

# Flavonoids rich apple for healthy life

## Abstract

Apple is one of the intensive grown and widely cultivated fruit crop in the temperate region, around the world. More than 7,500 apple cultivars are grown around the world. Generally most popular apple varieties in the world are pink lady, honey crisp, red delicious, fuji and gala. The Australian apple industry is generated combined revenues of around \$1.1 billion in year 2014. Generally, apple is one of the staple food items for most Australian households. At least 13 major varieties of apples are produced in Australian orchards. However, Braeburn, Cripps Pink or Pink Lady, Cripps Red or Sundowner and Granny Smith are most common. Stone fruits such as apple are good source of vitamin C, potassium, dietary fibre and phytonutrients including antioxidants. Apples are also low in saturated fat, cholesterol and sodium as well as being a low GI (glycemic index) food and are often an important contributor to the intake of dietary components linked with chronic disease prevention, including flavonoids and soluble fruit fibre. Flavonoids are natural compounds, often called antioxidants. Flavonoids help to neutralise free-radicals, which are unstable molecules produced in the human body due to oxidation. Free radicals have been associated with a range of chronic diseases such as heart, auto immune, liver disease and cancer. Apples contain a range of flavonoids compounds within the peel, which contains procyanidins, catechin, epicatechin, chlorogenic acid, phloridzin and quercetin conjugates. The apple flesh also contains similar compounds but lower in concentrations. Clinical studies proved that quercetin rich apples significantly improve vascular function. Flavonoid content varies widely between apple varieties and even within the types of fruit tissues. Flavonoids tend to be higher in the peel rather than the flesh of apples. Research studies revealed that flavonoids content is higher in the darker, redder and bluer coloured apples. New Western Australian apple variety call “Bravo” was developed after many attempts and was selected over many years to ensure to obtain all required qualities such as has higher flavonoids content than other commercial apple varieties.

**Keywords:** apple health benefit, flavonoids

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**Abbreviations:** NO, nitric oxide; FMD, flow mediated dilatation; GI, glycemic index; CVD, cardio-vascular disease

## Introduction

Apple is one of the intensive grown and widely cultivated fruit crop in the temperate region, around the world. China, USA, Iran, India and Italy are the highest apple producing countries in the world. More than 60% of world apple productions come from these countries. More than 7,500 apple cultivars are grown around the world. Generally most popular apple varieties in the world are pink lady, honey crisp, red delicious, fuji and gala.

The Australian apple industry is comprised of approximately 2,007 mostly small orchards that generated combined revenues of around \$1.1 billion in year 2014.<sup>1</sup> Generally, apple is one of the staple food items for most Australian households. At least 13 major varieties of apples are produced in Australian orchards. In addition, over 15 different varieties of apple are grown commercially in Australia. However, followings varieties are most common.

Braeburn-originally discovered in New Zealand in 1952 as a chance seedling. It is thought to have been a cross between Lady Hamilton and Granny Smith varieties. The apple has a red/orange colour with vertical streaky appearance on yellow/green background. It has a sweet and tart flavour.

Cripps Pink or Pink Lady™-Breed in Western Australia in 1973 by John Cripps who crossed the Golden Delicious and Lady Williams varieties. The apple has a pink blush colour over a greenish yellow base skin. It is high in sugar content and has a crisp firm flesh and pleasant effervescent flavour. It is Australia's favourite apple and is grown in at least 15 countries.<sup>2</sup>

Cripps Red or Sundowner™-This apple is also cross between a Golden Delicious and Lady Williams. The apple has a dark red skin and a round shape with white markings or “lenticles” occurring naturally on the skin. It has a sweet, flavoursome taste and sugar levels improve with storage.

Fuji-This apple originated in Japan and is one of the main varieties in that country. It has a red/dull pink blush over a green/yellow base. It is a large apple and has a honey sweet flavour with firm texture and a crisp and juicy taste. It has been described as the “perfect eating apple” and has high sugar content and is suitable for cooking due to its ability to retain its shape. Golden Delicious-This apple originated in West Virginia USA in 1912 and is considered an excellent eating apple. It has a bright yellow to golden skin colour that may have a pink tinge. It also has a creamy white flesh that is sweet, tasty and juicy.

Granny Smith-This apple was discovered in 1868 by “Granny” Anne Smith of NSW. It is thought to be a cross between a French Crab apple and other varieties. The apple has a bright green flesh and a sharp tart taste. It is popular for cooking.

Green Star™-Originating in Europe this apple is large with a bright shiny green skin and a crisp white flesh. The apple is bred for its sweet taste despite its green skin colour. The Green Star™ is very juicy and contains a high amount of vitamin C. they don't brown as quickly as many other apples when cut. Lady Williams-Discovered in the 1930s in Donnybrook Western Australia and is the parent stock for Pink Lady™ and Sundowner™ apples. It is thought to have its origins in the Granny Smith and Jonathan apples.

