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REPORT

Very Berry - and Grape too!**Benefits Abound: An Update on Blueberries, Bilberry Extract, Cranberry Extract, and Grape Seed Extract**

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My grandmother was a folk healer. She knew a lot about herbs. But her favorite medicinal potions were home-made wines, which she prepared herself. She favored black currant, elderberry and blackberry wine. Tart cherries and small, dark navy-blue grapes were also acceptable, but black currants and elderberry were credited with greater preventive and healing power. "For a strong heart and long life," my grandmother explained.

Modern science has confirmed that dark-colored berries and red, purple and dark-blue grapes are a treasure house of health-giving and possibly even life-extending phenolic compounds, including proanthocyanidins, anthocyanins and quercetin. And while the days of home-made wine may be over, we now have excellent extracts that provide standardized doses of the active polyphenols in berries and grapes. Bilberry extract and grape seed extract are the best known; cranberry extract and elderberry extract are also available for special therapeutic uses.

Before we look at some of these benefits, a quick note on the often confusing current terminology. Different authors use different terms. Proanthocyanidins, being short chains of catechin subunits, are also called oligomeric condensed tannins and are occasionally referred to as "oligomeric proanthocyanidin complexes," or OPCs. Anthocyanins, which are larger molecules, are sometimes called polymeric condensed tannins. Both types of compounds, often referred to by the general term such as polyphenols, polyphenolics, or flavonoids, or even simply "plant pigments," are widely distributed in plants, including peel, seeds, flowers and bark. Various berries, dark grapes and pine bark are particularly rich sources of proanthocyanidins and anthocyanins. Plants usually contain complex mixtures of phenolic compounds, including simple phenolic acids, quercetin, catechins, epicatechins, proanthocyanidins and anthocyanins. Wine is estimated to contain over two hundred phenolic compounds, though it is known that proanthocyanidins are the major bioactive polyphenols.

I find the broad term polyphenols to be the most convenient. The range of health benefits of polyphenols is extremely wide. Known primarily as potent antioxidants, they have also been reported to show antibacterial and antiviral action, to be anticarcinogenic, antiangiogenic, anti-inflammatory and anti-allergic. Various polyphenols have been shown to inhibit platelet aggregation and lipid peroxidation, as well as promote vasodilation and improve microcirculation. They can also chelate metals. Other benefits of high intake of polyphenols may include fewer cavities (an anti-caries action), improved kidney function, younger- looking skin and even the promotion of hair growth.

Cardiovascular benefits

A recent study done in Brazil showed that red wine as well as wine polyphenols without alcohol can provide marked protection against atherosclerosis. Rabbits were fed a high-cholesterol diet to produce a marked increase in their LDL cholesterol. One group of rabbits received red wine with their diet, another group was given non-alcoholic wine products and the third group served as control. All animals showed an increase in LDL cholesterol and some arterial plaque formation. The rabbits receiving red wine, however, fared best: on the average, only 38% of their arterial surface was covered with plaque (in some wine-fed animals, only 29%). Non-alcoholic wine products placed second, with 47%. Control animals showed plaque in 69% of their arterial surface. Thus, red wine and non-alcoholic but polyphenol-rich wine products were shown to inhibit arterial plaque formation even in the presence of high LDL cholesterol.

In addition, the authors checked the thickness of the inner arterial lining, the so-called "intima" layer. A thickening of the intima



Dry red wine is now recommended for diabetics, and is thought to be one reason for the greater slenderness of the French compared with other Europeans.

indicates excess smooth muscle proliferation, one of the many pathological processes involved in atherosclerosis. In terms of the ratio of the intima to the middle layer, the control group showed the greatest thickening (.60). The wine-fed group showed the least thickening (.14). The group consuming no alcohol but fed red wine polyphenols also showed significantly less thickening than the controls (.39). (The greater degree of protection provided by wine is probably due to the synergy between the wine polyphenols and ethanol. Ethanol, the alcohol found in wine, has been shown to have some cardioprotective properties when consumed within a moderate dose range.)

A similar Japanese study found that a proanthocyanidin-rich extract from grape seeds significantly reduced the severity of atherosclerosis in cholesterol-fed rabbits. The rabbits receiving grape seed extract in their cholesterol-laden diet showed less atherosclerosis in general and less oxidized LDL cholesterol in their foam cells (a component of plaque).

