

ROLE OF FRUITS IN BRAIN HEALTH

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ABSTRACT

The human brain is a complex, active machine affected greatly by diet. According to Psychology the right food increases mental capabilities including concentration, motivation, memory and even brain aging. Eating the right food can keep one focus and increase recall levels throughout the day. Varieties of brain-healthy fruits are available to prevent many diseases associated with brain and memory loss. These fruits also increases and improves concentration. This review includes the role of specific fruits in brain function and that helps in keeps the brain health.

Keywords: brain, fruits, diseases.

INTRODUCTION

The single greatest system ever designed in the history of the universe is human brain. Human brain is responsible for every thought, emotion, and behavior. Human brain weighs 2 to 4 pounds and is comprised of 60% fat and is the fattiest system in our body. It consumes 25% of the blood from every heartbeat and it has two sides or hemispheres (left hemisphere and right hemisphere). Left hemisphere helps for language, detail, and analysis Right hemisphere helps for faces, spatial orientation, sounds. It has a cortex and subcortex¹.

Cortex is conscious and helps to learn, remember, communicate, read, write, orient to space, process sensory information, and personality. Sub cortex processes subconscious motor or procedural behaviors such as dressing, driving, and typing on computer. Hippocampus is the structure in the brain that enables for learn¹.

New brain cell development and increased cellular connections (“Synaptic Density”) are due to exposure to enriched environments. Synaptic Density or Brain Reserve may help to delay the onset of neurodegenerative diseases such as Alzheimer’s and related dementias¹.

The human brain (like the animal brain) can generate new brain cells. This new brain cell development (neurogenesis) occurs in the hippocampus. The human brain is now thought to have “neural plasticity” or be a system that is highly dynamic, constantly reorganizing, and malleable. It is shaped by environmental input¹.

We’ve known for years that a poor diet can contribute to chronic diseases, such as Type 2 diabetes, heart disease, high blood pressure, and even some types of cancer. In recent years, though, researchers have found a link between the foods we eat and brain function. Those same bad habits that lead to chronic disease can lead to impaired memory, reduced cognitive function and even Alzheimer’s disease².

Brain aging

Brain aging is characterized by the continual concession to battle against insults accumulated over the years. One of the major insults is oxidative stress, which is the inability to balance and to defend against the cellular generation of reactive oxygen species (ROS). These ROS cause oxidative damage to nucleic acid, carbohydrate, protein, and lipids. Oxidative damage is particularly detrimental to the brain, where the neuronal cells are largely post-mitotic. Therefore, damaged neurons cannot be replaced readily via mitosis. During normal aging, the brain undergoes morphological and functional modifications resulting in the observed behavioral declines such as decrements in motor and cognitive performance. These declines are augmented by neurodegenerative diseases including amyotrophic lateral sclerosis (ALS), Alzheimer’s disease, and Parkinson’s disease³.

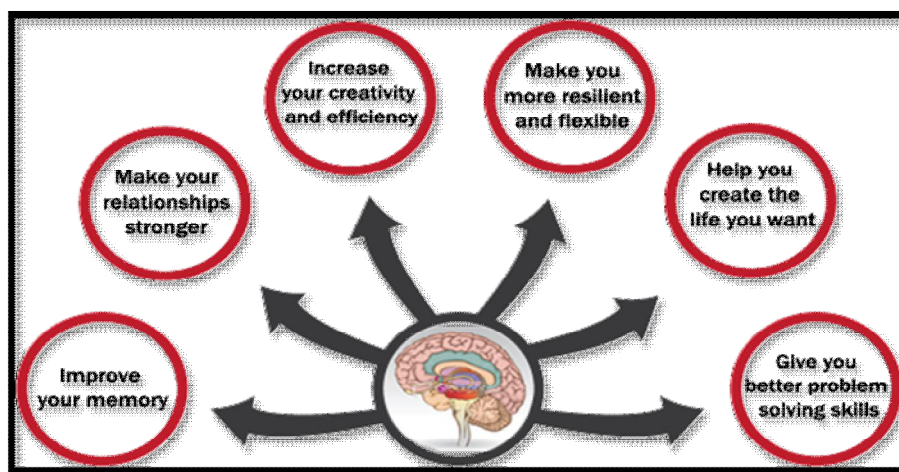
Memory

One of the important function of the brain is memory. Memory is carried in a network of brain cells called neurons, which resemble a tree with a trunk – the axon -- and small branches – the dendrites -- which connect to other neurons.