Red Delicious-this crimson to dark red coloured apple has a tapered shape with four distinct crowns at its base. It originated in Iowa USA in the 1870s and is one of the most commonly grown apples in NSW. The apple has a sweet, highly aromatic, creamy white flesh. Royal Gala-It was bred in New Zealand around 1934 as a cross between Kidd's Orange Red and Golden Delicious. It was brought into Australia in the 1980s. The apple has a pink/red blush with orange to deep orange strips over a yellow base. It is sweet to the taste, with dense white flesh.

### Health benefits of apple

Increasing trend of fortified food products availability in the market indicated that consumers are becoming more health conscious. Fortification of nutrients to the foods during processing can be observed as a trend nowadays. Further, it can be observed current consumer trend create very high demand for organically grown natural fruits and vegetables. This implies, consumers are increasingly interested in eating healthier diets.

Stone fruits such as apple are good source of vitamin C, potassium, dietary fibre and phytonutrients including antioxidants. Apples are also low in saturated fat, cholesterol and sodium as well as being a low GI (glycemic index) food and are often an important contributor to the intake of dietary components linked with chronic disease prevention, including flavonoids and soluble fruit fibre.

Several previous prospective observational studies had found that apple intake<sup>3</sup> is associated with reduced risk of Cardio-vascular disease (CVD) and specific cancers. Higher fruit intake is associated with lower risk for all-cause and disease-specific mortality in older people.<sup>4</sup>

### What are flavonoids in apples?

Flavonoids are natural compounds, often called antioxidants, which are concentrated in some plant foods. There are more than 3000 naturally-occurring flavonoids, and the dietary effect of each is known to be different. Flavonoids help to neutralise free-radicals, which are unstable molecules produced in the human body due to oxidation. Free radicals have been associated with a range of chronic diseases such as heart, auto immune, liver disease and cancer.

Antioxidants/flavonoids can be sourced from a wide range of foods that contain different types of these compounds. Apples contain a range of flavonoids compounds within the peel, which contains procyanidins, catechin, epicatechin, chlorogenic acid, phloridzin and quercetin conjugates. By contrast the flesh contains similar compounds but lower in concentrations.<sup>5</sup>

Further, benefits of flavonoids are understood to be related to the ability of the antioxidants to reduce the oxidation of LDL cholesterol, which is thought to be associated with atherosclerotic diseases. As such these antioxidant benefits of flavonoids may have a positive impact on the human cardiovascular system.<sup>5</sup> The flavonoid quercetin

is one that has been found to have a positive benefit on the possible prevention of chronic diseases, and apples are rich source of quercetin. These antioxidant benefits of flavonoids are due to their "free radical scavenging properties and because they are chelators of metal ions", which if included in regular diets at relatively high levels may help to reduce the risk of some chronic diseases such as ischemic heart disease, cerebrovascular disease, lung cancer and prostate cancer as well as Asthma.<sup>7</sup>

Further, some epidemiological studies have also suggested that a flavonoid rich diet can reduce the risk of developing cardiovascular disease. Certain flavonoids, in particular quercetin, have been shown to ameliorate endothelial dysfunction and reduce blood pressure, possibly by increasing the bioavailability of the potent vasodilator nitric oxide (NO). These studies also observed that quercetin rich apples significantly improve vascular function, as assessed with the use of flow mediated dilatation (FMD) of the brachial artery, and increased plasma nitric oxide (NO) compared with the administration of a low-flavonoid apple control.<sup>8</sup>

### Identification of flavonoids rich apples

Flavonoid content varies widely between apple varieties and even within the types of fruit tissues. Flavonoids tend to be higher in the peel rather than the flesh of apples. Research studies revealed that flavonoids content is higher in the darker, redder and bluer coloured apples. According to CSIRO- Australia research, the apple peel has the best marker of antioxidants with between 1.5 to 9.2 times the total antioxidant activity, and 1.2 to 3.3 times the level of phenolic content compared to the apple flesh. Darker peels with more red or blue colours, and flesh that is lighter in colour and with lower soluble solids, are likely to contain more antioxidant compounds.<sup>5</sup>

Bravo; newly developed apple variety at Western Australia has higher flavonoids content than other commercial apple varieties because of its dark burgundy colour. Darker peels contain more phenolic content, are contain more antioxidant compounds.<sup>5</sup> This apple variety was developed after many attempts and was selected over many years to ensure that it has all the qualities required by growers as well as consumers. This new apple variety is a cross between Cripps Red and Royal Gala. Bravo apple has a good balance between sugar and acid, is crisp and likely to stand out on retail shelves due to its striking dark burgundy colour and rich in flavonoids.

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### Conflict of interest

The author declares no conflict of interest.

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