

# Nutrition Profile on Grape Juice – A Review

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**Abstract:** *Vitis vinifera* (grapes) is a well-known tropical fruit which has been used in India since 1300 AD. Grape juice is well relished by all age groups of the society. It was reported that consumption of grape juice at moderate level helps in prevention of aging related diseases. The aim of this review, a summary of the nutrient content which is available in grape juice and to obtain a further understanding of the reported beneficial health effects of the naturally occurring nutrient content in the grape juice. It has been systematically studied for various biological activities with particular reference to clinical effects. Several other potential beneficial properties in grape juice like flavonoids, polyphenols, antioxidants, anthocyanins, and resveratrol have since been ascertained. We review the potential clinical applications of these fascinating natural substances.

**Keyword:** Grape juice, antioxidants, flavonoids, poly phenols, resveratrol

## INTRODUCTION

Grapes (*Vitis Vinifera*) are natural sources which may promote generally health by providing a mix of plant nutrients (19). They are considered as “the queen of fruits,” since centuries. These little berries are the warehouse of abundant health promoting phyto-nutrients such as poly-phenolic antioxidants, vitamins, and minerals.

Each berry features semi-translucent flesh encased in a smooth, thin skin in structure. Some of them contain edible seeds, while others are seedless. The presence of poly-phenolic pigments in them are responsible for the colour.

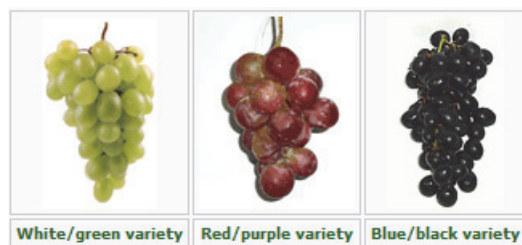


Fig 1 Grapes variety

Red or purple berries contain more of anthocyanins while white-green berries contain more tannins, especially, catechin. Fascinatingly, these antioxidant compounds are heavily concentrated on the skin and seeds. The three major species of grapes grown around the world are; European (*Vitis vinifera*), North American (*Vitis labrusca* and *Vitis rotundifolia*), and French hybrids.

- Some of popular green cultivars include **Thompson seedless**, **sugarone**, and **calmeria**.
- Red varieties are **emperor**, **red globe**, **cardinal**, and **flame seedless**.
- Concord** and **zinfandel** are some of flavorful blue-black cultivars.

Commercially, many cultivars of grapes are grown for different purposes either can be eaten as table fruit, fresh or dried (raisin, currant, sultana) or used in wine production.

The below mentioned table shows the deep analysis of grape nutrients: Grapes, red or green (European type, Thompson seedless), Nutritive Value per 100 g.

TABLE 1 NUTRIENT ANALYSIS OF GRAPES

| Principle        | Nutrient value | Percentage of RDA |
|------------------|----------------|-------------------|
| Energy           | 69 kcal        | 3.5%              |
| Carbohydrates    | 18 g           | 14%               |
| Protein          | 0.72 g         | 1%                |
| Total fat        | 0.16 g         | 0.5 %             |
| Cholesterol      | 0 mg           | 0%                |
| Dietary fiber    | 0.9 g          | 2%                |
| <b>Vitamins</b>  |                |                   |
| Folates          | 2 ug           | 0.5%              |
| Niacin           | 0.188 mg       | 1%                |
| Pantothenic acid | 0.050 mg       | 1%                |
| Pyridoxine       | 0.086 mg       | 7.5%              |

