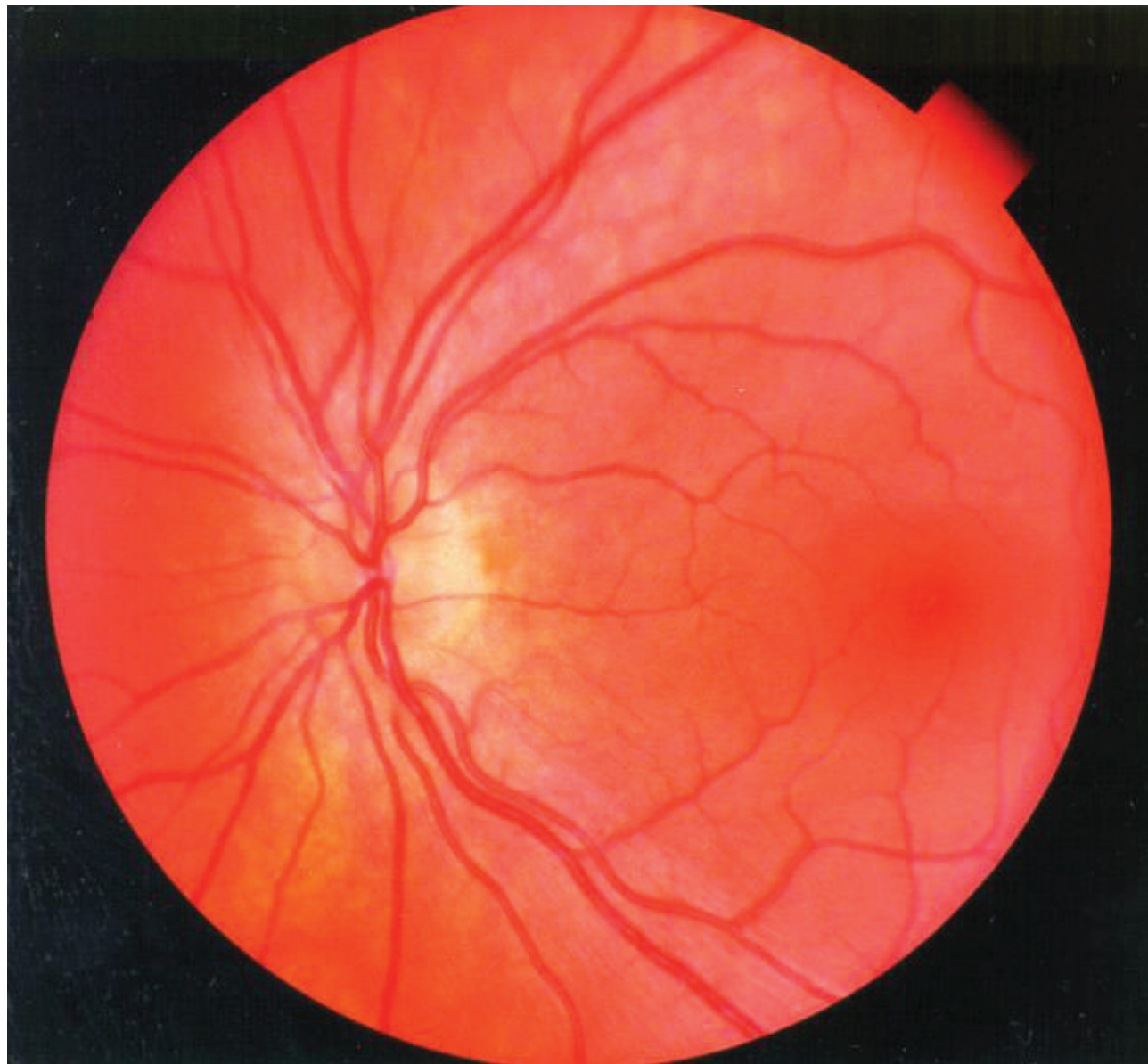


VISION INSTITUTE OF CANADA'S
CONFERENCE GUIDE
TO NUTRITION AND VISION



The Retina of the Human Eye

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Advice about nutrition and its impact on vision and eye health can be confusing and frustrating. One day a report tells us that a certain food or supplement is good for us; the next day another report tells us that it is not. But what can be said, without contradiction, is that the foods we eat (or don't eat) play a major role in all aspects of health.

