, and stroke; type 1 diabetes; obesity and type 2 diabetes; multiple sclerosis, Crohn's disease, rheumatoid arthritis and fibromyalgia; kidney disease; asthma and

²⁵ Masterjohn, "Seafood to Sunshine," 2.

²⁶ Masterjohn, "Seafood to Sunshine," 17.

²⁷ Masterjohn, "Seafood to Sunshine," 25.

upper-respiratory disease; and neurological function including Alzheimer's disease and dementia. Vitamin D levels also affect mood and depression, sleep, and a person's general mental outlook on life.²⁸

Vitamin D requirements and testing. Vitamin D recommendations range from the United States' Institute of Medicine's 200 IU/day for adults under the age of 50 to as high 4,000 IU/day, a level believed safe by Drs. Vieth and Heaney, two vitamin D authorities. The official government guidelines call of 400 IUs/day of vitamin D, a level most experts believe is too low for optimum health. Michael Holick recommends 2,000 IUs for most people, but two to three times this amount for the obese (since fat cells store vitamin D and only reluctantly release it to the blood stream). At the higher end, Dr. Reinhold Vieth and Dr. Robert Heaney suggest 3,000-4,000 IU daily, levels they believe to be both optimum and safe.²⁹

The preferred vitamin D test measures calcidiol, termed 25 (OH) D, the non-active, storage, circulating form of vitamin D produced by the liver. This is the precursor to activated vitamin D, known as calcitriol, or 1,25-vitamin D. Some people question the value of testing, arguing that appropriate levels of vitamin D are difficult to establish because people react to vitamin D differently and because vitamin D levels need to be interpreted in the context of an individual's overall diet and general nutrition.

Vitamin D toxicity and deficiency symptoms. While rare, *vitamin D toxicity symptoms* include nausea, vomiting, constipation, thirst, depression and strange behavior, weight loss, and elevated calcium levels that can lead to calcification of the kidneys and arteries.³⁰ High levels of vitamin D also create problems by consuming vitamin A to then leave less vitamin A for its important functions (see below), including the prevention of soft tissue calcification. Thus, kidney stones and heart disease are linked to excess vitamin D in relationship to vitamin A.³¹ Similarly, vitamin D is required to prevent vitamin A toxicity: Vitamin A is stored in the liver and other organs; vitamin D supports the utilization of vitamin A to prevent vitamin A toxicity.³²

Vitamin D deficiency symptoms include many types of chronic pain, including bone and muscle pain, sternum and shin bones tender to the touch, pitted nails, as well as kidney disease, Crohn's disease, osteoporosis, osteopenia, osteomalacia, and rickets.

Vitamin D and vitamin A as Working Partners. German scientist F. Thoenes in 1935 discovered that vitamin D does not work alone, but rather in tandem and in a variety of ways with vitamin A. Thoenes also discovered that *a relative deficiency of vitamin A can lead to vitamin D toxicity*. From modern molecular biology, we now understand that select enzymes in the body convert, in a two stage process,

²⁸ Michael Holick, Ph.D., M.D., *The Vitamin D Solution*, for complete discussion of the vitamin D link to these diseases.

²⁹ Robert Vieth, "The Pharmacology of Vitamin D, including Fortification Strategies" and Robert Heaney, "The Vitamin D Requirement in Health and Disease."

³⁰ Holick, 220.

³¹ Masterjohn, "Seafood to Sunshine," 12.

³² Chris Masterjohn, "Science Validates the Benefits of Our Number One Superfood," 4.

vitamin D and A into hormones³³ that bind to specialized receptors, travel to the nucleus, bind to DNA of specific genes to affect gene expression, thus having broad implications for a person's health. Because vitamin A acts as a signaling partner with vitamin D in this process, the *presence of vitamin D will increase the turnover of vitamin A to help prevent vitamin A toxicity,*³⁴ while sufficient vitamin A also helps to prevent vitamin D toxicity.

Optimum ratio of vitamin D/vitamin A: There is no ideal ratio. People react differently to vitamin D. The ideal ratio varies with the individual, based on skin type, genetics, and the season of the year.³⁵

Vitamin A:

"Only Animal fats contain vitamin A and vitamin A is present in large amounts only when the animals have a source of carotenes or vitamin A in the diet, such as green pasture, insects and fish meal."³⁶

Vitamin A Contrasted to Beta Carotene. Like vitamin D, which has two major forms in D3 and D2, there are also two main types of vitamin A. *Preformed vitamin A*, or retinol, is the animal-based, active form of vitamin A, which is found in liver and fish liver oil, fish eggs, egg yolks, and milk products/butter from grass-fed cows. *Provitamin A (beta carotene)*, in contrast, is found in plant-based foods, mostly yellow and orange vegetables and fruits and dark leafy green vegetables of the carotenoid family.