|                       |          |      |
|-----------------------|----------|------|
| Riboflavin            | 0.070 mg | 5%   |
| Thiamine              | 0.069 mg | 6%   |
| Vitamin A             | 66 IU    | 3%   |
| Vitamin C             | 10.8 mg  | 18%  |
| Vitamin E             | 0.19 mg  | 1%   |
| Vitamin K             | 14.6 ug  | 12%  |
| <b>Electrolytes</b>   |          |      |
| Sodium                | 0 mg     | 1%   |
| Potassium             | 191 mg   | 4%   |
| <b>Minerals</b>       |          |      |
| Calcium               | 10 mg    | 1%   |
| Copper                | 0.127 mg | 14%  |
| Iron                  | 0.36 mg  | 4.5% |
| Magnesium             | 7 mg     | 2%   |
| Manganese             | 0.071 mg | 3%   |
| Zinc                  | 0.07 mg  | 0.5% |
| <b>Phytonutrients</b> |          |      |
| Carotene -            | 1 ug     | -    |
| Carotene -            | 39 ug    | -    |
| Crypto-xanthin        | 0 ug     | -    |
| Lutein -zeaxanthin    | 72 ug    | -    |

ORAC Value 3,277 (Source: USDA National Nutrient data base)

Fruit beverages are well appreciated by all age groups of the society. Grape juice is considered as an extraordinary beverage, due to its rich constituents with nutritional and bioactive effects (33). It was reported that consumption of grape products at moderate level helps in prevention of aging related diseases (13).

Many researchers have recommended that there is a link between the consumption of bioactive compounds and the prevention of some diseases. The data's for such an association has increased interest in the behavior of bioactive compounds during various industrial processes. Thus, in addition to increasing nutritional and pharmacological interest in phenolic compounds, attention to technological aspects of food production has also been growing (6)(11).

Grape juice contains largely of water (81-86%), with a high concentration of the sugar glucose and fructose. It presents an high acidity due to the presence of tartaric acid, malic and citric acid. These acids ensure a low pH value, guaranteeing equilibrium between acidic and sweet tastes. Regarding its mineral elements, a high potassium value and low sodium value are found (30). Among the bioactive compounds present in grape juice, phenolic constituents are of great importance because their characteristics are directly or indirectly related to the quality of the juice and affect its color and astringency (10).

The potential health benefits of grape juice were measured in many research studies. Grape juice and grape products have many nutraceutical properties like antioxidants, anti-clotting, carcinostatic and anti-inflammatory agents etc (20). In a study it is reported that the consumption of grape juice resulted 75% reduction in risk factors associated with Alzheimer's disease (4).

## STRENGTH OF GRAPES

A large body of research supports the idea that consumption of grape juice, as part of a produce rich diet can positively impact health. Polyphenols which give grapes their vibrant colour that naturally function as anti-oxidants and help promote overall health (36). The grape juice helps manage the effect of health of LDL cholesterol. In a study 15 healthy adults are asked to drink grape juice (10 ml/kg/d) each day for two weeks. They found that the rate of LDL oxidation was significantly reduced after grape juice consumption (28). Research suggests that phyto nutrients like those found in grapes can contribute the heart health in certain populations by promoting health arteries (40).

While more research is in process to uncover the natural goodness and health benefits of grapes. Current research is pointing to the heart health benefits such as the grape juice

- 1) May help support flexible arteries to promote health blood flow (1).
- 2) May help manage the effects of bad cholesterol to keep arteries clear of excess plaque buildup in certain populations (38).
- 3) May have an anti-clotting effect similar to red wine (8).
- 4) May play a role in healthy blood pressure (29).

Grape juice is a rich source of flavonoids and polyphenols such as catechin, quercetins, anthocyanins, proanthocyanidins and also non-flavonoid poly phenols like resveratrol which all are active antioxidants effective in preventing or reversing the destructive effects of old age on the behavior and function of the brain (39).

## HEALTH PROMOTING NUTRIENTS

Grapes which are natural sources of plant nutrients can help support healthy life styles. It provides an excellent source of manganese, vitamin K and also contributes to thiamin (vitamin B1), vitamin B6, potassium and vitamin C (36).