As humans, we are biological beings; part of the animal kingdom of life on this planet. We are the result of many years of evolution; a product of natural selection and our genetic inheritance. Research has shown that our genes have changed very little in the last 40,000 years. We have the same genetic makeup as our primitive hunter-gatherer ancestors from 10,000 years ago. What we know today is that the foods we eat are chemical triggers that can turn genes (the good ones and the bad ones) on and off.

Proper nutrition for vision and eye health, and health in general, requires that we eat foods that are "gene-friendly." This means eating a diet of foods that contribute to turning the health-promoting genes on and turning the disease-promoting genes off. The diets of our primitive ancestors, who lived as Paleolithic or "stone-age" people, did just that.

Our "stone-age" ancestors ate a wide variety of wild plant and animal foods so that their diets consisted of healthy meats and animal organs, fish, shellfish, eggs, fruits, nuts, seeds, berries and complex carbohydrates in the form of wild plants, roots, and vegetables.

This "gene-friendly" diet provided four things:

(a) the right balance of saturated and unsaturated fats for cell membranes and nerve function;

(b) complex carbohydrates for fibre and the maintenance of stable blood-glucose and insulin levels;

(c) high quality plant and animal protein for enzymes, muscles and other body tissue; and

(d) an abundance of essential vitamins, minerals and phytochemicals to act as antioxidants and enzyme system catalysts.

Our present genetic make-up, which has not significantly changed in 40,000 years, is geared to this nutrient supply. Our modern Western diet of processed foods with their high levels of refined grains, modern vegetable oils, sugar, salt and chemical additives, and low in important nutrients, is turning on genes that promote inflammation and chronic disease. When it affects the genes that control the eye, it can lead to such conditions as **macular degeneration, cataracts, myopia, and diabetic and hypertensive retinopathy**

The dietary information and advice contained in this booklet is adapted from the **Nutrition and Vision Lecture Series** presented in Calgary and Toronto in 2008 by the **Vision Institute of Canada**. It represents the views and opinions based on the research presented during the conferences and is supplemented by various peer-reviewed papers and books on nutrition and vision. *It is not intended to represent the views of the staff or board of the Vision Institute of Canada.*

Our Early Ancestral Heritage

Before the agricultural revolution ten thousand years ago, the diets of our primitive ancestors were based on wild plant and animal foods that were gathered and hunted from their environment. Although there was no single diet that could be called “human” or “stone-age,” the great variety of nutrient dense wild foods that were eaten did provide the optimal balance and combination of nutrients that we are genetically adapted for today. Our modern nutritional requirements have been genetically determined by over two million years of evolution. Natural selection has uniquely shaped our nutritional requirements. The lesson from our hunter-gatherer ancestors is simple. **We need to eat a wide variety of nutrient dense foods and these foods must be as natural and free of modern additives and processing as possibly for optimal vision and eye health.**

In understanding our ancestral heritage, we are fortunate to know what foods early native tribes of Canada and the United States consumed based on the written records of their descendants and the European explorers who first encountered them. Before 1500 AD, there were as many as eight million inhabitants of North America living in tribes that were either nomadic hunter-gatherers, or more settled agrarian people who had discovered how to grow their own crops. Research has shown that the nomadic tribes were better nourished than the agrarian tribes due to the wider variety of foods they ate. Agriculture did not extend the life span of the agrarian tribes, but introduced nutritional deficiencies, an increase in infectious diseases and a general decline in overall stature and health. The cultivation of a few basic high-calorie low-nutrient crops by the agrarian tribes (such as corn, beans, and squash) led to a reduction in the consumption of wild plant and animal foods – foods which had fewer calories and were more nutrient dense.

