AUTOCHTHONOUS AND EXOTIC TROPICAL BERRIES. A COMPARATIVE STUDY OF BIOACTIVE COMPOUNDS AND THE BENEFITS ON HUMAN HEALTH. A REVIEW

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Summary: Blackberries *(Rubus fruticosus L)*, blueberries *(Vaccinium myrtillus L)*, raspberries *(Rubus idaeus)* -are rich in anthocyanins- the natural antioxidants and contains a high amount of C, A, E vitamins, copper, selenium, zinc, iron. Antocyanins annihilate the action of free radicals and prevent the appearance of neurodegenerative diseases, cardiovascular diseases and early aging and also combat oxidative stress. Also, tropical berries such as *Euterpe oleracea, Eugenia uniflora, Myrciaria cauliflora, Myrciaria dubia , Syzygium cumini* are rich in polyphenols. The following paper is a comprehensive and comparative review on nutritional and non-nutritional bioactive compounds of autochthonous and exotic berries.

Keywords: Berries, bioactive compounds, human health

Introduction

Berry fruits are popularly consumed not only in fresh and frozen forms but also as processed and derived products, including dried and canned fruits, yogurts, beverages, jams, and jellies (Heber D, 2006). Among the colorful fruits, berries such as blackberry (*Rubus species*), black raspberry (*Rubus occidentalis*), blueberry (*Vaccinium corymbosum*), cranberry (*Vaccinium macrocarpon*), red raspberry (*Rubus idaeus*), and strawberry (*Fragaria ananassa*) are popularly used in the human diet either fresh or in processed forms.

Tropical countries produce a large amount of native and exotic fruit species which are potentially interesting for the food industry. Exotic fruits, consumed regionally are gaining popularity in the market place due to their nutritional and therapeutic value, but also because of their pleasant flavors and variety of color (Clerici, 2011). The nutritional and therapeutic value is mainly due to the presence of bioacti ve compounds, secondary metabolites, which have potential effects on human health (Oliveira, 2006). Fruits like berries may be an important component of a healthy diet because of their bioactive compounds content.

The aim of this review was to provide an overview of the main bioactive compounds in autochthonous and exotic berries.

Bioactive compounds in autochthonous and exotic berries

Berries contain high levels of a diverse range of phytochemicals, most of which are phenolic molecules. These phytochemicals include a variety of beneficial compounds, such as essential minerals, vitamins, fatty acids, and dietary fibers. Berries are an important source of provitamin A, minerals, vitamin C, and B complex vitamins. Berry fruits contain about 15% soluble solids (mainly sugars) and their high level of fructose makes them valuable for individuals with diabetes. The high dietary fiber content is important because fruit pectin acts as an intestinal regulator (Ramadan MF, 2008).

Anthocyanins are an important group among polyphenols in berry fruits. Anthocyanins belonging to the flavonoid family represent a group of pigments responsible for most of the colors in fruits, leaves, flowers, stems and root s of plants (Leite, 2012). Their spectrum of color varies from red to blue (Prior, 2006) and also presents itself as a mixture of both color shades resulting in purple-black tones.

The Table 1 shows the levels of vitamin C, total anthocyanins and total phenolics of the exotic tropical red-black fruits.

Table.1. Bioactive compounds in exotic tropical red–black berries (Andre Gustavo Vasconcelos Costa, 2013)

Scientific name	Total phenolic (dry matter)	Total anthocyanins (fresh matter)	Vitamin C (fresh matter)
Euterpe oleracea	31.2 mg GAE/100 g	282–303 mg /100 g	84 mg/100 g
Eugenia uniflora	4140–5810 mg FAE/100 g	26 mg/100 g	21.5 mg/100 g
Myrciaria cauliflora	3160 mg GAE /100 g	58.1 mg /100 g	238 mg/100 g
Myrciaria dubia	1161 mg GAE /100 g	42.2 mg /100 g	1882 mg/100 g
Syzygium cumini	787 mg GAE /100 g	93.3 mg /100 g	112 mg/100 g
FAE, ferulic acid equivalents; GAE, gallic acid equivalents.			

Açai palm is the commonly used name for the specific specie of palm tree known as *E. oleracea* Martius. Palm tree present an edible small purple-black berry which, at complete maturity, reaches 10–12 mm diameter. The pulp of this fruit is largely consumed as food, and presents an unusual flavor similar to raspberries with a nutty taste (Gallori, 2004).