Brain cells need oxygen, and lots of it, to perform. The brain receives oxygen through the blood stream. When blood vessel flow is restricted by diabetes, high blood pressure, or

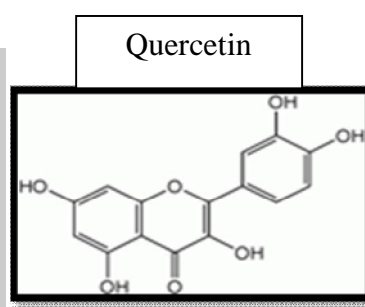
coronary artery disease, the amount of blood— and oxygen—available for the brain decreases.

Type 2 diabetes damages blood vessels so blood flows less efficiently. High blood pressure and high levels of LDL, or low-density lipoprotein cholesterol, cause plaque buildup in the walls of arteries, which can also impair cognitive function, or contribute to vascular dementia, an Alzheimer's-like disease. A study in the Netherlands found that patients with high blood pressure showed a loss of neurons in a brain scan. This loss of neurons may not cause immediate memory decline, but over time, memory loss is an almost certain outcome. Another potential cause of memory loss is the presence of high levels of homocysteine, a natural amino acid found in the brain. Researchers have isolated several nutrients and chemical compounds that seem especially effective at improving memory and keeping the cogs of our brain running smoothly. The following figure shows the important activities of brain.



Memory Boosting-Fruits

Apples



- **Apples.** Apples contain a bioflavonoid that reduces inflammation known to destroy brain function. Organic apples with the skin on for maximum benefit. Apples are rich in Quercetin which is a type of phytochemical called a flavonoid.

Berries



- **Berries.** Berries are loaded with powerful antioxidants that protect your body and brain from cellular damage. Blueberries have the highest levels of antioxidants, according to the USDA Human Nutrition Center, but all berries are helpful.
- **Citrus Fruits.** Citrus fruits contain vitamin C, folate, potassium and antioxidants, powerful compounds known to reduce the risk of inflammation, oxidative stress and even coronary disease and stroke. These compounds keep blood vessels flowing so oxygen can reach the brain, improving cognitive function and memory.
- **Pomegranates.** Pomegranates contain high levels of polyphenols, antioxidants that reduce clogging of the arteries. In fact, pomegranate juice has higher levels of polyphenols than orange, grape or blueberry juice, and even red wine. One study found that patients with heart disease who drank one cup of pomegranate juice daily for three months had improved blood flow to the heart. Better blood flow to the heart means better blood flow to the brain.
- **Tomatoes.** Tomatoes get their color from lycopene, a phytochemical believed to be even more powerful than beta carotene and vitamin E at protecting the heart and brain from damage⁴⁻¹⁵. Researchers have found that heating tomatoes helps the body absorb lycopene.

Diseases associated with Brain

Alzheimer's disease

Epilepsy

Meningitis

Encephalitis

Arachnoid cysts

Huntington's disease

Attention deficit/hyperactivity disorder (ADHD)

Locked-in syndrome

Parkinson's disease

Tourette's syndrome

Multiple sclerosis

Fruits for treating and prevention of brain diseases

Growing evidence suggests that oxidative damage caused by the beta-amyloid peptide in the pathogenesis of Alzheimer's disease may be hydrogen peroxide mediated. Many polyphenols, the most abundant dietary antioxidants, possess stronger neuroprotection against hydrogen peroxide than antioxidant vitamins¹⁵.

Fruit and vegetable juices may play an important role in delaying the onset of Alzheimer's disease, particularly among those who are at high risk for the disease. These results may lead to a new avenue of inquiry in the prevention of Alzheimer's disease¹⁵.

Fruits and vegetables should also be washed thoroughly before consumption to avoid further infections. Juices from citrus fruits like lemons, pineapples and oranges are also helpful in strengthening the immune system¹⁶.