The plant nutrients or phytonutrients within the grape include

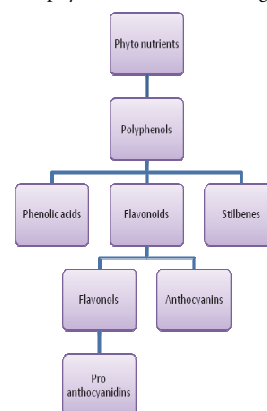


Fig 2: Flow Chart of Phytonutrients

polyphenols such as anthocyanins, catechin, epicatechin and quercetin which are flavonoids (25) and potentially resveratrol which is a stilbene.

## POLYPHENOLS

This subgroup of phytonutrients is found in a variety of foods, including grapes and grape juice. They are often concentrated in the skin of fruits and act as a protector from pathogens, parasites and predators. Research is currently investigating whether these plant-based nutrients can also protect the health of humans (19).

## FLAVONOIDS

Flavonoids are a large family of secondary compounds synthesized by plants and collectively known as vitamin P or citrin. They are found in skin and seed of the grapes (9). Flavonoids are determined to have many subclasses such as flavonols, flavones, flavonones, flavon-3-ols, anthocyanidins. Preliminary research indicates the potential role in the human health

- May lower risk for cardiovascular disease (37).
- May reduce risk of several types of cancer (24).
- May promote lung health and protect against asthma (43).

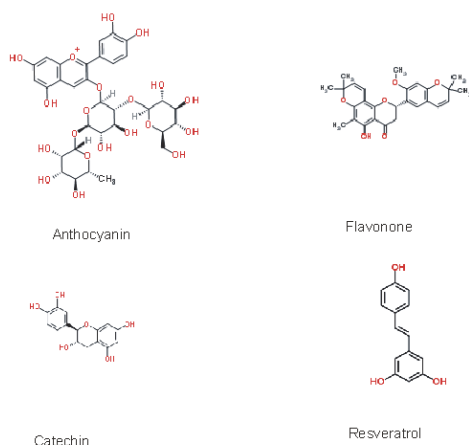


Fig 3 Structural formula of flavonoids

## ANTHOCYANINS

A major sub-class of flavonoids, they are typically found glycosylated (linked to a sugar) in nature and they are responsible for the red, purple or blue colour of fruits (26).

## CATECHIN AND EPICATECHIN

These two related compounds are the subclass of flavonoids which are commonly found in the beverages. They are the building block of the proanthocyanidins (3).

## RESVERATROL

Resveratrol (trans-3, 4, 5-trihydroxystibene) is a phytopolyphenol present in skins and seeds of the grapes. Recent studies indicate that it can block the process of multistep carcinogenesis namely tumour initiation, promotion and progression.

## CLINICAL APPLICATIONS

### ANTICANCER PROPERTIES

Grape antioxidants have drawn an increased attention for their potential anticancer effects. A number of studies suggest that the high consumption of grape components could be associated with the reduced risk of certain cancers such as breast cancer and colon cancer (23) (14). The anti cancer effects of grape antioxidants have been demonstrated in vitro and in vivo models (12). Grape antioxidants have been shown to induce cell cycle arrest and apoptosis in cancer cells (2). Considering the diversity of grape antioxidants, it is very likely that these compounds are to exert potential anticancer activity by acting on multiple cellular events associated with tumor initiation, promotion, progression (27). They act as free radicals scavengers and chelating agents helps to reduce physiological reactive oxygen species (ROS). ROS is known as an important mediator of apoptosis. Since initiation and regulation of apoptosis is associated with modification in the oxidative environment (15).

### ANTI-INFLAMMATORY PROPERTIES

Grape antioxidants also exert anti-inflammatory activity which is believed to be associated with their chemo preventive effects (35). Cyclooxygenase and lipoxygenase play an important role as inflammatory mediator. They are involved in the release of arachidonic acid, which is a starting point for a general inflammatory response. Neutrophils containing lipoxygenase create chemotactic compounds from arachidonic acid. They also provoke the release of cytokines. Selected phenolic compounds were shown to inhibit both the cyclo oxygenase and 5 lipoxygenase pathway (7)(18). This inhibition reduces the release of arachidonic acid (45). Quercetin, a grape flavonoids, in particular inhibits both cyclo oxygenase and lipoxygenase activities, thus diminishing the formation of these inflammatory metabolites. But the exact mechanism by which flavonoids inhibit the enzymes is not clear (34)(16).

