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Versatile Health Benefits of Active Components of Grapes (Vitis Vinifera)

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ABSTRACT *Grapes (Vitis vinifera) are an extensively used fruit in the world. Grapes are highly beneficial as a fruit because of its excellent nutrient profile. Various preparations of grapes like grape pomace, grape flesh, grape seed and its extract, raisins and beverages of grapes like juice and wine have most potent active components like phenols, flavanoids, resveratrol which contribute to the antioxidant, anti-inflammatory, cardio protective and anti-oncogenic properties. Because of this, consumption of grapes should be encouraged among the people of all age groups to improve their dietary habits which in turn improve their health status. Even though it is available at our door steps, the health facts of grapes remain unknown to every person. This review provides comprehensive information on the versatile health benefits provided by the active components present in grapes.*

Introduction

Grapes (*Vitis vinifera*) are one of the most commonly consumed fruits in the world. Grapes can be used in numerous forms viz, raisins, jam, jelly, beverages like juice, wine and also added for other culinary purposes. Being an inexpensive fruit, the demand for grapes is increasing day by day due to its immense potential towards improving the health of the humans.

Grapes possess a very long and interesting history. At the times of Greek and Roman civilizations, grapes were utilized for wine making. Now –a - days, the most utilizing varieties of grapes are European grapes (*Vitis vinifera*), North American grapes (*Vitis labrusca* and *Vitis rotundifolia*) and French hybrids. Grapes are classified on usage into table grapes, wine grapes, raisin grapes and others with edible seeds or seedless. Grapes are cultivated in all countries especially in the temperate regions which have sufficient rain, warm and dry summers along with mild winters.

Grapes provide lots of nutrients like carbohydrates (glucose), vitamins, minerals, fibre, phytochemicals and antioxidants. Owing to its high glucose content, glucose is also termed as grape sugar.The functional quality of grape fruit is characterized by its metabolic compositions. It contains a number of secondary metabolites like flavonols, anthocyanins, proanthocyanidins, stilbene derivatives which are both quantitatively and qualitatively high in grapes.

The biological activities of grapes has been studied widely which showed that it is rich in phenolic compounds with approximately two –thirds of grape polyphenols present in skin and seeds.These grapes owing to its phenolic compounds, provides wholesome health benefits including cardio protective, anti-inflammatory, anti-carcinogenic, antimicrobial and antioxidant properties.

This review paper is aimed to summarize recent findings on the significance of grapes and grape product constituents on health.

Antioxidant Potential of Grapes

Antioxidants are substances which scavenge free radicals and prevent the damage caused due to oxidation. These substances can minimize the damage due to oxidants by neutralizing the free radicals before they damage the cells, enzymes and DNA. Both *in vivo* and *in vitro* investigation has been done extensively on the antioxidant activity of grapes and was reported that skin, seed and pomace extracts possess free radical scavenging activity.

A study done by Jonath *et al* revealed that grape seeds are a good source of polyphenolic compounds exhibiting both antioxidant and antibacterial effects. The antioxidant capacity of seed extract depends on the Total Phenolic Content (TPC). They also found that the antioxidant content was lesser in the seeds after making wine. The researches suggest utilizing grape and grape extract as antioxidant and antibacterial agents to prevent spoilage of stored foods by oxidation and bacterial proliferation.

Flavonoids represent a large group of low molecular weight substances showing higher antioxidant properties. The consumption of dietary flavonoids from grape seed and grape extracts or seed powder has been shown to suppress oxidation and formation of free radicals *in vivo*.

Phenolics, being the most important bioactive component in grapes, the antioxidant properties of grapes and its related products have been widely studied by employing various methods such as 1, 1 Diphenyl 2 – Picrylthydrazyl (DPPH) radical scavenging method, Oxygen Radical Absorbance Capacity (ORAC) assay, Crocin Bleaching Assay (CBA), 2, 2 – Azino – Bis (3 – ethylbenzothiazoline 6 – sulfonic acid) - ABTS assay, Thiobarbituric Acid Reactant Substances (TBARS), Trolox Equivalent Antioxidant Capacity (TEAC) assay and Ferric Reducing Antioxidant Power (FRAP) assay. Using these methods, antioxidant activities were found for grape pomace, grape seed, grape skin, grape flesh, grape juice and grape wine.

It was observed from these studies that the antioxidant values of different products vary differently for different methods. Among the various products of grapes, the grape seeds have got the highest antioxidant capacity followed by skin and flesh. Thus it reveals that the extracts from grape seeds are a promising antioxidant for promoting positive health.

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Anti-inflammatory Action
Inflammation is the protective response of tissue against cell injury, pathogen invasions and irritation. Negative effects of acute inflammation can be overcome while chronic inflammation can lead to risk of getting cancer, Alzheimer's, neurodegenerative diseases, diabetes mellitus, arthritis, autoimmune and pulmonary diseases.

Grape polyphenols have been shown to decrease chronic inflammation either by modulation of inflammatory pathways or by reducing Reactive Oxygen Species (ROS) levels.

Grape flavonoids and proanthocyanidins can overcome negative effects of chronic inflammation, thus it is more effective compared to synthetic drugs. This is because; it has high free radical scavenging property apart from preventing lipid per oxidation and inhibiting formation of pro-inflammatory cytokines. Phenolic compounds in grape seeds have presented notable anti-inflammatory effects and other contributory effects may due to the presence of flavanols, flavonols and procyanidins.

Anti-aging Effects
Due to its significant activity of polyphenolics of grapes, it also possesses anti-aging effects. It was proved by a study in which rats aging 19 – 21 months were fed 10 per cent grape juice and the improvements were noticed on release of dopamine from striatal slices. It was also discovered that supplementing 100 µg/kg body weights of grape seed extract for 30 days inhibited the accumulation of age related oxidative DNA damage in neural tissue.