If a heart attack should happen, there is reason to think that those patients who have been consuming plenty of polyphenols would do better than those who do not have the help of those powerful antioxidants. A recent American study showed that the hearts of rats that had been fed grape seed extract were much more resistant to the injury caused by reperfusion (the return of blood to the tissue after a period of oxygen deprivation), as evidenced in greater ability to resume contractions. Likewise, a study on rats that focused specifically on the cardioprotective effects of resveratrol, found that pretreatment with resveratrol before inducing ischemia-reperfusion injury reduced the incidence and duration of arrhythmias and ventricular fibrillation. The authors concluded that resveratrol is a potent antiarrhythmic agent.

Anti-atherosclerotic benefits have been reported for purple grape juice as well. A study done at the University of Wisconsin, Madison, showed that when coronary patients consumed a large quantity of purple grape juice for 14 days, their flow-mediated vasodilation significantly improved, while their LDL cholesterol showed less susceptibility to oxidation. However, it takes a lot of juice to provide the same benefits as those of one glass of red wine - and a lot of juice means a lot of sugar. Grape seed extract, providing a rich mix of proanthocyanidins and other phenolic compounds, is a practical alternative for those who wish to avoid either the alcohol in wine or the sugar in grape juice.

A French study found that both red-wine proanthocyanidins and certain anthocyanins were able to produce a relaxation of the rat aorta, an effect due most likely to the ability of various phenolics to promote the production of nitric oxide. Proanthocyanidins turned out to be generally effective. However, one of the anthocyanins tested, delphinidin, showed exceptional effectiveness. A more recent American study done at Tufts University showed that the four anthocyanins found in elderberry extract were taken up by the membranes of the cells lining blood vessels, providing increased protection against oxidative stress. Another Tufts study found that blueberry anthocyanins protected red blood cells against oxidative stress by hydrogen peroxide both in vitro and in vivo.

Yet another way in which polyphenols help prevent atherosclerosis is by boosting the activity of vitamin C, which in turn increases the levels of vitamin E. This synergy increases the overall resistance to oxidative stress. It is oxidized LDL cholesterol and not cholesterol by itself, that is harmful. Thus the effort to lower LDL cholesterol is only part of the prevention of cardiovascular disease; reducing the oxidation of cholesterol is at least as important.

Besides the need to minimize the oxidation of LDL cholesterol, one needs to consider the role of platelet aggregation in arterial disease. Platelet aggregation is the first step in the formation of clots, which may lead to heart attack or stroke. Part of the effectiveness of aspirin in preventing heart attacks lies in its ability to inhibit platelet aggregation and thus the formation of clots. Dr. Lester Packer demonstrated that Pycnogenol, an extract from pine bark that is similar in composition to grape seed extract, "works better than aspirin in terms of controlling platelet aggregation, but without the unwanted side effects associated with aspirin. Pycnogenol reduced human smoking-induced platelet aggregation to the same extent as a five-time-higher dose of aspirin" (p. 127). This is a very dramatic finding, suggesting that cardiac patients especially should consider taking Pycnogenol or grape seed extract for preventive purposes.

Another study found that alcohol (ethanol) and wine polyphenols synergize in inhibiting platelet aggregation both in vitro and in vivo. Alcohol itself can inhibit platelet aggregation, but at rather high blood plasma concentrations (blood alcohol content of .2 or higher). In a study using dogs, it was found that a beneficial effect could be detected at much lower concentrations (blood alcohol content of .028) with polyphenol-rich red wine.

What might be the mechanism by which certain polyphenols in grape seed extract or pine bark extract inhibit platelet aggregation? Here we go back to the potent antioxidant properties of various phenolic compounds. If fewer free radicals are present, there is less inflammatory cascade that starts with the release of arachidonic acid from cell membranes and ultimately results in greater mobilization of platelets, creating a risk of a heart attack-inducing clot.

It is only recently that we have learned that heart disease is largely inflammatory in nature. Inflammation de-stabilizes the arterial plaque. Here again polyphenols turn out to be relevant, since they are known to have anti-inflammatory action. The main mechanism appears to be the inhibition of the metabolism of arachidonic acid. Studies have shown that various phenolic compounds can inhibit both the cyclooxygenase and the lipoxygenase inflammatory pathways, thus reducing the production of inflammatory prostaglandins and leukotrienes. In addition, some polyphenols (including resveratrol) have the ability to inhibit the activation of nuclear factor kappa-B, thus inhibiting the production of inflammatory cytokines. Proanthocyanidins have also been found to protect against a nitrogen-based free radical, peroxynitrite, one of the mediator molecules in inflammation. Yet another

anti-inflammatory mechanism may involve the inhibition of cell adhesion molecule proteins, thus dampening over-recruitment of immune cells.

