

POMOGRANATE- HEALTH BENEFITS, NUTRITION VALUE AND USES

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Introduction

A healthful diet means eating nutrient dense foods, in the right quantities, from all the major food groups. Healthy dietary patterns can be generally described as those that are rich in health-promoting foods, including plant-based foods, fresh fruits and vegetables, antioxidants, soya, nuts, and sources of omega-3 fatty acids, and low in saturated fats and trans fats, animal-derived proteins, and added/refined sugars. Among them fruits are highly recommended by its many health promoting factors.

Plants remain a primary source of medicines for most people in the world. Therefore, research in plant science is of great importance for human health, both for the production of healthier food and for development and production of medicines. Fruits, in general, play a major role in the maintenance of a balanced diet. They provide plenty of macro- and micronutrients, as well as bioactive compounds that promote health. Over the past few decades, there have been many studies indicating the importance of fruit consumption in the prevention of health-associated risks, as well as campaigns for the incorporation of fruit in the diets of children.

Pomegranate (*Punica granatum* L.) is one of the ancient fruits associated with several human cultures of the world. It is estimated that pomegranate might have been introduced into culture about 5000 years ago. According to various reports, wild pomegranate grows in Transcaucasia and Central Asia from Iran and Turkmenistan to northern India. Thus, it is considered to be native of these regions. Its nutritional, therapeutic and ornamental values were known to humans since antiquity. Although pomegranate was reported to have a narrow genetic base, its huge collections available in different parts of the world indicate that it has high genetic diversity among the germplasm.

The pomegranate tree is highly adaptive to a wide range of climate and soil conditions, it is grown in different tropical and subtropical regions. However, its main cultivation is confined to the northern hemisphere. Interestingly, the best quality fruits are produced in arid regions. Numerous studies concerning the potential health benefits, in addition to the nutritional value, of the pomegranate and its constituents have been conducted. Encouraging findings have increased the interest shown in this specific fruit over the past few years. Pomegranate, being rich in bioactive compounds like polyphenols, has shown many health-related properties, such as antioxidant, anti-inflammatory and antihypertensive, through *in vivo* and *in vitro* studies. The health-promoting properties of the fruit are considered to mainly be due to the presence of punicalagin and, to a lesser extent, to other metabolites, such as flavonols and anthocyanins. Several studies have brought up the potential contribution of pomegranate in the treatment of cancer, diabetes and heart disease.

Pomegranate is commonly used in many preparations. An excellent flavor, nutritive value, medicinal properties and post-harvest losses of pomegranate fruit indicates its good potentiality for processing into value added products having extended shelf life, preserved for future time and satisfying the consumer with a high nutritional quality product.

NUTRITIONAL FACTS

Pomegranate fruit is spherical and bears a distinctive, prominent tubular calyx at its crown. The fruit is made up of the edible and the non-edible fractions. The non-edible part (all fruit parts without arils) is often regarded as waste whereas the edible portion (arils), which constitutes 48 – 52% of the whole fruit, comprises 78% juice and 22% kernels. A constituent that plays a major role in the pomegranate as a functional food is anthocyanins. These water-soluble plant pigments belong to the family of flavonoids and are responsible for the color of the fruit and its juice. They have been thoroughly studied for their numerous effects on health, such as their antioxidant, anti-inflammatory and antiproliferative properties, meaning that they can contribute to the prevention of several diseases.

About 50% of the total fruit weight corresponds to the peel, which is an important source of bioactive compounds such as phenolics, flavonoids, ellagitannins, and proanthocyanidin compounds, minerals, mainly potassium, nitrogen, calcium, phosphorus, magnesium, and sodium, and complex polysaccharides. The edible part of the pomegranate fruit (50%) consists of 40% arils and 10% seeds. Arils contain 85% water, 10% total sugars, mainly fructose and glucose, and 1.5% pectin, organic acid, such as ascorbic acid, citric acid, and malic acid, and bioactive compounds such as phenolics and flavonoids, principally anthocyanins. The seed cover of the fruit contains delphinidin-3-glucoside, cyanidin-3-glucoside, delphinidin-3,5-diglucoside, cyanidin-3,5-diglucoside, pelargonidin-3,5-diglucoside, and pelargonidin-3-glucoside with delphinidin-3,5-diglucoside being the main anthocyanin in pomegranate juice.

Pomegranate is an excellent source of dietary fibre and health-benefiting nutrients, including vitamins (i.e., vitamin C, A, folic acid) and minerals (such as potassium). It is also a rich source of phenolic compounds and some alkaloids, triterpenes, and sterols.

Pomegranates are also rich in unsaturated fatty acids like the omega 5 punicic acid that constitutes around 70% of pomegranate seed oil. These compounds have been suggested to exert numerous beneficial health

activities (beyond their nutritional properties) and are the basis for considering pomegranate as a possible functional food. Punicic acid, which is a conjugated isomer unique to pomegranate oil, constitutes 70–76% of the seed oil.