The various diets of the hunter-gatherers exceeded the minimal requirements for the daily intake of vitamins and minerals and the large variety of foods consumed provided a great blend of nutrients. Roots, starchy tubers, nuts, fruits, berries, and leafy vegetables provided carbohydrates, sugars, vitamins and fibre. Land and sea animals of all kinds provided fats, proteins, minerals and other trace nutrients. Their diets were low in sodium and their meats were lean, since wild game has less fat than domesticated animals. The diet was also higher in the omega-3 essential fatty acids and richer in monounsaturated fats than saturated. **Since there were almost no cereal grains, fewer carbohydrates were eaten.**

Wild green plants were the mainstay of gathered foods and were supplemented by a variety of gathered vegetation, from acorns to yucca fruit. The gathering of wild plants, shellfish, seeds, berries, and other foods often provided most of the calories in the hunter-gatherer diet. Hunting and fishing would provide a secondary role but were crucial for providing fat, which was the real objective. Fatty acids are essential for all aspects of health. The lean muscle meat of wild animals was eaten with the fats from bone marrow, internal organs, and other fatty deposits under the skin and in various body cavities.

In the bigger picture of world wide hunter-gatherer societies, slightly more than half relied on hunting and fishing as a primary source of food. Plant foods played a secondary role.

However, if we compare our ancestral diet with our modern Western diet, the differences are apparent. In order to achieve an optimal level of ocular health and health in general, we need to match our dietary habits with the ancestral diet that conditioned our genes.

Nutrient	Ancestral Diet	Western Diet
Protein	High	Low to Moderate
Carbohydrates	Complex	Starchy and Refined
Refined Sugars	Low	High
Total Fat	Moderate	High
Saturated Fat	Moderate	High
Monounsaturated Fat	High	Low
Omega-3s	Moderate	Low
Omega-6s	Moderate	High
Fibre	High	Low
Fruits and Vegetables	High	Low
Nuts and Seeds	Moderate	Low
Salt	Low	High
Antioxidant Intake	High	Low
Vitamins/Minerals	High	Low
Calorie Intake	Moderate	High
Physical Activity	High	Low

All living beings flourish and thrive when they eat the diet for which they are genetically adapted. A wide variety of nutrient dense foods from wild plants and animals were the basis of the diets of our primitive ancestors and together with regular physical activity, they promoted health and longevity. Our modern Western diet of refined, processed and synthetic foods combined with our limited physical activity is responsible for most of the chronic degenerative diseases of civilization. The foods of our ancestors before the agricultural revolution hold the key to the ideal diet best suited to ocular health and health in general.

Knowledge of our dietary evolution must set the stage for any advice on nutrition for ocular health and health in general.

The **Ideal** Human Diet

(a) the right balance of saturated and unsaturated fats for cell membranes and nerve function:

In numerous studies on the effects of dietary fat on health, the results have shown that it is not the total fat content that is a concern, but the balance of fats. Animal fats and oils were a very important part of primitive people's diets, so much so that they were celebrated in their myths and legends. Nearly all hunted and gathered foods were perceived to be enhanced by adding oil. Hot and crisp pieces of cooked fat were considered a great treat and a gift of grease from one tribe to another was a significant gesture.

We should not be afraid of fat in our diet if it reflects the healthy balance of natural fats eaten by our ancestors. Fats from wild animals and fish, nuts and seeds were eaten in moderate amounts, providing a good source of energy and the right balance of building materials for healthy cells and nerves.

Our Western diet is out of balance with too much saturated fat and too much grain-based polyunsaturated omega-6 fats found in modern processed vegetable oils and our grain-fed cattle which contribute to inflammation. Less saturated fat and more monounsaturated and omega-3 fats from green plants, grass-fed animals and wild caught fish can help restore the dietary balance of fats to which we are genetically adapted, thus reducing inflammation.

(b) complex carbohydrates for fibre and the maintenance of stable blood-glucose and insulin levels:

Carbohydrates are an important food group but our Western diet is overloaded with refined grains, starches and sugars. These foods are digested and absorbed rapidly causing blood sugar and insulin levels to rise quickly. These rapid elevations in sugar and insulin lead to almost as rapid a decline in sugar and insulin in the blood, leading to chronically unstable blood sugar levels and disease processes such as diabetes.

The wild green plants (a good source of healthy omega-3 fats) and the various fruits and non-starchy vegetables of our ancestor's diets cause only a limited rise in blood sugar while providing needed fibre for intestinal health. The carbohydrate content of fruits and vegetables is low compared to cereal grains, and contain far more vitamins and minerals.