Neuroprotective effects of fruit polyphenols

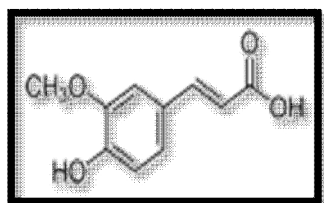
Since the endogenous antioxidant defense systems are not 100% effective, it is plausible to suggest that nutritional antioxidants be exploited to combat the accumulation of oxidative stress over the ever-prolonging human lifespan¹⁷⁻²³. Therefore there is an increased focus in the study of the beneficial effects of nutritional antioxidants on health via the delay of aging and age-related diseases.

Polyphenols in fruits

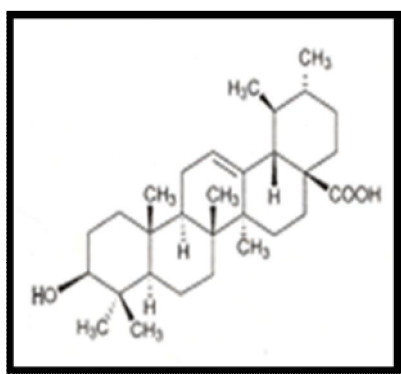
Fruits and vegetables rich in polyphenols have been found to be beneficial to brain function. Some of the fruits and vegetables include blueberries, cranberries, strawberries, and spinach, all of which are high in antioxidant capacities as measured by the modified oxygen radical absorbance capacity (ORAC) assay. This may account for the positive results observed with blueberry as well as other berry supplementation in rodent studies²⁴.

High polyphenol fruits:

Ferulic acid is a phenolic phytochemical which is present in apples and many plant cell walls and seeds.

Ferulic acid

Ursolic acid, a pentacyclic triterpenoid, is also found in many other plants and fruits besides apples, including cranberries, prunes, peppermint, lavender, oregano and thyme.

Ursolic acid

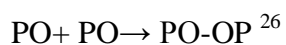
Apples without skin, apple butter, or applesauce, Apple cider and juice, Apricots, Black- or red currants, Blackberries, Blood oranges, Blueberries, Chokeberries, Cranberries, Dates, Elderberries, Gooseberries, Green apples (with skin), Kiwi, Lemon, Ligonberries, Limes, Mangoes, Marionberries, Nectarines, Oranges: navel, tangelos, tangerines, etc. (the white pithy stuff is flavonoid-rich), Peaches, Pears, Plums and prunes (dried plums), Pomegranates, Quinces, Red or purple grapes, Red apples (with skin), Raspberries, Rhubarb, Raisins, Strawberries and Sweet or sour cherries.

Practical aspects of dietary polyphenol antioxidants

The regulation theory considers a polyphenol antioxidant's ability to scavenge free radicals and up-regulate certain metal chelating reactions. Various reactive oxygen species, such as singlet oxygen, peroxynitrite and hydrogen peroxide, must be continually removed from cells to maintain healthy metabolic function. Diminishing the concentrations of reactive oxygen species can have several benefits possibly associated with ion transport systems and so may affect redox signaling²⁵.

The "deactivation" of oxidant species by polyphenolic antioxidants (POH) is based, with regard to food systems that are deteriorated by peroxy radicals (R), on the donation of hydrogen, which interrupts chain reactions: $R + POH \rightarrow R-H + PO$

Phenoxy radicals (PO) generated according to this reaction may be stabilized through resonance and/or intramolecular hydrogen bonding, as proposed for quercetin, or combine to yield dimerisation products, thus terminating the chain reaction:



The polyphenolic compound resveratrol (3,4',5-trihydroxystilbene) is a naturally occurring phytochemical which has been found in more than 70 plant species, including herbs and human food products such as grapes, berries, and peanuts. Resveratrol was first isolated in 1940; however, little attention was paid to it until its benefits in coronary heart disease were studied in 1992. Since then, increasing evidence has indicated that resveratrol may be useful in treating cardiovascular diseases, cancers, pain, inflammation, tissue injury, and in reducing the risk of neurodegenerative disorders, especially Alzheimer's disease.

Alzheimer's disease is characterized by a progressive dementia, and is one of the most common neurodegenerative disorders in the elderly. It has been reported that resveratrol exhibits neuroprotective benefits in animal models of Alzheimer's disease. Resveratrol promotes the non-amyloidogenic cleavage of the amyloid precursor protein, enhances clearance of amyloid beta-peptides, and reduces neuronal damage²⁷.