As has already been mentioned, excess proliferation of smooth muscle cells in the arterial lining also plays an important role in the progression of atherosclerosis. Here again wine polyphenols have been shown to have a anti-atherosclerotic effect. Japanese scientists have demonstrated that the polyphenols extracted from red wine had a powerful inhibitory effect on smooth muscle proliferation in the rat aorta. A more recent Japanese study focused on the effects of resveratrol and found that this potent phenolic antioxidant (found chiefly in red wine, grape skins and, in lower concentrations, in peanuts) was able to inhibit smooth muscle proliferation induced by high levels of AGEs in the plasma. AGEs is an acronym for advanced glycation end-products that result from the crosslinking of proteins by simple sugars. This, again, suggests that grape seed extract could be of special importance to diabetics.

Finally, polyphenols play a role in the regulation of nitric oxide production. The correct amount of nitric oxide is crucial for relaxing the smooth muscles of blood vessels, thus producing vasodilation. Polyphenols found in red wine and grape seed extract, including resveratrol, have been shown to upregulate nitric oxide production by healthy arterial endothelium (cells lining the inner surface of blood vessels). Excess production of nitric oxide by macrophages (a type of immune cell), however, is associated with inflammation and various inflammatory diseases, including arthritis and atherosclerosis. If macrophages drawn to the vascular walls produce too much nitrogen oxide, the result is damage to the lining of the blood vessel. Excess nitric oxide gives rise to dangerous nitrogen-based free radicals such as peroxynitrite, which damages proteins and destroys glutathione. Packer places great emphasis on the ability of polyphenols to help regulate the production of nitric oxide, as well as help protect against not only oxidation, but also nitration. New findings indicate that alcohol can synergize with phenolic compounds found in red wine in inhibiting excess nitric oxide production by macrophages.

While a lot of research has concentrated on single phenolic compounds such as quercetin and resveratrol, it is likely that a rich mixture of various polyphenols is more effective in providing cardiovascular protection than any single compound. As Dr. Packer points out, "In almost every circumstance, combinations of antioxidants have been proven to be more effective than single antioxidants" (p. 118).

Potent anticarcinogens

Epidemiological studies confirm that those who consume plenty of polyphenol-rich foods and beverages have a lower risk of cancer. We are always being urged to eat more fruits and vegetables. There has been little guidance, however, as to which fruits and vegetables should be particularly emphasized. There is reason to think that berries should be very high on the list.

Blueberries and other berries, notably raspberries and strawberries, contain a potent anticarcinogenic compound called ellagic acid. While the anticarcinogenic properties of ellagic acid are particularly well documented, polyphenols in general are known to inhibit the bioactivation of carcinogens. They also exert antiproliferative (anti-mitotic) effects that are particularly pronounced in tumor cells. Add to this the growing evidence that some classes of phenolic compounds, including anthocyanins and proanthocyanidins, have an anti-angiogenic effect (that is, they prevent the development of new blood vessels).



Raspberries and strawberries contain a potent anti-carcinogenic compound called ellagic acid, which is well documented, however flavonoids in general are known to inhibit the bioactivation of carcinogens.

Red wine and grape seed extract also show a great promise in the prevention of cancer. Resveratrol in particular has been extensively studied for its anticarcinogenic properties. Its action on tumor cells has been found to be dose-dependent. Very low doses appeared to increase proliferation; higher doses decreased proliferation and induced apoptosis (programmed cell death). Exposure of colon cancer cells to resveratrol resulted in growth inhibition through cell-cycle arrest and an inhibition of polyamine synthesis, apparently through inhibition of a crucial enzyme, ornithine decarboxylase. Resveratrol also strongly inhibited the proliferation of liver-cancer cells. Interestingly, ethanol (the alcohol present in wine) lowered the threshold for the effectiveness of resveratrol, again showing that alcohol can enhance the action of polyphenols. Resveratrol and quercetin have also been shown to some effectiveness against leukemia.

Grape seed extract has been found to provide greater protection against DNA damage than vitamins C, E and beta-carotene. In addition, grape seed extract has proven effective in vitro in arresting the growth of human breast cancer, lung and gastric adenocarcinoma. In animal studies, topical application of grape seed extract has been shown to provide excellent protection against skin cancer. Of special interest is the recent finding that grape seed extract may also work against prostate cancer. Up to 98% growth inhibition was obtained in a dose- and time-dependent manner. Another study found that resveratrol downregulates androgen-upregulated genes, thus inhibiting androgen-stimulated cell growth. It should be stressed that while resveratrol is often referred to as a phytoestrogen, it has no feminizing side effects.