Cereal grains also contain natural chemical substances called "phytates" that can inhibit the absorption of vitamins and minerals. Unless grains are properly prepared by soaking, sprouting or fermenting to neutralize the phytates and other toxins, these substances can contribute to nutrient deficiencies. Many primitive people used soaking and fermenting as food preservation techniques and they benefited from the enhanced nutritional properties that resulted since the proteins, vitamins and minerals could be absorbed more easily from these foods. Today's refined cereal grain foods are fortified with minerals and synthetic vitamins in part to off-set the anti-nutrient effects of "phytates" and other such substances.

(c) high quality plant and animal protein for enzymes, muscles and other body tissue:

Protein is essential for our body to build muscle and other tissues. It is believed that our hunter-gathering ancestors ate more protein than we consume today. Protein also satisfies hunger more than fat and carbohydrates. However, too much protein can lead to an excess of nitrogen in the body and make us ill, and should be eaten with complex carbohydrates from fresh fruits and vegetables and with moderate well-balanced amounts of fats and oils.

Protein does not interfere with blood-sugar and insulin levels. It also helps with weight loss since it stimulates our metabolism more than fats or carbohydrates.

(d) an abundance of essential vitamins, minerals and phytochemicals to act as antioxidants and enzyme system catalysts:

By eating a diet consistent with our hunter-gatherer ancestors, whose diet contained a wide variety of wild plant and animal foods, we will be getting an abundance of essential vitamins, minerals, and phytochemicals to act as antioxidants and enzymes in our body.

The high antioxidant content in the diets of our early ancestors determined our needs for a diet rich in antioxidants. Essential phytochemicals such as carotenoids, bioflavonoids and polyphenols are found in the skins and pulp of berries and other colourful plant foods. Their antioxidant and anti-inflammatory properties are vital for good vision and eye health.

In Summary

Ancestral diets contained a variety of wild animal foods making up, on average, about half of their food energy. Various wild plants provided the remaining half of their food calories.

Their dietary fat intake ranged from 30 to 60 percent of their total calories with a moderate amount of their fat calories from **polyunsaturated fatty acids** found naturally in meats, fish, nuts, seeds and other plants. The balance of their fat calories came from high amounts of **monounsaturated fatty acids** and moderate amounts of **saturated fatty acids**.

Their diets contained a ratio of **omega-6 to omega-3 essential fatty acids** of about **2 to 1** to **4 to 1**. (Our Western dietary ratio is estimated to be nearly **20 to 1**.)

Their diets had higher levels of protein from animal and plant sources than our diets today.

Their diets had high levels of fibre from lots of fruits and non-starchy vegetables.

Their diets had high levels of minerals, phytochemicals, and water-soluble and fat-soluble vitamins from wild plant and animal foods.

Their diets contained little added salt and five to ten times more potassium than sodium.

The Top **Sixteen** Dietary Recommendations

In our modern world, we “hunt and gather” down the aisles of grocery stores. It is possible to eat in a style that fits more closely with our early ancestor’s diets without having to return to their way of life – which no one is suggesting! By knowing what foods were eaten before the agricultural and industrial revolutions, we can make wise choices about what to eat today. The following sixteen “gene-friendly” dietary recommendations provide some basic guidelines to help maintain optimal vision and eye health, and health in general.