Black berries

Health benefits: Blackberries have a high abundance of healthy antioxidants and nutrients such as anthocyanins, salicylic acid, ellagic acid, and fiber. Recent research on berries has shifted focus away from antioxidants as there is ample evidence that the antioxidants in berries do not get into the bloodstream and act as radical scavengers. However, there is evidence that they are important in cardiovascular health. Anthocyanins are antioxidants found in blackberries that are responsible for giving blackberries their rich and dark color. This concentrated pigment of blackberries is acknowledged with decreasing the rate at which the memory deteriorates.

Blackberries contain a compound called salicylic acid. This compound found in blackberries has been used for centuries for its medicinal qualities. Salicylic acid has been proven to numb bodily pains and treat unusually high body temperature, or fevers. Salicylic acid may have similar properties to aspirin that aid in protecting the body against heart disease. The most beneficial property of the blackberry is its profusion of ellagic acid. Ellagic acid is a phytochemical, meaning it is only found in certain plants.

In experimental studies, ellagic acid is used to treat tumors in mice; the result being ellagic acid is reliable for causing the death of particular cancer cells. Researchers believe that ellagic acid may also work to reduce the harmful effects of estrogen that create breast cancer cells²⁸.

Blackberries have both soluble and insoluble fiber. One cup of blackberries (144 g) has an average of 7.6 g of fibre and contains half the daily recommended dose of vitamin C, which protects the immune system and can lower the risk of developing certain cancers. Fiber is important in maintaining a healthy digestive system as it pushes toxins and other excess waste through the intestines and supports healthy and conventional bowel movements. One of the soluble fibres found within blackberries is pectin. Pectin helps lower harmful cholesterol levels which lowers ones' chances of heart disease. Blackberries have few calories. Blackberries are more nutritious compared to other berries making it one of the best berries one can consume²⁹.

The blackberry is known to contain polyphenol antioxidants, naturally occurring chemicals that can up regulate certain beneficial metabolic processes in mammals. The astringent blackberry root is sometimes used in herbal medicine as a treatment for diarrhea and dysentery. Blackberries are notable for their high nutritional contents of dietary fiber, vitamin C, vitamin K, folic acid (a B vitamin), and the essential mineral manganese.

Blackberries rank highly among fruits for antioxidant strength, particularly due to their dense contents of polyphenolic compounds, such as ellagic acid, tannins, ellagitannins, quercetin, gallic acid, anthocyanins and cyanidins. Blackberries have an ORAC value (oxygen radical absorbance capacity) of 5347 per 100 grams, including them among the top-ranked ORAC fruits³⁰.

Grape Juice for Brain Health

Grape phytochemicals, such as resveratrol (a polyphenol), have been shown in basic research to possibly inhibit mechanisms of cancer, heart disease, degenerative nerve disease, viral infections and Alzheimer's disease³¹.

In vitro studies indicate that protection of the genome through antioxidant actions may be a general function of resveratrol³². In laboratory studies with mice, resveratrol has transcriptional overlap with the beneficial effects of calorie restriction in heart, skeletal

muscle and brain. Both dietary interventions inhibit gene expression associated with heart and skeletal muscle aging, and prevent age-related heart failure³³

Polyphenols in grape skins may help prevent cognitive decline and Alzheimer's disease. Drinking grape juice three times per week helps to maintain or improve cognitive function. The juice may be freshly squeezed, or a purchased 100 percent fruit juice product may be used. Avoid selecting fruit juices that are made from concentrate because they contain water, which dilutes the benefits of the fruit juice, and sugar, which may have harmful effects.

According to the average values reported in the USDA Database, the antioxidant power per 8-ounce serving of Welch's 100% Grape Juice, made from Concord grapes, is:

- More than twice as high as orange juice
- Nearly twice as high as 100% grapefruit juice
- More than twice as high as 100% cranberry juice blend
- Five times higher than 100% tomato juice
- Six times higher than 100% apple juice.³⁴

A healthy vascular system is necessary for a healthy brain – suggesting that Concord grape juice may also promote brain health. Further, brain tissue is particularly susceptible to oxidative stress, which research suggests accelerates the mental and physical declines associated with aging.

With growing evidence, many scientists believe that consumption of antioxidant-rich foods, such as fruits and vegetables and their juices may help preserve cognitive function and/or slow or reverse cognitive/memory decline in certain populations.