Plant sources of vitamin A are not equivalent to animal sources because the conversion of beta-carotene (the easiest carotene to convert) is inefficient. This conversion is carried out in the upper intestinal tract and also in liver but the process requires more than five units of beta-carotene to produce one unit of retinol. And, it is poorly performed by individuals with diabetes, low-thyroid function, liver problems, celiac disease, or those who consume little fat or high amounts of refined vegetable oils. In addition, other factors such as vigorous exercise, stress, alcohol, drugs, zinc deficiency, and winter weather can hamper the conversion of beta-carotene to vitamin A. Butterfat works as a helpful offset, not only for its vitamin A content but also because it can stimulate bile salts required for the conversion of beta-carotene to vitamin A.³⁷

Vitamin A and the Prevention of Disease: Critical to our daily functioning and survival, vitamin A is stored in the liver and other organs to be ready for ready future needs. Vitamin A is a key fat soluble vitamin that is required for the proper assimilation of minerals and water-soluble vitamins. Specifically, vitamin A is important for vision; growth and healing; healthy skin, bones, and teeth; protein digestion; immune function, proper cellular function and genetic expression, and the prevention of free-radical damage.

³³ Sally Fallon Morell, April 30, 2009, 5.

³⁴ Masterjohn, 3,7.

³⁵ Masterjohn, "Science Validates..." 6.

³⁶ Sally Fallon and Mary G. Enig, Ph.D., "Vitamin A Saga," 4.

³⁷ Fallon and Enig, 4.

Vitamin A Toxicity and Deficiency.

“...over a quarter of Americans consume less than half the RDA [of vitamin A]. If people eating diets low in vitamin A begin supplementing with vitamin D... the danger of such a low intake of vitamin A may be greatly increased.”³⁸

Rich sources of vitamin A are present only in animal fats from animals that eat green grass and insects (e.g., eggs from barnyard chickens). These are not, of course, the kind of foods that are mass produced on today's huge commercial farms. As we have traded food quality for quantity, *vitamin A deficiency* now appears to be a far greater risk than *vitamin A toxicity*: the average vitamin A intake of the typical American is one-tenth that of traditional cultures who ate organ meats, eggs from free-ranging hens, and butter from grass-fed animals.

Also, traditional fats which are rich in vitamin A provide their own safeguard for the liver because saturated fats protect against liver damage (why we intuitively pair wine with cheese and pate?). This antidote action of saturated fat is in stark contrast to refined vegetable oils that actually *promote* the negative effects of toxins like alcohol and drugs to create damage to the liver.³⁹

Vitamin A toxicity is far more likely from *synthetic* vitamin A (retinol) than from vitamin A obtained through whole, traditional foods. Synthetic vitamin A is used in supplements and is also added to fortified foods such as margarine and breakfast cereals.⁴⁰ As Fallon and Enig note,

“While some forms of synthetic vitamin A found in supplements can be toxic at only moderately high doses, fat-soluble vitamin A naturally found in foods like cod liver oil, liver, and butterfat is safe at up to then times the doses of water-soluble, solidified and emulsified vitamin A found in some supplements that produce toxicity. The vitamin D found in cod liver oil and butterfat from pasture-raised animals protects against vitamin A toxicity and allows one to consume a much higher amount of vitamin A before it becomes toxic.”⁴¹

Beta-carotene and Vitamin A Toxicity. Beta-carotene (in yellow and orange vegetables and fruits and dark leafy green vegetables) cannot cause vitamin A toxicity because the body converts beta carotene only when vitamin A is needed—a wise choice because the body uses up significant enzyme reserves in its conversion. When huge amounts of beta carotene are consumed over time (such as drinking great quantities of carrot juice) the skin can turn a orange-yellow color, a condition known as carotenosis.

³⁸ Masterjohn, “Science Validates...,” 5.

³⁹ Masterjohn, “Seafood to Sunshine,” 9.

⁴⁰ Fallon and Enig, 8.

⁴¹ Fallon and Enig, “Cod Liver Oil Basics and Recommendations,” 2, from Myhre, et al., “Water-miscible, emulsified, and solid forms of retinol supplements are more toxic than oil-based preparations,” *American Journal of Clinical Nutrition*, 78 (2003) 1152-9.

This carries no medical repercussions and quickly rights itself once beta carotene consumption is reduced to normal levels.⁴²

Symptoms of Vitamin A (retinol) Toxicity. Signs include pressure headaches, a result of a swelling of the brain; nausea and vomiting; irritability; dizziness; hair loss; dry, itchy skin; weight loss; liver enlargement; stunted growth; dry, bleeding lips; and birth defects when high doses are taken in pregnancy.⁴³

Symptoms of Vitamin A Deficiency. Night blindness is one of the first signs of deficiency. Other signs include skin problems, dandruff and lack-luster hair, insomnia, and fatigue. Vitamin A deficiency also cripple immune function and is linked to a variety of forms of cancers, including breast, cervical, prostate, lung, and stomach cancers.