- 1. Eat foods that are as whole, natural, fresh and unprocessed as possible.**
- 2. Eat a variety of fresh fruits daily**, preferably organic, that are washed to remove any pesticide residue from skins that can be eaten. They are an excellent source of vitamins and antioxidants. An apple and orange every day are a good foundation for having several servings of fruit daily. Other choices include avocados (which have twice as much potassium as bananas and are a good source on monounsaturated fats,) berries (such as blueberries, cherries, cranberries and strawberries,) cantaloupe, grapefruit, kiwifruit, mangos, olives, pineapple, papaya, peaches, plums, pumpkin, red grapes and tomatoes.
- 3. Eat a variety of non-starchy and dark green leafy vegetables**, preferably organic, in soups and salads, or lightly steamed with a healthy fat such as extra virgin olive oil or butter. The use of these healthy oils helps with the absorption of fat-soluble nutrients such as *lutein* and *zeaxanthin* which are important nutrients for vision and eye health. Good dark green leafy vegetables include kale, parsley, romaine lettuce and spinach. Other good nutrient rich vegetables include beets, bok choy, broccoli, Brussels sprouts, carrots, cauliflower, garlic, green and red peppers, green peas, onions and sweet potatoes.
- 4. Eat healthy meats and fats** from poultry, lamb and beef, and organ meats such as calf’s liver, preferably organic and from pasture-fed animals. *Healthy (lean) meat has saturated and unsaturated fat levels in a balance and amount that is closer to that of wild animals.*
- 5. Use animal bones** to make gelatin-rich bone broths for soups and stews.
- 6. Eat wild-caught fatty fish and shellfish** such as salmon, sardines, mackerel and herring, and shrimps, scallops, oysters, lobster, clams and mussels. These foods are good sources of protein and EPA and DHA long-chain omega-3 fatty acids.
- 7. Eat eggs**, preferably from organic free-range poultry. Lutein and omega-3 enriched eggs are a good source of lutein and ALA short-chain omega-3 fatty acids.
- 8. Eat whole grains, beans and nuts** that have been soaked, fermented or sprouted to neutralize anti-nutrients such as phytates, tannins and lectins. A hand full of nuts every day, such as almonds or walnuts, is a good source of fibre and unsaturated fats.
- 9. Eat only natural sweeteners** such as honey and maple syrup in moderation.
- 10. Avoid all refined processed vegetable oils** from corn, safflower, sunflower, and soy.
- 11. Avoid all hydrogenated and partially hydrogenated vegetable oils.**
- 12. Avoid commercially manufactured and processed foods**, including cakes, cookies, donuts, pastries, soft drinks, and packaged food products.
- 13. Avoid refined grain products** such as white flour, white flour products and white rice.
- 14. Avoid foods with chemical and synthetic additives.**
- 15. Avoid refined sugars**, especially high fructose corn syrup.
- 16. Avoid highly processed meats and meat products.**

Cooking Matters!

How we heat, cook, and prepare our food is as important as what we eat. Our early ancestors ate a significant portion of their foods raw and uncooked. Today we have methods of cooking that raise the temperatures of food to levels that can change their nature and nutrient content.

The use of fats and oils in cooking is one of the most significant concerns in our modern diet. When fats and oils are heated, they are subjected to temperatures that can damage them by oxidation. The saturated fats, such as butter, coconut oil, chicken and beef fat are the most stable fats to use for cooking. When heated, they do not become oxidized and damaged. Olive oil, a good source of monounsaturated fat is also good for cooking. **However, the polyunsaturated fats, such as corn, safflower, sunflower and soy oil, are the most unstable and should not be used for cooking.** They are easily oxidized which interferes with healthy cellular function. These damaged oils are often found in processed packaged foods and are one of the reasons why such foods should be avoided.

Boiling, steaming, poaching, and slow-cooking are the healthiest ways to prepare foods since the use of lower temperatures and the presence of water limit the amount of oxidation. But even these methods can affect the nutrient content of foods. For example, simply boiling or steaming vegetables for a few minutes can cause the loss of 25 percent of their vitamin C content. Cooking fruits or vegetables for 10 to 20 minutes can result in the loss of over half the vitamin C. Light steaming can increase the amount of lutein but prolonged cooking of dark green leafy vegetable reduces the amount. In most cases the amount of antioxidant carotenoids in vegetables is also reduced by prolonged cooking. One notable exception is lycopene, the red pigment in tomatoes, which becomes more easily absorbed through the digestive tract after cooking. Much of the vitamin E in foods is damaged by modern factory processing and exposure to air.

Deep-frying, especially with the unstable polyunsaturated fats, does the most damage to foods. This method of cooking should be limited. Eggs, a good source of lutein, vitamins A, D, and E, zinc and many other nutrients, should be poached or hard-boiled. The high heat used in frying eggs causes their cholesterol content to be damaged by oxidation, which increases the risk of inflammation in blood vessels.

The high temperatures used in baking and broiling can lead to the formation of substances called *advanced glycation end products* (AGEs) or glycotoxins which give cooked foods their browned colour and much of their taste, aroma and texture. These substances are the result of sugar molecules binding to proteins or fats. They accumulate in cell membranes, causing membrane stiffness, harming cellular function and resulting in inflammation. **They are found in the retinal vessels of people with diabetes and may play a role in the development of macular degeneration and cataracts.** Many modern processed foods contain synthetic AGEs which have been added by the food industry to increase flavour. The damaging effects of these oxidative AGEs can be reduced by a diet high in antioxidants.