### ANTIOXIDANT PROPERTIES

One major group of the bioactive components present in grape juice is phenolic antioxidant typically including anthocyanins, catechin, resveratrol, phenolic acids and procyanidins (32). Anti oxidant activities of grape phenolic compounds have been extensively investigated in various studies and demonstrated in various model systems such as protecting low- density lipoprotein (LDL) against oxidation is brought about by  $\text{Cu}^{2+}$  and oxygen centered radical-generating AAPH in vitro systems. Body cells and tissues are continuously threatened by the damage caused by free radicals and reactive oxygen species which are produced during normal oxygen metabolism (5). This cellular damage can be protected by the antioxidant defense mechanism of the body include enzymes such as super-oxide dismutase, catalase and glutathione peroxidase.

#### ANTI-CLOTTING EFFECT

Flavonols which is a sub class of flavonoids are particularly anti thrombotic because they directly scavenge free radicals, thereby maintaining proper concentrations of endothelial prostacyclin and nitric oxide (22). The main anti-aggregatory effect of flavonoids is thought to be by inhibition of thromboxane A<sub>2</sub> formation (17). In vitro studies showed that flavonoids bind to platelet membranes and may therefore have an accumulative effect over time (41).

#### CARDIO VASCULAR EFFECT

Resveratrol which is present in grape and its product can also reduce the risk of cardiovascular disease in human. The molecular mechanisms of resveratrol in chemoprevention of cancer and cardiovascular disease are interesting and under investigation. It may act as a reactive oxygen species scavenger to suppress tumor development (45). Resveratrol can also reduce the risk of cardiovascular disease in man. The molecular mechanisms of resveratrol in chemoprevention of cancer and cardiovascular disease are interesting and under intensive investigation. Resveratrol was found to strongly inhibit nitric oxide (NO) generation in activated macrophages, as measured by the amount of nitrite released into the culture medium, and resveratrol strongly reduced the amount of cytosolic inducible nitric oxide synthase (iNOS) protein. The activation of nuclear factor κB (NFκB) induced by lipopolysaccharide (LPS) was inhibited by resveratrol. The phosphorylation and degradation of nuclear factor inhibitor κBa (IκBa) were inhibited by resveratrol simultaneously. Reactive oxygen species (ROS) are regarded as having carcinogenic potential and have been associated with tumor promotion. Resveratrol may act as a reactive oxygen species scavenger to suppress tumor development. In addition, resveratrol may block multistep carcinogenesis through mitotic signal transduction blockade. Reactive oxygen species are pivotal factors in the genesis of heart disease. Meanwhile, efficient endogenous antioxidants, including superoxide dismutase (SOD), glutathione peroxidase (GSHPx), and catalase, are present in tissues. A fine balance between reactive oxygen species and endogenous antioxidants is believed to exist. Any disturbance of this balance in favor of reactive oxygen species causes an increase in oxidative stress and initiates subcellular changes, leading to cardiomyopathy and heart failure. The experimental results indicate that exogenous antioxidant resveratrol is of value in hemopreventing the development of heart disease (44).

#### CONCLUSION

The review of the nutrient content and potential properties of grape juice and grape products emphasize the society to utilize them to lead a life style disease free life. And it is too early to make recommendation on daily intake for the effective management of many diseases. The potential use of grape nutrients in preventive cardio vascular diseases and the investigation in that exciting field is warranted. The grape juice has been marketed in few Indian fruit beverages limited as grape Ready to serve (RTS), grape nectar etc., and that should have of enough encouragement among scientists in exploring more information about

the grape products in order to exploit its commercial potential. An extensive research and development work should be undertaken for the economic and value added product utilization.

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#### CONFLICTS OF INTEREST

"The authors declare no conflict of interest".