

## ANTIOXIDANTS IN FRUITS AND HUMAN MEDICAL RESEARCH: AN OVERVIEW

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### Abstract

Antioxidants are chemical compounds that bind the free radicals in human body preventing the development of many diseases and reducing the severity of degenerative diseases and cancer.

Antioxidants are found in fruits, vegetables, grains, nuts, spices etc. Antioxidants are ranked for concentration in specific food using a method called the ORAC-Oxygen Radical Absorbance Capacity. The ORAC measures the antioxidant strength in foods assigning each food with a numerical value.

Recent studies concluded that berries, such as blueberries, blackberries, strawberries, cranberries, and raspberries, contain some of the highest levels of antioxidants. The acai berry and pomegranates has high ORAC level also. Current clinical studies showed that antioxidants in these fruits are beneficial in preventing the development of breast, prostate, lung, colon and skin cancers, atherosclerosis, dementia and many other diseases. The healthy properties of berries, pomegranates and other fruits are studied for everything from cancer prevention to skin care.

We are presenting a summaries and conclusions of several recent studies concerning the protective antioxidant effect of some fruits with high ORAC levels, hoping that this would initiate a future closer collaboration between food producers and clinicians.

**Key words:** Antioxidants, ORAC, fruits.

### 1. Introduction

**Oxygen free radicals** (or **reactive oxygen species (ROS)**) are active bimolecular which are formed during normal metabolism and through external factors such as x-rays, ultra-violet radiation and pollution. Oxygen free radicals are involved in the development of many degenerative diseases and pathological conditions, including atherosclerosis, dementia, Parkinson's disease, cancers, cardiovascular diseases etc, highlighting the need to consider the level of

consumption of antioxidants in our body (Harman [1]).

**Antioxidants** are bimolecular that help to counteract the detrimental effects of oxygen free radicals, preventing the development of many diseases and reducing the severity of degenerative diseases and cancer. These substances act as "free radical scavengers" and hence prevent and repair damage done by oxygen free radicals (Ames *et al.* [2]).

Antioxidants are mostly found in fruits and vegetables, but in different levels and concentrations. Concerning this, the benefit and healthy effects of consumed food depends on quality and concentration of antioxidants in consumed nutrients, especially fruits.

Foods are ranked by their antioxidant potency using a method called the **ORAC-Oxygen Radical Absorbance Capacity** (Ou *et al.* [3]). The ORAC measures the antioxidant strength in foods assigning each food with a numerical value (Table 1).

**Table 1. ORAC levels of some fruits**

Fruits (100 g)	ORAC level
Açaí berries	18,400
Pomegranates	10,500
Blackberries	5,100
Bilberry	4,200
Blueberries	3,200
Plums	2,800
Raspberries	2,700
Strawberries	2,600
Oranges	2,400
Grapes, Red	739
Cherries	670
Grapefruit, pink	495
Grapes, white	460
Banana	210
Apple	207
Peach	170
Watermelon	100

Developed by scientists at the USDA Human Nutrition Research Center on Aging, the ORAC test is considered one of the most sensitive and reliable methods for measuring the ability of antioxidants to absorb free radicals, because of its biological relevance to antioxidant action *in vivo* (in living organisms) (Weller [4]). This method measures both the degree and speed with which a certain food inhibits the action of an oxidizing agent, and then integrates these two measurements into a single value, producing an accurate assessment of different types of antioxidants of different strengths. The ORAC value of a food is proportional to its polyphenol content. Fruits with a higher ORAC value or richer color - have been shown to suppress free radicals more effectively than lightly pigmented foods (Dávalos *et al.* [5]).

## 2. SCIENTIFIC SEARCH FOR BEST FRUITS

### 2.1 Anthocyanins

The most powerful antioxidants that some fruits, such as berries, contain in its composition are a class of polyphenols (or bioflavonoids) known as **anthocyanins** (Zafra-Stone *et al.* [6]). These nutrients produce the deep red, blue, and purple plant pigments. Anthocyanins are distributed widely among nature's most brightly colored fruits (Aiyer *et al.* [7]). Fruits bearing these colors-**blueberries, cranberries, pomegranates, black currants, beets, and açai**-are especially rich in anthocyanins. Although present only in minimal quantities, they are readily absorbed into the blood upon ingestion, where they counteract the pathological effects of free radical activity (Seeram *et al.* [8]). Anthocyanins express a broad spectrum of health benefits, including (Lee *et al.* [9] and Shin *et al.* [10]): inhibiting cancer cell growth and inducing apoptosis (programmed cell death) in several cancer cell lines, reducing the risk of cardiovascular disease, improving eye function, limiting cellular oxidative DNA damage.

### 2.2 Açai

The açai (*Euterpe oleraceae* Mart.) is a species of palm tree indigenous to the area surrounding the Amazon in South America. Modern scientific analysis revealed the value of açai's antioxidant capability in several recent scientific studies (Marcason [11]).

A study designed to evaluate total free radical scavenging capacity among various antioxidant foods revealed that when compared to common European fruit and vegetable juices, the açai samples ranked in the top class of peroxy radical scavengers. The authors found the samples to be so high in antioxidant capacity that the numbers could only be estimated (Mertens-Talcott *et al.* [12]). Another study found that

human plasma antioxidant activity is significantly increased after the consumption of açai fruit and juice, observing individual increases in plasma antioxidant activity of up to 2.3-3-fold, respectively (Lichtenthaler *et al.* [13]). Its potent antioxidant properties endow açai with a singular ability to combat cellular aging and oxidative damage (Schauss *et al.* [14]). There is a scientific evidence that açai is a major cancer fighter. Polyphenolic mixtures of açai pulp, juice and oil extracts inhibited the proliferation of human colon cancer cells in the lab by up to 90.7% and a study on human leukemia cells found açai polyphenols reduced cell proliferation from 56-86% (Del Pozo-Insfran *et al.* [15]). Açai's high antioxidant capacity also improves brain function, with potential for the treatment of neurological disorders, including Alzheimer's disease and Parkinson's disease.

