



The Pomegranate: The Forbidden Fruit in the Garden of Eden? (*Punica Granatum*: Nature's Storehouse of Polyphenols)

The pomegranate is one of the earliest cultivated fruits and domesticated crops. Historical evidence suggests that man first began planting pomegranate trees sometime between 4000 B.C. and 3000 B.C. The pomegranate's irresistible appeal and legendary medicinal properties have also made it the subject of countless myths, epics and works of art, from Raphael and Cezanne to Homer and Shakespeare. *Punica granatum* was heralded for its sweet taste as well as its vivid color. It was often used as a dye or decoration.

Throughout history, this richly colored and delicious fruit has been revered as a symbol of health, fertility, and rebirth. Because the pomegranate is an ancient fruit, several legends have grown up around it. Some biblical scholars suggest that the 'fruit of knowledge' consumed by Adam and Eve against God's command may have been a pomegranate, since it was prevalent during the time of Moses. In the mythical tale of the unicorn, pomegranate seeds "bleeding" from its horn symbolized Christ. The pomegranate tree to which it was bound represented eternal life. In some cultures, a representation of the pomegranate is placed in the bedroom of newlyweds to encourage fertility.

A pomegranate is the fruit of a bush native to the Middle East region, although it is also grown commercially in California and other areas with similar climates. The average pomegranate bush grows to be around 15 meters (approximately 50 feet) tall, but many species remain relatively close to the ground. Pomegranate bushes have been known to live for hundreds of years, although fruit production tends to drop after a few decades.

The fruit's name combines the French words *pomme* and *garnete*, meaning: seeded apple. A pomegranate is about the size of an orange, with a yellowish shell that turns a rich red color as it matures. Inside the inedible husk are individual cells containing seed kernels. Each seed is surrounded by a juice-filled sac, which is pressed out during processing. It is the juice of the pomegranate, which interests most cooks and health food enthusiasts.

Depending on the variety, pomegranate juice can be extremely sour or pleasantly tart with a degree of sweetness. Typically, pomegranate is consumed in the form of a juice because it is a rather messy fruit to eat. Many Westerners compare the taste of pomegranate juice to that of cranberries or sour cherries. Since straight pomegranate juice can be a challenge to drink, beverage producers may create a more palatable cocktail blend. Chilled pomegranate juice blends can usually be found in health food outlets and grocery stores. Straight pomegranate juice is also blended with blueberry or raspberry juice as a healthy beverage. Pomegranate juice is commonly boiled down into a form of molasses in Middle Eastern countries. A sweet variety of pomegranate juice is also used to produce grenadine, an ingredient used as a flavor enhancer and colorant in mixed drinks.

A single medium-size pomegranate (154 g) has 100 calories and provides vitamins C and E. As a juice, the sugars are concentrated and could possibly increase insulin levels that might contribute to chronic inflammation and a pose challenge to diabetics maintaining their blood sugar.

Some cultures also believed it held profound and mystical healing powers. The ancient world used the pomegranate to treat a range of conditions. Ancient folklore praises the fruit

for its purported ability to restore appetite, reduce thirst, aid digestion, control diabetes and treat breast cancer. In India it was considered a heart tonic and leukemia treatment, Greeks and Egyptians believed it boosted fertility, and Hippocrates thought it aided digestion. The main reason many people have become interested in the pomegranate is its antioxidant properties. Antioxidants are believed to protect the body's cells from the damaging effects of free radicals found in oxygen.

Tannins are plant polyphenols that add color and a slightly tart taste to pomegranates and many other vegetables and plants. The word tannin comes from the Celtic word for Oak and refers to the source of tannins used to convert animal skins into leather. In folk medicine, tannins were used to treat burns and as an astringent. While there are tannins in some teas and in red wine, tannins are truly abundant in pomegranate juice, which account for the juice's incredible antioxidant properties. Punicalagin is a hydrolyzable tannin that is almost exclusively found in pomegranates. This highly unique and potent polyphenol antioxidant breaks down to ellagic acid. Ellagic acid is a phenolic compound that acts as a potent cancer fighter with proven anti-mutagenic and anti-cancer activity.

Critics argue that once the active ingredients in pomegranate are broken down, the fruit appears to have no particular biochemical components not found in other fruits. Merely including a variety of fruits daily would help counter atherosclerosis equally as well as pomegranate juice. Pomegranate juice is high in polyphenolic compounds such as anthocyanins, anthoxanthins and ellagic acid. At the 11th meeting of the International Society for Free Radical Research, a claim was made that the pomegranate contained more polyphenols than any other fruit. Dr. Hasas Mukhtar of the University of Wisconsin presented data that pomegranate juice was higher in antioxidant activity than red wine, green tea, blueberry juice, grape juice, cranberry juice and orange juice (Aviram '02).