Results from a recent pilot human study suggest that including Concord grape juice in the diet may provide benefit for older adults with early memory decline. This study represents the first placebo-controlled human study to investigate whether regular consumption of a polyphenol-rich food or beverage could have beneficial effects against age-related cognitive decline. Participants who drank Concord grape juice showed significant improvement in list learning and trends suggested improved short-term retention and spatial memory.

Concord grape juice and red wine polyphenols show promise in counteracting beta-amyloid plaques associated with cognitive decline. A characteristic hallmark of Alzheimer's disease-type neuropathology is the accumulation of beta-amyloid peptides and their formation into

plaques in the brain. Researchers at Mount Sinai School of Medicine found that polyphenol extracts from Cabernet Sauvignon and Concord grape juice reduced the generation and accumulation of beta-amyloid peptides in experimental models of Alzheimer's disease. These preliminary results show the potential protective role which non-alcoholic, polyphenol-rich Concord grape juice may play in maintaining long term cognitive health³⁵.

In one of the animal study it was concluded that drinking Concord grape juice improved some memory and neuro-motor skills. In this laboratory study, older animals were presented with several commonly-accepted challenges designed to measure their short-term memory and neuro-motor skills. Consuming Concord grape juice significantly improved the animals' performance in a water maze test of memory and some physical tests of coordination, balance and strength. Interestingly, while Dr. Joseph has noted improved cognitive function with a number of high-antioxidant fruits and vegetables, only concord grape juice and a few other fruits have demonstrated improvements in motor functions as well³⁵.

Frequent consumption of 100% Juices associated with reduced risk of Alzheimer's disease development although not specific to Concord grape juice, additional research has shown an association between fruit and vegetable juice consumption and a reduced risk of Alzheimer's disease, suggesting that fruit and vegetable juices may play an important role in delaying the onset of this disease³⁶.

Commercial juice products from Concord grapes have been applied in medical research studies, showing potential benefits against the onset stage of cancer³⁷, platelet aggregation and other risk factors of atherosclerosis, loss of physical performance and mental acuity during aging and hypertension in humans³⁸.

More evidence that grape juice may 'reverse' brain aging. Drinking concord grape juice appears to reverse the course of neuronal and behavioural aging in rats, an effect that is proposed to be due to the complex mix of polyphenols³⁹.

As per the findings of animal study, it may take a higher concentration of grape juice to enhance motor performance, whereas lower concentrations may be sufficient to alter cognitive performance.

While previous studies have identified specific polyphenols that have a direct effect on cell signalling, such as resveratrol, the researchers suggest that the effects of the Concord grape juice may be due to the mixture of polyphenols present.

One of the previous studies suggested that the entire grape, which is a mixture of many different polyphenols, may be more effective than any one single component because individual polyphenols might exert their effects through different and/or independent mechanisms. The Concord grape juice has been shown to reduce the oxidation of LDL (bad) cholesterol⁴⁰.

Concord grape juice is rich in polyphenols, an important antioxidant compound that helps to combat reactive oxygen species suggested contributing to the aging process. Robert Krikorian, from the University of Cincinnati Health Center (Ohio, USA), and colleagues enrolled 21 men and women, average age 76 years, with mild cognitive impairment, in a 16 week long study. Subjects received either a weight-dependent quantity of Concord grape juice, equivalent to 6.3 to 7.8 mL per kilogram of body weight, or a placebo beverage. Results showed that consumption of grape juice was associated with fewer errors in memory tasks, compared with placebo. Magnetic resonance image of the brains of the study participants showed significantly greater activation in anterior and posterior regions on the right side of the brain of the subjects receiving the grape juice, suggesting improvements in memory performance and mental function. The study authors conclude that: "These findings provide further evidence that Concord grape juice can enhance neurocognitive function in older adults with mild memory decline."⁴¹