The fact that polyphenols raise glutathione levels is also of great importance in cancer prevention. Glutathione is one of the chief factors in the defense of DNA. In fact, one of the many jobs performed by glutathione is activating the enzymes that repair damaged DNA. The liver also needs enormous amounts of glutathione to detoxify the endless carcinogens and other toxins to which we are constantly exposed. By boosting glutathione levels with various polyphenols, we increase our ability to detoxify harmful chemicals.

People who show a slow rate of aging and a resistance to cancer (both thought to be due to “centenarian genes”) tend to have higher levels of glutathione than their chronological peers. Conversely, people suffering from age-related diseases are deficient in glutathione. Likewise, animal studies have shown that raising glutathione levels can extend life span. Thus, if we can keep our glutathione levels from declining with age, it is likely that we will age more slowly and will be more resistant to cancer. Dr. Packer, for one, thinks that reaching 100 should not be a difficult feat as long as we can maintain youthful levels of glutathione. Dr. Packer, of course, advocates the boosting of the entire antioxidant network, which means consuming an antioxidant-rich diet and supplementing with a variety of antioxidants, including a mix of polyphenols.

Supplementation with oral glutathione is controversial because of uncertainty as to its absorption in the reduced state. However, there is reason to think that if glutathione is taken together with sufficient amount of bilberry extract, it can be absorbed in the reduced (antioxidant) state. It may still be more cost-effective, however, simply to consume a lot of polyphenol-rich food and/or take supplements that contain a mixture of various phenolic compounds, along with lipoic acid, also known to be very effective at raising the levels of glutathione.

Packer also reports the findings that Pycnogenol enhances the immune function, increasing the production of Interleukin 2 and stimulating natural killer cell activity. A healthy immune system is regarded as one the crucial factors in resistance to cancer.

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Preventing UTIs and dental decay

No, you don't need to drink huge amounts of cranberry juice! In fact, cranberries are not the only berry that can fight urinary infections. A cup of blueberries a day ought to do the trick. Dr. Amy Howell at the Rutgers Blueberry Cranberry Research Center at Rutgers University in New Jersey was part of the team that discovered the anti-UTI effect of blueberries. She admits that she eats blueberries by the pint when in season.

What is the secret of the antibacterial effectiveness of these amazing berries? According to Dr. Howell, it is the condensed tannins in blueberries that prevent bacteria from adhering to the wall of the bladder, literally making it difficult for the infection "to take hold." Thus, these tannins could be called "anti-adhesins." By the way, part of the mechanism through which blueberry polyphenols fight dental decay is the same as the way they fight urinary infections: they interfere with the ability of the bacteria to adhere to dental surfaces.

Recent research has confirmed this and identified specific proanthocyanidins, composed of epicatechin units, that appears to be the most bioactive anti-adhesive polyphenols.

But anti-adhesive activity is probably not the only mechanism of action. Tannins in general have been found to have an antimicrobial effect. The growth of many bacteria, viruses, yeasts and fungi is inhibited by these compounds. Very likely, they interfere with genetic signaling in the microbial cells. (Note that polyphenols are generally anti-proliferative, inhibiting even the proliferation of normal cells, but affecting especially cancer cells and pathogenic organisms.) Remember, however, that dosage is critical for effectiveness. At this point, we have barely begun to investigate these effects in a controlled manner.

This is not to say that you should forget about cranberries. Cranberries (*Vaccinium macrocarpon*) are the cousins of blueberries. It is not surprising that, in addition to preventing and relieving bladder infections, cranberries too have been shown to have considerable cardiovascular and anti-cancer benefits, similar to those of other berries. Unfortunately, cranberries are usually prepared with a lot of sugar. This makes the relatively low-glycemic blueberries (fresh or frozen) a better choice for daily consumption. As a bonus, slowly chewing blueberries is probably excellent against tooth decay. Drinking tea also has that effect. Polyphenols in general have an anti-bacterial and anti-viral effect.

If you prefer the traditional remedy of drinking cranberry juice by the quart, try the unsweetened variety. The typical commercial cranberry cocktails contain so much sugar that there is a danger of suppressing your immune system and thus possibly making the infection even worse. The best and most practical solution appears to be taking cranberry extract in the supplement form.