Advice **About** Vitamin and Mineral Supplements

If you are following all the basic dietary recommendations discussed in this booklet and using the cooking methods which protect the essential nutrients in food, you may be getting all the vitamins, minerals, phytochemicals, complex carbohydrates, fats and proteins your eyes and body require. However, very few of us can consistently eat all the fresh fruits and vegetables, seafood, nuts, seeds, and healthy wild meats and fats on a daily or weekly basis to meet our needs.

Our modern food industry with its long storage and transportation of our food resources, combined with the mineral depleted soils that our foods are grown in, contribute to making much of our food nutrient deficient even before it is cooked and eaten. The many chemical pollutants and other environmental stresses we have to deal with can also quickly deplete the body of its stored nutrient defences.

It would appear to be “common sense and common science” to supplement our diet with appropriate antioxidant vitamin and mineral supplements. It is good insurance against the various nutritional deficiencies and oxidative stresses that we experience in our daily lives.

Optimal vision depends on healthy eyes and a healthy brain, since they are intimately connected. The retina and brain contain a large amount of delicate omega-3 fats and we need to do as much as we can to protect their health and function from oxidative damage.

There are many eye related supplements on the market and many claims about their superiority over other brands. **However, the use of natural ingredients in any ocular vitamin and mineral supplement is essential.**

There are several major nutrients, which in diet and supplement form, have been shown in various studies to reduce the risk of macular degeneration, diabetic retinopathy and cataracts. These nutrients include the omega-3 fats that replenish the retina and the antioxidant vitamins and minerals that protect them. These are:

- **EPA and DHA, known as the long-chain omega-3 essential fatty acids,**
- **Vitamin A,**
- **Vitamin C,**
- **Vitamin D,**
- **Vitamin E,**
- **Lutein and zeaxanthin,**
- **Zinc.**

EPA and DHA are the fatty acid building blocks of the eye’s retina and the brain. Lutein and zeaxanthin are the only two plant carotenoids that are deposited in the macula (the most sensitive part of the retina) and eye’s crystalline lens to protect them from damage by ultraviolet light. Vitamins A, C, D, E and the mineral zinc are the essential antioxidant substances that work together to protect the sensitive structures of the eye from oxidation.

The Top **Five** Ocular Supplement Recommendations

1. A daily supplement of one teaspoon of natural source cod liver oil is the primary recommendation for adults, children over 12 years and nursing mothers. It is the best natural source of EPA, DHA, and vitamins A and D. One teaspoon provides up to 1,000 mg of EPA and DHA, 4,500 International Units (IU) of vitamin A and 450 IU of vitamin D. *Look for toxin-free or natural source USP (pharmaceutical) grade cod liver oil from Norway.*

Natural vitamin A is called *retinol* and is found only in foods of animal origin. Synthetic vitamin A is manufactured as vitamin A acetate or palmitate. Synthetic vitamin D is manufactured as vitamin D2 (ergocalciferol) and natural vitamin D occurs as *vitamin D3 (cholecalciferol.)* Although vitamin A can be toxic in long-term use in amounts over 30,000 IU, this is more commonly associated with synthetic vitamin A in the absence of vitamin D.

Beta-carotene is often used as a source of vitamin A in supplements. Beta-carotene is a carotenoid derived from plants which is converted in the liver into *retinol*, the active form of vitamin A. Unless the supplement is listed as “natural beta-carotene” it is synthetic. All beta-carotene supplements, natural or synthetic, should be avoided by those who smoke or drink alcohol regularly.