Grape seeds

Proanthocyanidins are compounds naturally found in fruits, vegetables, seeds, nuts, flowers and bark. They are a class of phenolic compounds that are either oligomers or polymers of flavan-3-ol units. Grape seeds are a particularly rich source of proanthocyanidins, both in quantity and variety. Interest in grape seed extract developed in the late 20th Century with explorations into the "French Paradox." The paradox describes how despite a diet high in saturated fats, the French rate of mortality from heart disease is relatively low. Investigators were especially interested in the protective role of red wine, a staple of the French diet. Proanthocyanidins, which are present in red wine due because fermentation takes place in the presence of grape seeds and skin, were shown to bestow cardioprotection against cardiac ischemia and had a role in lowering cholesterol levels. However, many other benefits of

grape seed extract proanthocyanidins have also been uncovered including potent antioxidant activity and cytotoxicity to cancer cells. The popularity of antioxidants has brought grape seed proanthocyanidin extract (GSPE) into mainstream consumer consciousness. There are many different brands of grape seed extracts on the market in countries such as the United States, Australia, Japan and Korea. One of the mostly prevalent products is a novel IH636 grape seed proanthocyanidin extract available as "ActiVin" from InterHealth Nutraceuticals Incorporated. It is composed of a water-ethanol extract of red grape seeds. The daily recommended dosage is "50 mg for adults ages 30 years to 40 years, 100 mg for adults ages 40 years to 50 years, and 200 mg for adults older than 50 years".

Blueberries

Blueberries and bilberries belong to the genus *Vaccinium*, which includes more than 450 plants grown in all parts of the world. Members of the *Vaccinium* genus possessing the darkest colored fruits appear to provide the greatest health benefits, a fact that scientists attribute to the compounds that give the plants their dark pigmentation. These bioflavonoids include anthocyanins and their precursor, proanthocyanidins, both of which are voracious scavengers of free radicals. Research demonstrates that blueberry consumption boosts serum antioxidant status in humans. Elevated antioxidant levels in the body may protect against damage to cells and cellular components, thus helping to reduce the risk of many chronic degenerative diseases⁴²⁻⁴⁴

Blueberries can help improve and regenerate cognitive functions in the brain, according to United States Department of Agriculture. Aging causes cognitive decline in most people as they age. For years, the scientific community believed the brain cells once dead could not be revived. However, blueberries polyphenolic compounds may help regenerate brain cells⁴⁵.

It has since been bolstered by animal studies demonstrating that daily consumption of modest amounts of blueberries dramatically slows impairments in memory and motor coordination that normally accompany aging. Moreover, a wealth of exciting new research clearly establishes that in addition to promoting brain health, this long-prized native North American fruit—whether consumed fresh, frozen, canned, or as an extract—may confer a range of diverse health benefits.

After testing 24 varieties of fresh fruit, 23 vegetables, 16 herbs and spices, 10 different nuts, and 4 dried fruits, the US Department of Agriculture determined that blueberries scored highest overall in total antioxidant capacity per serving⁴⁶. Separate studies show that

blueberries may help to lower blood cholesterol, promote urinary tract health, and reduce the risk of urinary infections. Studies in Europe have documented the relationship between consumption of bilberries (the blueberry's close European cousin) and eye health, highlighting the berries' ability to improve night vision, halt cataract progression, and protect against glaucoma. New studies also support blueberries' ability to reduce age-associated lipid peroxidation, a contributor to cardiovascular disease, and to suppress the growth of several types of cancer cells, suggesting that blueberry phytochemicals may well play a future role in human cancer treatment⁴⁷⁻⁵³.

In one of the study it was concluded that dopamine levels were much more higher in the brain of blueberry supplemented rats when compared to other non-supplemented rats.

Dopamine is an essential neurotransmitter that enables smooth, controlled movements as well as efficient memory, attention, and problem-solving function. It was concluded that blueberry extract might also increase brain cell membrane fluidity while reducing levels of inflammatory compounds, thus slowing the brain's normal aging process⁵⁴.

Blueberries may also prove capable of helping humans whose brains have been damaged by a loss of blood flow and the critical oxygen and nutrients it provides, a condition known as ischemia (one of the two principal causes of stroke). In a May 2005 study published in the journal *Experimental Neurology*, researchers documented how three groups of rats whose diets were supplemented with blueberries, spinach, and spirulina, respectively, all suffered less brain cell loss and were better able to recover lost function following artificially induced ischemia than rats in a non-supplemented control group. At autopsy, the scientists observed that the physical extent of ischemic damage to the brains of rats that had been fed the three supplements was significantly less than that suffered by the control group⁵⁵.