Why consider berries and berry extracts for urinary tract infections when we have antibiotics? One reason is the development of bacterial resistance due to the overuse of antibiotics. Another excellent reason for decreasing the use of antibiotics is that these are not harmless compounds. They have side effects, such as diarrhea. The killing off of friendly bacteria often results in an overgrowth of harmful organisms such as *Candida*. Many women experience a miserable vaginal *Candida* infection practically every time they use antibiotics. The use of a potent cranberry extract has no side effects, while producing multiple benefits.

Since it is women who tend to suffer more frequently from urinary tract problems, it may be worth mentioning here that according to alternative clinicians, menstrual problems typical of perimenopause can also be alleviated with large doses of flavonoids, including the powerful anthocyanins in bilberry extract. According to an Italian study, high intake of bilberry flavonoids (anthocyanins) may also decrease or even eliminate the soreness in fibrocystic breasts. This may be due mainly to the anti-inflammatory action of these phytonutrients and also to their probable ability to bind to Type II estrogen receptors and exert hormone-like effects, counteracting too much estrogenic stimulation.

Polyphenols slow aging

In his excellent book, *The Antioxidant Miracle*, Dr. Lester Packer reports that antioxidants such as vitamin E and the pine-bark polyphenols (similar to those contained in grape seed extract) have shown in vitro the ability to slow cellular aging. In the case of the pine-bark proanthocyanidins (Pycnogenol), Packer demonstrated that these polyphenols could protect brain cells against apoptosis (programmed cell death) in an experimental model that mimics the aging process.

Research has also established that the rate of telomere shortening in dividing cells and thus, indirectly, the rate of aging, can be significantly modified by the amount of oxidative stress. (Telomeres are end points of each chromosome; their length decreases with each cell division until the telomeres become so short that the cell can no longer replicate.) It has been shown that if oxidative stress is lowered through enrichment with potent antioxidants, the rate of telomere shortening is slowed down. Mixtures of anthocyanins and proanthocyanidins are among the most powerful antioxidants yet discovered.

Likewise, the accidental discovery by Dr. Winter that regular consumption of ginkgo may extend both the average and the maximum life span in rats could prove to be very important. It would be interesting to repeat his study using grape seed extract, since the proanthocyanidins found in grape seed extract show some of the same properties (e.g. inhibiting platelet aggregation and improving microcirculation) as the compounds found in ginkgo.

There is extensive epidemiological evidence that populations consuming larger quantities of polyphenols show less obesity and lower cardiovascular, cancer and Alzheimer's disease mortality. Take Eastern Asia, for instance, with its high intake of green tea, miso, ginger and a great variety of vegetables; Southern France and other Mediterranean countries, with their high consumption of red wine and olive oil, both known to be rich in phenolic compounds. Chocolate too may have similar benefits, due to its high content of proanthocyanidins similar to those found in red wine. Epidemiological studies tend to confirm a correlation between low risk for various degenerative disorders and high consumption of polyphenols. If red wine and chocolate do not agree with you, you can always reach for grape seed extract.

One of the most anti-aging important properties of anthocyanins and simpler phenolic compounds such as ellagic acid and quercetin is their ability to recycle glutathione. Glutathione is one of our most important antioxidant defenses. It is a tripeptide consisting of amino acids glutamate, glycine and cysteine. Some experts call glutathione the "ultimate antioxidant" and regard high glutathione levels as the key to longevity. Higher than average glutathione does indeed seem to be one of the characteristics of centenarians. Those of us who do not happen to have centenarian genes (and that means practically all of us) can perhaps compensate by eating a lot of berries and/or taking bilberry extract in order to raise our glutathione levels (lipoic acid and n-acetylcysteine also raise glutathione). If you wish to take oral glutathione, it might be a good idea to take a high dose of bilberry extract with the glutathione capsule in order to help prevent glutathione from being oxidized right in the gastrointestinal tract.

High serum glucose is a major factor in accelerated aging. Simple sugars such as glucose, fructose and galactose can act as free radicals. They can also attach themselves to amino acids, thus damaging proteins. Polyphenols, especially the large polymers often called "condensed tannins," can protect against this damage by lowering blood sugar, as well as through their antioxidant action. Diabetics especially should take note of the finding that consuming more polyphenols is likely to lower the rate of glycosylation, a process of sugar-induced protein damage that leads to severe problems such as cataracts, neuropathy and even kidney failure. Eating the whole fruit may be of special value for lowering blood sugar, since the pectin in blueberries also has a hypoglycemic (glucose-lowering) effect.