2. A daily supplement of 10 to 15 mg of lutein with zeaxanthin has been shown to reduce the risk of macular degeneration and cataracts. Lutein cannot be absorbed without the presence of dietary fat. *Look for supplements that contain Flora-GLO brand crystalline lutein from marigold flowers. Other brands of marigold extracts are absorbed less efficiently.*

3. A daily supplement of 500 mg of a vitamin C complex preferably taken in two daily doses of 250 mg will help protect the eye and body from oxidative damage. Vitamin C is the body’s most important water-soluble antioxidant acting primarily in cellular fluid to prevent oxidation and inflammation. Most supplements of vitamin C are the synthetic form called ascorbic acid. However, when combined with the bioflavonoids that are found with natural vitamin C in fruits and vegetables, it forms a close-to-natural “complex” of ingredients that make vitamin C more bioactive. *Look for vitamin C supplements that have added bioflavonoids such as rosehips, hesperidin, rutin and citrus bioflavonoids.*

4. A daily supplement of 200 IU of vitamin E complex with the natural vitamin E form *d-alpha tocopherol* is the body’s most important fat-soluble antioxidant. It acts to protect our cell membranes and other fat molecules from damage. The synthetic version of vitamin E, called dl-alpha tocopherol, is less potent. *Look for supplements with a complex of “mixed tocopherols,” meaning they also contain the beta, delta, and gamma forms of vitamin E.*

5. A daily supplement of 15 to 20 mg of zinc can help reduce the deficiencies that play a significant role in diabetic retinopathy and macular degeneration. Zinc protects the structure and function of retinal cell membranes by helping to reduce oxidative damage. It is found in high concentrations in the retina and brain. *Look for supplements that contain zinc picolinate. Other forms such as zinc citrate and zinc gluconate are not as bioavailable.*

These five recommendations are the essentials. The amounts recommended will raise dietary levels closer to those consumed from a diet composed of wild plant and animal foods. There are other important nutrients that can be incorporated into this list such as **selenium, manganese, Co-enzyme Q10** and **lipoic acid**. These function to enhance the effectiveness of the body's antioxidant defences and help to regulate blood sugar. They play a significant role in maintaining healthy eyes and vision. They can be found together in a variety of quality multi-vitamin and multi-mineral ocular supplements.

It is always best to take supplements with meals since the body's absorption of the nutrients is generally enhanced by the digestive process when we eat. Some of the best and most natural sourced supplements can be found in health food stores and vitamin specialty shops. Be well informed and always read labels.

Food Sources of Vitamins and Minerals for Eye Health

Always start with food sources for obtaining the necessary vitamins and minerals that your vision and general health require. A few good sources are listed below:

- **EPA and DHA** – fish oils, herring, mackerel, salmon and sardines
- **Vitamin A (retinol)** – butter, calf's liver, cod liver oil, crab meat, eggs and salmon
- **Beta-carotene** – dark green vegetables such as green peppers, kale, romaine lettuce and spinach; and orange/yellow vegetables such as carrots, squash, sweet potatoes
- **Vitamin C** – vegetables such as broccoli, Brussels sprouts, cauliflower, kale, red peppers and romaine lettuce; and fruits such as grapefruit, kiwifruit, lemon juice, oranges, and strawberries
- **Vitamin D** – calf's liver, cod liver oil, herring, mackerel, salmon and sardines
- **Vitamin E** – dark green leafy vegetables such as broccoli and spinach; and nuts and seeds such as almonds, hazel nuts, and sunflower seeds
- **Lutein and Zeaxanthin** – dark green vegetables such as broccoli, dandelion greens, garden peas, green beans, kale, parsley, romaine lettuce, spinach, watercress, and zucchini; and orange/yellow fruits and vegetables such as cantaloupe, corn, kiwifruit, mangoes, oranges, papayas, peaches, squash, and yellow flesh potatoes
- **Zinc** – almonds, beef, calf's liver, cashews, dark chicken meat, dark turkey meat, herring, mushrooms, oysters, shrimp, spinach, and sunflower seeds
- **Selenium** – Brazil nuts, calf's liver, cod, halibut, mushrooms, salmon and shrimp
- **Manganese** – kale, pineapple, romaine lettuce and raspberries
- **Co-enzyme Q10** – fish, calf's liver and whole grains
- **Lipoic Acid** – dark green vegetables such as broccoli and spinach; and animal sources such as beef and calf's liver

A "gene-friendly" balanced diet consisting of lean meats and healthy fats, fish, nuts, seeds and lots of fresh fruits and vegetables will protect the health of your eyes and vision.

Always talk to your doctor before making any dietary changes or starting a program of vitamin and mineral supplements.

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16 York Mills Road, Suite 110, Toronto, Ontario.

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