Promising new therapeutic applications:

In a study reported in the *Journal of Agricultural and Food Chemistry*, cold-pressed blueberry, Marionberry, boysenberry, and red raspberry seed oils were evaluated for their fatty acid composition. The oils were found to contain antioxidants with a high capacity to absorb oxygen radicals, and were deemed potent sources of tocopherols, carotenoids, and natural antioxidants⁵⁶.

Blueberry extracts have the advantage of delivering the fruit's phytochemicals in a simple, standardized dose, while consuming blueberries as food offers the benefit of flavor.

This finding suggests that blueberries may have applications in helping prevent heart disease and stroke in humans⁷⁸.

- In an in-vitro study published in *Biochemistry and Cell Biology*, 24 hours of exposure to extracts of blueberry antioxidants sharply reduced the production of matrix metalloproteinases—enzymes believed to play key roles in malignant tissue metastasis—in human prostate cancer cells. This led the researchers to postulate that blueberry supplementation may help prevent tumor metastasis⁵⁸.

Apples

Apples may have a myriad of health benefits that impact the brain, including alleviating inflammation, which may contribute to cognitive decline related to aging. Specifically, apples lower levels of CRP, a indicator of inflammation. The whole fruit as well as additional apple products, such as apple juice and apple sauce, are beneficial, according to *Arthritis Today*.

Apple juice is a fruit juice made by the maceration and pressing of apples. The resulting expelled juice may be further treated by enzymatic and centrifugal clarification to remove the starch and pectin, which holds fine particulate in suspension, and then pasteurized for packaging in glass, metal or aseptic processing system containers, or further treated by dehydration processes to a concentrate⁵⁹.

Health effects

Vitamin C is sometimes added by fortification, because content is variable⁶⁰, and much of that is lost in processing. Vitamin C also helps to prevent oxidation of the product⁶¹. Other vitamin concentrations are low, but apple juice does contain various mineral nutrients, including boron, which may promote healthy bones. Apple juice has a significant concentration of natural phenols of low molecular weight (including chlorogenic acid, flavan-3-ols, and flavonols) and procyanidins that may protect from diseases associated with aging due to the antioxidant effects which help reduce the likelihood of developing cancer and Alzheimer's disease. Research suggests that apple juice increases acetylcholine in the brain, possibly resulting in improved memory⁶².

Pomegranate

Pomegranate is one of nature's richest sources of antioxidants. Accumulating research offers ample evidence that routine supplementation with pomegranate juice or extract may protect and even improve cardiovascular function. Pomegranate also appears to counter the

deleterious effects of diabetes and metabolic syndrome, and may even help to prevent and arrest the development of certain cancers. Exciting new research findings suggest that pomegranate likewise fights the inflammatory processes involved in Alzheimer's disease, osteoarthritis, and gum disease, while protecting the health of the skin and the liver.

Utilizing concentrated, low-cost pomegranate juice or standardized pomegranate extract capsules offers consumers a way to reap the broad-spectrum health benefits of this exotic fruit, while avoiding the excessive sugar calories and high cost associated with commercial pomegranate juice products⁶³.

Pomegranate (*Punica granatum*) is one of the oldest edible fruit and belongs to the Punicaceae Family⁶³. P.g. is extensively cultivated in the Mediterranean area and most Near and Far East countries. This botanic isolation is coincident with a unique biochemistry, the seeds contain an oil of which about 80% is a rare trans 18 carbon fatty acid (punicic acid)⁶⁴. There have been numerous reports on the *in vivo* properties of P.g., namely on anti-atherosclerotic capacity⁶⁵; antiproliferative and pro-apoptotic activities of pomegranate extract; anti-inflammatory activity⁶⁶ as well as chemopreventive and chemotherapeutic potential towards prostate cancer⁶⁷.

It could be concluded that, Pomegranates juice reversed the deteriorated antioxidant enzymes activity in the brain tissue of adult male albino rats intoxicated with CCl₄ through scavenging free radicals, decreasing lipid peroxidation, attenuating the brain susceptibility to oxidative stress thus, improving cellular membrane and organ functioning more profoundly and brought variables towards control values.

Pomegranates contain very high levels of polyphenols as compared to other fruits and vegetables⁶⁸⁻⁷⁰. Dietary supplementation of pregnant mice with pomegranate juice was recently shown by our laboratory to protect against neurodegeneration in neonatal mice subjected to hypoxic-ischemic brain injury. Therefore, we asked whether dietary supplementation with pomegranate juice would influence AD-like pathology and behavior in a mouse model of AD.