Phenolic compounds, together with flavonoids, anthocyanins, and tannins, are the main group of antioxidant phytochemicals that are important due to their biological and free radical scavenging activities. Pomegranate polyphenols, and particularly punicalagin and ellagic acid, are poorly absorbed in the gastrointestinal tract. Instead, these molecules are further catabolized by the gut microbiota into bioavailable derivatives named urolithins, which have been recognized as the main bioactive metabolites of ellagitannin-rich foods, such as pomegranate.

Anthocyanosides is another primary component present in the flower and fruit and is responsible for the red color of arils. Cyanidin-3-glucoside, cyanidin-3, 5-diglucoside, cyaniding 3-rutinoside, cyanidin-pentoside, delphinidin-3,5-diglucoside, delphinidin-3-glucoside, pelargonidin-3-glucoside, and pelargonidin-3,5-diglucoside are the major anthocyanins detected in the arils, fruit, juice, and flowers elucidated by HPLC and NMR. Lignans (e.g., furofuran, dibenzylbutyrolactone, and dibenzylbutane), minerals (e.g., Ca, P, K, N, Mg, and Na), ursane, oleanane triterpenes (e.g., triterpenic acids), and steroids are other active components isolated from pomegranate identified by LC-MS, HPLC-DAD, and GC-MS.

Pomegranate seeds contain rich oil that contains 64–83% punicic acid (PA) which is a ‘super conjugated linoleic acid’ (CLA) with a more potent effect than ordinary conjugated linoleic acid.

Health benefits

Therapeutic benefits of pomegranate in various diseases would lead to an increase in its consumption. Pomegranate consumption does not affect the oral bioavailability of drugs. Pomegranate juice is a rich source of soluble polyphenols including anthocyanins and tannins (e.g., ellagitannins (mostly punicalagin), ellagic acid, gallic acid, and catechins). These

compounds have anti-inflammatory, antioxidant, anti-hyperlipidemic, and anti-hypertensive properties.

Many studies have reported the anti-inflammatory potential of pomegranate extract. Both ellagitannins and ellagic acid are the main components of pomegranate extract, which have anti-inflammatory properties. They are metabolized by gut microbiota to yield urolithins. It is suggested that urolithins are the main components responsible for the anti-inflammation properties of pomegranate. Dried powder of pomegranate peel has a high inhibition of *Candida albicans*.

Antimicrobial effects of both methanol and dichloromethane pomegranate extracts have been demonstrated on the *Candida* genus yeast as pathogen-causing disease in immunosuppressive host. The use of pomegranate extract and flower showed significant reduction in wound area and increased the well-organized bands of collagen, fibroblasts, and few inflammatory cells. Properties of elevated wound contraction and the period of epithelialization, collagen, and protein synthesis were reported in hydroalcoholic pomegranate extract.

Punicic acid, the main constituent of pomegranate seed oil, has antiatherogenic effects. In a study on 51 hyperlipidemic patients, pomegranate seed oil was administered twice a day (800 mg/day) for 4 weeks. There was a significant decrease in triglycerides (TG) and TG: High density lipoprotein (HDL) cholesterol ratio by 2.75 mmol/L and 5.7 mmol/L, respectively, whereas serum cholesterol, LDL-C, and glucose concentration remained unchanged.

The most common forms of arthritis are osteoarthritis and its major progressive degenerative joint disease, which could affect joint functions and quality of life in patients. The addition of pomegranates in the diet may slow the progression of cognitive and behavioural impairments in Alzheimer's disease they have therapeutic effects and also contain sugars, pectins and sterols .

Anti-oxidant

Methanolic extracts from the peel of Pomegranate has a broad spectrum of antioxidant activities which were evaluated by 1,1-diphenyl 2-picrylhydrazyl (DPPH) free radical scavenging, phosphomolybdenum, Ferric (Fe³⁺) Reducing Antioxidant Power (FRAP), and Cupric (Cu²⁺) Reducing Anti-oxidant Capacity (CUPRAC) assays.

The protective effects of Pomegranate on the cardiovascular system, including reduction of LDL and cholesterol have been reported .Polyphenol and antioxidant rich fruits such as pomegranate have shown to stimulate beta cells to secrete insulin in animal studies.

Anti-inflammatory effect

Pomegranate juice has been associated with a reduction of inflammation, muscle damage, and an increase of platelets blood levels in healthy people. Pomegranate has shown anti-inflammatory effects in a colitis rat model. Cyclooxygenase (COX) and lipooxygenase (LOX), which are key enzymes in the conversion of arachidonic acid to prostaglandins and leukotrienes (important inflammatory mediators), respectively, are inhibited by Pomegranates.