Lower serum glucose and low insulin levels are among the dramatic biomarkers of slower aging in calorie-restricted animals. This effect very likely applies to humans. A massive National Institute of Health study has already established that older men with the lowest insulin are the healthiest. Low-normal blood sugar generally goes hand-in-hand with healthy-range blood lipids.

All in all, reduced absorption of both proteins and carbohydrates due to high polyphenol intake results to some degree in calorie restriction. Since the individual is eating his or her customary portions of food, this is calorie restriction without the discomfort of hunger. While tannins have a bad reputation in animal husbandry because they slow down the animals' growth and help prevent fattening up, the implications for humans are quite positive. Calorie restriction is well known to be an effective way to slow aging. Unfortunately, very few individuals are able to practice it by limiting their food intake. Adding blueberries, red wine and other sources of polyphenols to the diet might at least partly help this problem by slowing down digestion (by inhibiting enzymes such as amylase) and reducing absorption.

For now, we can only make an educated guess that blueberries and bilberry extract, as well as grape seed extract, with their spectacular antioxidant power, have anti-aging benefits and may even be able to extend life span if consumed daily in sufficient doses. This is highly likely in view of the documented antioxidant, chelating, hypoglycemic, antiatherogenic, anticarcinogenic, anti-inflammatory, immunostimulating and enzyme-modulating effects of polyphenols.

Our whole notion of the "inevitable" disabilities of so-called "normal aging" (isn't this like saying "normal cancer"?) is undergoing a revolutionary change. The stereotype of a "little old lady" or a "little old man" evokes the image of someone shrunken and stooped, wrinkled, forgetful and confused, hardly able to walk, weak and shaky, falling down for no apparent reason, part-blind and deaf and so on. These horrors have traditionally been shrugged off as simply "aging," with the implication that nothing can be done.

Now we are discovering that in fact a lot can be done. Aging can be slowed down and some aspects of it can even be reversed. Not too long ago, if anyone should have dared suggest that something as simple as eating blueberries could reverse aging-related loss of motor function, s/he would have been dismissed as a naïve optimist who doesn't understand the fundamental laws of biology. The official belief was that if we live long enough, we are doomed to develop cataracts, dementia, bone and muscle loss and so forth. Not any more. Now the evidence to the contrary is beginning to pour in. The belief that growing older is synonymous

with becoming senile and decrepit is being rapidly eroded.

So, based on this new evidence, it is wise to consume plenty of berries, cherries and plums and a moderate amount of red wine-the richest natural sources of proanthocyanidins, anthocyanins, simple phenolic acids and other phenolic compounds-and to initiate or continue a standard anti-aging regimen. Since even blueberries can get boring when eaten every day, it is good to try all kinds of berries and other antioxidant-rich fruit in order to enjoy variety. Blackberries, for instance, are also an extremely rich source of phenolic antioxidants. Likewise, tart cherries, now available in the dried form, are a delicious source of anthocyanins and ellagic acid. Unsweetened prunes are also high on the list of antioxidant-rich fruit. Think in terms of rich, deep pigments and somewhat tart taste-these signal the presence of the beneficial polyphenols.



Since even blueberries can get boring when eaten every day, it is good to try all kinds of berries and other antioxidant-rich fruit in order to enjoy variety.

In order to get the full benefits of blueberries and/or bilberry extract, you should eat an adequate amount and/or take an adequate dose. Half a cup of blueberries a day is probably the minimum needed to provide benefits for the brain; a whole cup works better for preventing bladder infections. The elderly who wish to reverse motor dysfunction may also consider consuming a larger amount, or else supplement their berry consumption with high-potency bilberry extract. You may want to experiment to see what dosage range works best for you in terms of vision improvement or arthritis relief. If you have arthritis and want to wake up free from stiffness and pain, you might also consider taking 300 mg of grape seed extract at bedtime. For anti-aging purposes, however, you can adjust the dose according to your age, body size and other antioxidants currently taken.

Much higher doses of anthocyanins may be needed as an adjunct treatment of diabetes and its complications, such as diabetic retinopathy, but such treatment requires the guidance of an experienced alternative clinician. The general rule is that a synergistic mixture of antioxidants works much better than relying on a single agent.

In summary, getting sufficient doses of polyphenols from diet and supplements should be an important part of any serious anti-aging regimen.

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