This study is the first to show beneficial effects (both behavioral and neuropathological) of pomegranate juice in an animal model of AD. These data suggest that further studies to validate and determine the mechanism of these effects, as well as whether PJ can protect against AD in humans, may be warranted.

Pomegranate offers abundant benefits for the cardiovascular system by preventing damage to arterial walls, promoting healthy blood pressure levels, improving blood flow to the heart, and preventing or reversing atherosclerosis.

- Pomegranate may benefit people with diabetes and those at risk for the disease.
- Pomegranate helps lower after-meal blood sugar levels and protects the cardiovascular system from diabetes-induced damage.
- Pomegranate shows promise in killing prostate cancer cells, whether the cells are hormone-sensitive or not. Pomegranate also helped halt the progression of prostate cancer in men who had undergone surgery or radiation for the disease.
- Pomegranate may fight the degeneration of joint tissue that leads to painful osteoarthritis, and may protect the brain against oxidative stress-induced changes that can lead to
- Alzheimer's. Pomegranate extracts—alone or in combination with the herb gotu kola help kill the bacteria that contribute to dental plaque, while helping to heal gum disease. Pomegranate also appears to protect the health of the skin and liver.
- The health benefits of pomegranate can be conveniently obtained through the use of low-cost, concentrated juices and extracts⁷².

The researchers knew that antioxidant polyphenols from other fruits and vegetables have protected brain cells in various animal models,⁷³ and that pomegranate juice itself had been shown to limit brain damage in mice that suffered experimentally induced strokes.⁹⁵ Since oxidation is thought to produce the Alzheimer's protein known as amyloid beta, the Loma Linda team decided to test their hunch that pomegranate juice could put a stop to amyloid-beta accumulation. They also explored the more radical notion that pomegranate juice alone would have a detectable effect on cognitive abilities, using a "water maze task" that tests animals' ability to accurately and quickly make their way out of a water-filled labyrinth. The researchers' intuition was rewarded, as mice with Alzheimer's-like disease that were given pomegranate juice from 6 to 13 months of age accumulated about 50% less amyloid beta than control mice. The juice-treated animals out-performed control animals, exiting the water maze 35% faster than the control group⁷⁴ The authors declared their study to be "the first to show beneficial effects (both behavioral and neuropathological) of pomegranate juice in an animal model of Alzheimer's disease."

Biochemical Constituents

Over the past decade, significant progress has been made in establishing the pharmacological mechanisms of pomegranate and the individual constituents responsible for them. Extracts of all parts of the fruit appear to have therapeutic properties, and some studies report the bark, roots, and leaves of the tree have medicinal benefit as well. Current research seems to indicate the most therapeutically beneficial pomegranate constituents are ellagic acid ellagitannins (including punicalagins), punicic acid, flavonoids, anthocyanidins, anthocyanins, and estrogenic flavonols and flavones⁷⁵.

An explosion of interest in the numerous therapeutic properties of *Punica granatum* over the last decade has led to numerous *in vitro*, animal, and clinical trials. Pomegranate is a potent antioxidant, superior to red wine and equal to or better than green tea. In addition, anticarcinogenic and anti-inflammatory properties suggest its possible use as a therapy or adjunct for prevention and treatment of several types of cancer and cardiovascular disease. Because of pomegranate's antimicrobial properties, it may aid in preventing infection by dental pathogens, pathogenic *E. coli* O157:H7, and antibiotic-resistant organisms such as MRSA.

Pomegranate's effect on bacterial pathogens has only been tested *in vitro*, however, necessitating human trials to refute or substantiate any clinical effect. The possibility that pomegranate extracts may also have an effect on several other disease processes, such as Alzheimer's disease, osteoarthritis, neonatal brain injury, male infertility, and obesity, underscores the need for more clinical research⁷⁶.

CONCLUSION

Many research studies proved that the fruits which are having high polyphenolic compound of resveratrol gave a significant effect on brain health and treating the disorders and diseases associated with brain. The various evidence based studies were conducted for the fruits of blue and black berries, Grapes, Pomegranates, Apples, Citrus fruits and Tomatoes.

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