A study conducted by Balu *et al* proposed that free radical lipid peroxidation was seen decreased in the central nervous system of aged rats on supplementing grape seed extracts

Antimicrobial Activity
The phenolic components in different parts of grapes exhibited different antimicrobial effects. Fermented grape pomace showed better antimicrobial activity than whole fruit grape extracts which do not exhibit any antimicrobial effect at all. Few studies have shown that seed extract has got very effective antimicrobial potential than other parts of grapes whereas the extract of grape leaves exhibited less antimicrobial activity than the former.

Brown *et al found* that grape skin exhibited strongest activity against *Helicobacter pylori* followed by grape synergy (skin and seed) and seed. The order of increase of antimicrobial activity was flesh, whole fruit grape extracts, fermented pomace, skin, leaves and seed.

A study conducted by Rodriguez – Vaquero *et al* showed that grape wine inhibited microbes' especially *E. coli* and found that inhibition was directly proportional to the concentration of grape wine.

Some studies suggested that polyphenolic substances in red wine are responsible for antimicrobial effects. The application of phenolic compounds from grapes would be best in food preservation than using for medical purposes because phenolics serves as nature preservative and antimicrobial agent for food.

Cardio Protective Action
Numerous studies have implied that intake of grape and its by products have beneficial effect on cardiovascular system by improving endothelial function, decreasing Low Density Lipoprotein (LDL) oxidation, altering blood lipids, enhancing vascular function and modulating inflammatory process.

Intake of flavonoid rich purple grape may decrease the risk of cardiovascular diseases and inhibits thrombosis which may be due to suppression of platelet dependant inflammation.

Grape extract which is rich in resveratrol could exert maximum cardiovascular protection. This was proved by a clinical study which revealed that regular intake of grape resveratrol extract will improve serum adiponectin, prevents incensement of plasminogen activator inhibitor type I (PAI - 1) and reduced activity of atherothrombotic signals in mononuclear cells.

Grape seed extracts which are rich in polyphenols exhibited reduction of platelet adhesion and aggregation and generation of superoxide anion and was found to be more effective than resveratrol.

Shanmuganayam *et al* done a rabbit study in which 225 ml of grape juice with hypercholesterolemic diet was given to the rabbits for a period of 96 days to investigate the potential of phenolic compounds against hypercholestrolemic induced platelet aggregation. The results showed that the platelet aggregation was significantly ameliorated and the development of atheroma was found to be 30 per cent lower than that of control group.

Dell Agli *et al* found that anthocyanins in wine and grape skin inhibited phosphodiesterase – 5 activities thereby decreasing the risk of cardiovascular diseases through vaso relaxation.

A scientific study done by Castilla *et al* explained the role of phenols in ameliorating plasma lipid levels after consuming 100 ml red grape juice for 14 days. They found that antioxidant capacity and cholesterol – standardized tocopheral of plasma increased and oxidized LDL and LDL were reduced. There was also a significant increase in plasma High Density Lipoprotein (HDL) and Apolipoprotein A – I.

Few animal studies have also shown that intake of moderate dose of grape extracts reduced 11 per cent plasma cholesterol while plasma Apolipoprotein A-I was increased to 26 per cent, 22 per cent and 19 per cent induced by catechin, quercetin and resveratrol respectively.

There are numerous studies showing that phenolics, flavanoids and resveratrol in grapes possess effective protection on cardiovascular system.

Anti-Cancer Effects
Many scientific evidences showed that extracts from grapes and it's by products had anticancer activities.

Phenolic compounds of grapes juice have been shown to inhibit carcinogenic- induced DNA adduct formation in rats and also reduced DNA synthesis in breast cancer cells.

Hudson *et al* reported that pomace extract remaining after wine production expressed a significant anti-proliferative effect on colon adenocarcinoma cells which confirmed that wine would help to fight carcinogenesis.

The phenolic compounds in grapes shows dual effect on cells i.e. modulated cell proliferation was dose dependent

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and at higher concentration, it may stimulate toxic effects and induce cell death.

Studies indicated that extracts of raisins from two varieties of grapes viz *V. vinifera* and *Sultana var*. exhibited anticancer efficacy on colonic region.

Grape seed proanthocyanidins were shown to reduce cancer cell viability and also induced apoptosis in pancreatic cancer cells due to inactivating the inflammatory transcription factor.

Other Potential Benefits

Grape flavonoids particularly anthocyanins may prevent neurodegenerative processes. This is because of inhibition of neuro-inflammation and oxidative stress.

Scientific studies evidenced that polyphenolic compounds in grapes and grape products have been shown to reduce metabolic syndrome and may prevent development of obesity and type II diabetes in addition to its antioxidant and anti-inflammatory effects.

Polyphenols rich grape skin extract was found to improve liver steatosis and may protect against diet- induced adiposity and hepatic steatosis which was due to suppression of lipogenic enzymes in liver and adipose tissues.

Resveratrol present in ethanol grape seed extract was more efficient than aqueous grape seed extract against hepatotoxicity of alcohol.

Conclusion

The data presented here indicates the marked health benefits of antioxidant, antimicrobial, anti-aging, anti-inflammatory, cardio protective and anti-cancer effects of grapes and grape products through various detailed scientific studies on its metabolic components like polyphenols and flavonols. Numerous studies have suggested using grape as a supplement for maximum health benefits. Therefore, consumption of grape and grape products should be encouraged in our daily diet as a healthy and nutritious food ingredient.

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