### 2.3 Pomegranate

The pomegranate (*Punica granatum*) is a subtropical fruit originating from Asia. It has been cultivated and naturalized over the Mediterranean region since ancient times. Pomegranates are mentioned in Egyptian papyrus scrolls dating back to 1550 BC, and pomegranate branches form part of the decorative motif on the pillars of King Solomon's temple.

Pomegranate is absorbed into the bloodstream far more efficiently than other fruit extracts. One study showed a pomegranate extract to be 95% absorbed, which is far greater than any polyphenol-containing fruit extract of its kind (Seeram *et al.* [16]). Dozens of recent studies concluded that pomegranates contain powerful antioxidants that inhibit the process of atherosclerosis (Gil *et al.* [17]). The scientists found that pomegranate concentrated juice significantly reduce oxidative stress in blood and atherosclerotic plaques, resulting in modestly lower blood pressure and reducing the risk of cardiovascular and cerebrovascular diseases (Aviram *et al.* [18]). The fact that pomegranate was shown to reverse carotid artery atherosclerosis indicates that even aged humans might be able to lower their risks of stroke and heart attack (Aviram and Dornfeld [19]). Pomegranate extract also has demonstrated anticarcinogenic properties that are effective in suppressing a variety of cancers, including prostate, lung, skin, breast, and colon cancers (Kim *et al.* [20]). This fruit has also been shown to reduce inflammation in colitis and suppress inflammation and joint damage in rheumatoid arthritis.

Medical scientists conducted a study on heart disease patients to ascertain pomegranate's effects on inducible angina and the rate of blood flow through the coronary arteries. The entire group was subjected to a baseline stress test to induce angina and to an advanced tomography technique to measure coronary

blood flow. This study showed for the first time that daily consumption of pomegranate can improve blood flow to the heart in coronary artery disease patients in a relatively short period of time. Scientists attributed the anti-atherosclerotic benefits of pomegranate to the high levels of polyphenols, tannins, and anthocyanidins contained in the fruit. They pointed out that while grape juice/red wine contain some of these extracts, neither grape juice nor red wine has been shown to improve coronary blood flow in patients with established heart disease (Ross [21]). In 2010, 23 clinical trials were registered in the National Institutes of Health of USA to examine effects of pomegranate extracts or juice consumption on following diseases: prostate cancer and hyperplasia, diabetes, lymphoma, coronary artery disease etc.

## 2.4 Berries

Recent studies confirm that **blackberries** appear to be extremely beneficial in the management of inflammation, suppressing pro-inflammatory cytokines. Blackberry extracts also show potential in inhibiting the growth of human colon cancer cells in the laboratory, suggesting a potential role in cancer prevention (Dai *et al.* [22]).

Over the past year, a record number of independent studies have confirmed the health effects of **blueberries**. Scientists tested blueberries against an array of common disorders and discovered significant results (Yi *et al.* [23]). One of the most studied and beneficial effect of Blueberries is the ability to improve memory and cognitive performance by reducing the degenerative changes in aging neurons. Blueberries are abundant in polyphenols that can cross the blood-brain barrier and localize in regions critical to learning and memory (Galli *et al.* [24]). Blueberries protect the myocardium from ischemic damage and prevent post-myocardial infarction heart failure. They have also been found to improve insulin resistance and thus glucose control in pre-clinical models.

**Cranberries** are probably best known for the beneficial effect in the urinary tract, by inhibiting the adherence of *E. coli* to the urethra and bladder (Gupta *et al.* [25]). They're also proven fighters of oxidative stress. A double-blind, placebo-controlled trial involving 65 healthy women found that 1,200 mg of cranberry extract per day prompted a significant decrease in serum levels of advanced oxidation protein products—a key measure of oxidative stress (Valentova *et al.* [26]). Cranberries also display anti-proliferative activity against several types of cancer in vitro and in vivo, including gastric cancer and esophageal adenocarcinoma.

**Grapes and grape seeds** are best known for their cardio protective features, by decreasing LDL oxidation

and platelet aggregation (Leifert and Abeywardena [27]). Also, grapes and grape seeds have been shown to inhibit colon cancer cell invasion and. Grapes also may help combat Parkinson's and other neurodegenerative diseases.

**Strawberry** extracts have been shown to inhibit the growth of oral, colon, and prostate cancer cells (Zhang *et al.* [28]), improve lipid profiles and peroxidation (Basu *et al.* [29]) and lower the risk of coronary artery disease (Jenkins *et al.* [30]).

## 3. Conclusions

- Recent years, in scientific community there is growing evidence that antioxidant properties of some fruits with high ORAC levels can interfere with development and severity of many degenerative diseases, cancers, as well as atherosclerosis and cognitive impairment. Consuming these fruits would help modern humans to improve their health and quality of their life.
- Presented summaries and conclusions of studies concerning the protective antioxidant effect of some fruits will arouse the interest in public, hoping that this would initiate a future closer collaboration between food producers and clinicians.

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