Vitamin K

“Vitamin K2 is the substance that makes the vitamin A- and vitamin D-dependent proteins come to life. While vitamins A and D act as signaling molecules, telling cells to make certain proteins, vitamin K2 activates these proteins by conferring upon them the physical ability to find calcium. In some cases these proteins directly coordinate the movement or organization of calcium; in other cases the calcium acts as a glue to hold the protein in a certain shape, but in all cases, the proteins are only functional once they have been activated by vitamin K.”⁴⁴

We now understand that vitamin K2 is the special activating factor that Weston A. Price intuitively knew to be in butter from grass-fed animals. Price appreciated that what he called “Activator X,” which was found in the butter, organs, and fat of animals grazing on luxurious green grass, was a necessary complement to cod liver oil. When taken together, they worked synergistically for the treatment of tooth decay, for normal growth and development, reproduction, brain function, and to prevent the calcification of arteries associated with heart disease.

Vitamin K1 Contrasted to K2. Vitamin K1 is plant-based and is found in green vegetables and oils, particularly olive oil. Vitamin K2 is produced by animals grazing on vitamin K1 in the form of rapidly growing green plants, and it is also found in lacto-fermented plant foods like sauerkraut. Vitamin K1, although generally plentiful in the diet, is poorly absorbed; in contrast, the body is able to absorb virtually all the vitamin K2 that is consumed. Because the typical diet contains about ten times the K1 compared to K2, vitamin K2 has been little researched until recent decades, yet its implications for good health are far reaching.

Sources of vitamin K1 (phylloquinone) are dark green vegetables such as asparagus, broccoli, kale, spinach, and sea vegetables. Foods high in vitamin K2 include natto, a fermented soy food and by far

⁴² Elson Haas, *Staying Healthy with Nutrition*, 97.

⁴³ Haas, 97.

⁴⁴ Chris Masterjohn, “On the Trail of the Elusive X-Factor,” 5.

the highest source of K2 (although lacto-fermented foods do not contain the same form of K2 as animal products—a difference that may or may not be important). Vitamin K2 is also found in goose liver; hard cheeses; egg yolks; butter; chicken liver; chicken; turkey; ground beef; calves liver; and sauerkraut.

Vitamin K1 and K2 and the Prevention of Disease. Vitamin K1 is associated with blood coagulation but offers no protection against soft tissue calcification. Vitamin K2 protects against vitamin D toxicity. Importantly, too, vitamin K2 directs calcium to the bones and teeth and away from soft tissues where it does not belong. In so doing, it prevents the calcification of arteries, other soft tissues, and heart disease. Weston Price found that the combination of traditional cod liver oil and butter oil from animals grazing on rapidly growing grass:

- Reverses tooth decay. It stopped tooth decay and even encouraged the dentin to develop and remineralize;⁴⁵
- Reverses bone loss and even increases bone mass with people suffering from osteoporosis;⁴⁶
- Protects against heart disease, with heart disease now linked to vitamin K deficiency. While it prevents the calcification of arteries, it also protects against inflammation and the buildup of white blood cells and lipids that are also involved with atherosclerosis.⁴⁷
- Protects the brain and nervous system to ward off dementia and prevent seizures.⁴⁸

Vitamin K Toxicity. Neither vitamin K1 or K2 is toxic.

Vitamin K2 Deficiency. Deficiency can cause vitamin D toxicity. Deficiency can also lead to dental cavities, osteoporosis, and the calcification of soft tissues—cardiovascular disease, kidney stones, and joint problems. A lack of vitamin K2 is also linked to some forms of cancer, seizures, and dementia.

Recognizing the scarcity of traditionally-raised animal foods, I believe that naturally fermented cod liver oil (vitamins A and D) and X-Factor butter oil (vitamin K2) taken together is one of the easiest and best ways to obtain vitamin D with its balanced co-factors. These, which are sold by nonprofit establishments and backed by research of the nonprofit Weston A. Price Foundation, seem to be sound choices in a world fraught with uncertainties about the best choices for our health and well being.

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⁴⁵ Masterjohn, "The Elusive X-Factor," 6.

⁴⁶ Vermeer C, et al., "Beyond deficiency: potential benefits of increased intakes of vitamin K for bone and vascular health." *European Journal of Nutrition* 2004; 43: 325-335, qtd. in Masterjohn, "The Elusive X-Factor," 9.

⁴⁷ Masterjohn, "The Elusive X-Factor," 9.

⁴⁸ Masterjohn, "The Elusive X-Factor," 12.