Carcinogenesis

Pomegranate possesses inhibitory effects on different type of cancers such as prostate. Pomegranate has inhibitory effect on breast cancers. One of the possible mechanisms in which Pg can inhibit breast cancer is its inhibitory effect on aromatase and 17 beta-hydroxysteroid dehydrogenase enzymes (17 β -HSDs), as well as its anti-estrogenic activity.

Pomegranate has also inhibitory effect on colon cancers. Intake of pomegranate (2 capsules/day for 6-7 weeks) protected against mucositis- and dermatitis-induced radiotherapy in head and neck cancer and Prostate cancer cells, when treated with pomegranate juice, increased adhesion and decreased the migration. Molecular analyses revealed that pomegranate juice increased the expression of cell-adhesion related genes and inhibited the expression of genes involved in cytoskeletal function and cellular migration. It would possibly affect prostate cancer because of its apoptotic,

antioxidant, antiproliferative, and anti-inflammatory properties, suggesting that it may be beneficial in slowing down or preventing cancer cell metastasis. Pomegranate extracts may be used as dietary adjuncts to manage patients with small, localized, incidentally identified renal tumors, and this may lead to the avoidance of nephrectomy.

Anti-mutagenicity

A mutagen is a physical or chemical agent that alters the genetic material of an organism, usually DNA, permanently and thus increases the frequency of mutations above the natural background level. Mutagenicity is the capacity of a chemical or physical agent to cause such permanent change. It has been shown that Pomegranate peel fractions, especially methanol, has anti-mutagenic activities as was detected by the Ames Salmonella/microsome assay against sodium azide (NaN₃), methyl methane sulphonate (MMS), 2-aminofluorene (2-AF), and benzo(a)pyrene (B(a)P) induced mutagenicity in Salmonella typhimurium tester strains. Methanolic extract of Pomegranate (15 mg/plate) shows the highest anti-mutagenic activity in TA 100 cells.

Cardiovascular diseases

Hypertension is the most common disease in primary care of patients. It is found in comorbidity with diabetes and cardiovascular disease, and the majority of patients do not tend to be medicated. Pomegranate juice prevents the activity of serum angiotensin-converting enzyme and reduces systolic blood pressure.

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Fasting blood glucose

Several human studies have also evaluated the anti-diabetic effects of pomegranate. The effect of pomegranate juice (PJ) in diabetic patients in reducing fasting blood glucose (FBG) may be associated with punicic acid, methanolic seed, and pomegranate peel extracts. Fresh Pomegranate juice consumption (1.5 ml/kg) in 85 diabetic patients revealed significant reduction in FBG and insulin resistance and increased β -cell function. This hypoglycemic effect was correlated with baseline FBG levels, as patients with lower FBG levels showed better hypoglycemic response.

Oxidative stress

The beneficial role of pomegranate on reducing oxidative stress and lipid peroxidation through direct neutralization of reactive oxygen species (ROS), upregulating antioxidant enzymes, and inhibition or activation of transcription factors such as nuclear factor κ B (NF- κ B) or peroxisome proliferator-activated receptor γ (PPAR γ) has been reported.. Various ingredients in pomegranate (e.g., punicalagin, ellagic, gallic, oleanolic, ursolic, and uallic acids) have antidiabetic effects. Also, antioxidant polyphenols including tannins and anthocyanins in the juice sugar fraction could be effective in T2D patients.

Obesity

Central obesity is the most common cause of diabetes, cardiovascular disease, and hyperinsulinemia. Pomegranate is a flavonoid-rich fruit with antioxidant properties. The effects of PJ on insulin resistance, hs-CRP, and obesity were studied in an RCT on 50 T2D patients. After 8 weeks, a significant reduction in insulin resistance, body weight, and hip and waist circumference was observed in the study group (respectively), whereas serum glucose, HbA1C, and hs-CRP remained unchanged.

Dental Plaque and Gingivitis

Pomegranate extract acts as an anti-inflammatory compound and free radical scavenger capable of reducing macrophage oxidative stress and lipid peroxidation. It protects against gingivitis through direct antioxidant activity of flavonoid content and indirect effects via increasing free radical scavengers.

Prebiotic effect

The prebiotic effect of pomegranate juice has been evaluated by using the simulated gastrointestinal digestion of different pomegranate juices with lactic acid bacteria, resulting in the increased bio-accessibility of phenolic compounds and ensuring the survival of lactic acid bacteria (which may be due to metabolism of the ellagitannins, epicatechin, and catechin).

Conclusion

Pomegranate, one of the oldest known edible fruits, is nowadays broadly consumed through the world. Its fruits and seeds as well as other anatomical compartments (e.g. flowers and leaves) are rich in numerous bioactive compounds. It has been shown that pomegranate and its extracts exhibit potent antioxidative, antimicrobial and anticarcinogenic properties. Eating pomegranate as a whole can have anti-inflammatory effects and can protect a human body from various diseases like type-2 diabetes and obesity. Regular consumption of pomegranate helps in improving gut health, digestion and keep bowel diseases at bay.

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