Research has primarily centered on the cardiovascular benefits and the potential to prevent heart attacks and strokes. Preventing fatty acids from collecting in arterial walls has been demonstrated both in mice and human cell cultures (Proceedings of the National Academy of Sciences '05). . The many antioxidative polyphenols may protect vascular lining and prevent the progression of atherosclerosis by preventing the oxidation of LDL and reducing lipid peroxidation by macrophages (AJCN '00, '04). The capacity to inhibit angiotensin converting enzyme activity (ACE-inhibitor) is one explanation for the fall in blood pressure (Atherosclerosis '01). Another possibility is that the antioxidants reduce the oxidative stress on the endothelial cells lining blood vessels. These cells produce nitric oxide (NO) which is a substance that helps blood vessels relax and remain dilated (Proceedings of the National Academy of Sciences '05). Blood clotting is the primary cause of heart attacks and strokes, and pomegranate juice may reduce the aggregation of platelets (AJCN '00) responsible for blood clots. There have also been unsubstantiated claims such as increased levels of the good cholesterol (HDL) and maintaining hemoglobin levels for maximum oxygen saturation of blood. The contribution to vascular health is intriguing, but researchers caution that most of these studies were conducted in vitro (outside the body) or performed in mice. Often scientists need more convincing since rodents are not necessarily good models for human health and the what is considered significant is what actually happens inside the human body.

Patients who drank 2 ounces of pomegranate juice daily showed a 30% decrease in vascular narrowing based on ultrasound tests. This change resulted in a lowering of the systolic blood pressure. In the control group, the conditioned worsened by 10% (J Clin Nutr '04). However, this is the only clinical study that has been published using pomegranate

juice. The research was carried out on individuals with pre-existing cardiovascular disease and may not apply to the average population.

One must always be careful not to associate the consumption of any natural food or supplement with the prevention or cure of cancer. Only after vigorous scientific testing conducted long term on huge numbers of individuals is one permitted to make such claims. Pomegranate juice does not meet these stringent requirements, but a few studies have stimulated interest in studying this fruit more intensely. Men who drank 8 ounces of pomegranate juice per day significantly increased the time it takes for the prostate specific antigen (PSA) levels to rise (American Urological Association meeting in San Antonio '05). Prostate cancer cells are driven under the influence of male androgens to express PSA. Pomegranate extract was shown to decrease the androgen receptors and PSA expression. In vitro testing produced a dose-related inhibition of cell growth when prostate cancer cells were incubated with low concentrations of pomegranate extract. The fruit juice decreased cancer cell division and proliferation and increased cancer cell death (*Proceedings National Academy of Sciences* '05). The explanations for this may be the presence of the phytonutrients tannins, punicalagin, and ellagic acid. Punicalagin is hydrolyzable tannin that is almost exclusively in pomegranates. This highly unique and potent polyphenol antioxidant breaks down to ellagic acid. Ellagic acid is a phenolic compound that acts as a potent cancer fighter with proven anti-mutagenic and anti-cancer activity. The pomegranate also contains phytoestrogens that could be useful in combating prostate cancer. It is not clear the quantity of each phytonutrient (and therefore how much pomegranate juice) is needed to produce the potential cardiovascular and anti-cancer benefits described. Studies present in Phoenix at the American Association for Cancer Research's 2003 Annual International Conference on Frontiers in Cancer Prevention Research may prevent sun-related skin damage in animal and laboratory tests.

Antioxidants in pomegranates may additionally fight inflammation. Work at Case Western University by Dr. Tariq Haqqi (2005) showed that pomegranate extract did two things in lab tests. The extract cut levels of an inflammatory chemical called interleukin-1b and curbed enzymes that erode cartilage. The results indicate the pomegranate fruit extract or compounds derived from it may inhibit cartilage degradation in osteoarthritis and may also be a useful nutritive supplement for maintaining joint integrity and function. Such studies eventually may prove the pomegranate to be beneficial for arthritic sufferers.

The pomegranate is a fruit that is rich in history and quickly gaining popularity because of its possible medicinal properties. The pomegranate has one of the highest antioxidant concentrations of all fruits. Several lab and animal studies suggest several of its phytochemicals may assist in reducing the risk of heart disease and cancer. Ellagic acid is a key polyphenol that may contribute to the pomegranate's potential use as an anti-carcinogen and anti-mutagen. New studies on the anti-inflammatory potential have also created hope for arthritic sufferers. However, as with most claims that are made for natural plant derivatives, there are few clinical studies available to confirm their benefits. To single out drinking solely pomegranate juice would be ill advised due to the contribution of the myriad of benefits obtained from eating a variety of deeply pigmented fruits. The pomegranate does rank high on the list of nutritious fruits that would contribute greatly to overall health and well being.