The Pitanga or Brazilian cherry (*E. uniflora*) is a member of the *Myrtaceae* family. It is a native tree from Brazil that is widely distributed in South American countries (Bicas, 2011). A high phenolic content was found in immature fruits and the ripening reduced the levels of these compounds. In addition, a high antioxidant activity was observed for unripe fruits (Andre Gustavo Vasconcelos Costa, 2013).

The polyphenolic composition of *M. cauliflora* (Jaboticaba) extracts was identified for the first time by (Reynertson, 2006). Other bioactive compounds that were found in Jaboticaba fruit (in 100 g FW) are vitamin C (238mg), total anthocyanins (93.3 mg) and total carotenoids (0.32 mg) (Rufino, 2011).

M. dubia (Camu – camu fruits) is very rich in C vitamin. The content of vitamin C is 100 times greater than lemon (Vidigal, 2011). In table 2 are presented the bioactive compounds in berries.

Table 2. Bioactive compounds in berries (Castrejón, 2008).

Berries	Bioactive compounds	mg/g fresh weight
Blackberry *(Rubus fruticosus L*)	Phenolic compounds Flavonoids Anthocyanins	486 276 326
Blueberry *(Vaccinium myrtillus L)*	Phenolic compounds Flavonoids Anthocyanins	585 50 495
Raspberry (*Rubus idaeus*)	Phenolic compounds Flavonoids Anthocyanins	77 121 6

The main phenolic compounds found in berries include phenolic acids, flavonoids (flavonols, anthocyanins, catechins), stilbenes, hydrolysable and condensed tannins (proanthocyanidins), and lignans (Nazan Çevik, 2010).

Health benefits of berry and tropical berry compounds

Various phytochemicals from berries are thought to be antioxidants, which help to protect the body against various diseases and disorders and the damaging effects of free radicals which results in chronic diseases that are associated with aging. Berries are the source of many naturally occurring antioxidants, such as various flavonoids, phenolic acids, and vitamin C (Shivraj Hariram Nile, 2014).

The comparative of berry and tropical red- black berry health benefits is shown in ***Table 3*** (Shivraj Hariram Nile, 2014) (Andre Gustavo Vasconcelos Costa, 2013).

Table 3. Berry and tropical red- black berry health benefits

Scientific name/ Family	Bioactive compounds	Health benefits
Euterpe oleracea / Arecaceae	Anthocyanins, flavonoids, phenolic acids, procyanidin, lignans , stilbenes	Increase plasma antioxidant capacity; decrease of oxidative stress . Anti-inflammatory effects Ameliorating properties over metabolic syndrome Anti-allergic and anticancer properties
Eugenia uniflora/ Myrtaceae	Anthocyanins, carotenoids, flavonols	Anti-diarrheic, diuretic, anti-rheumatic, anti-febrile and anti-diabetic Antimicrobial activity against *S. aureus* , *L. monocytogenes* , *C. lipolytica* and *C. guilliermondii*
Myrciaria cauliflora/ Myrtaceae	Anthocyanins, ellagic and gallic acid, carotenoids, depsides, tannins, rutin, vitamin C	Anti-inflammatory, against asthma and anti-diarrhea
Myrciaria dubia / Myrtaceae	Anthocyanins, ellagic acid, flavan-3-ol s, vitamin C	High antioxidant capacity Decrease of oxidative stress and anti-inflammatory

Continuation of ***Table 3.***

Syzygium cumini / Myrtaceae	Anthocyanins, ellagic acid, quercetin, rutin, vitamin C	Antiscorbutic and diuretic features
Rubus fruticosus L / Blackberry	Antioxidants, polyphenols, manganese, folate, fibers, cyaniding- 3-O-glucoside, and vitamin C. Contains salicylate and high tannin	Fights free radical damage; antiseptic, antibacterial/viral, anticancer; reduces cholesterol; delays process of aging; is an analgesic and pain reliever; provides strength to blood vessels
Vaccinium myrtillus/ Blueberry	Antioxidants, vitamin C, B complex, E, and A; selenium, zinc, iron, and manganese. Contains b-carotene, lutein, and zeaxanthin	Anticancer, anti-inflammatory, anti-diabetic. Prevents weight loss, macular degeneration. Helps prevent Alzheimer's disease; reverses signs of aging; protects and enhances circulation; reduces cholesterol
Rubus idaeus / Raspberry	Rich in vitamins C, B, u-3, fibers, gallic acid, ellagic acid, and acts as a strong antioxidant. Contains folate, iron, potassium, copper, and lutein	Anticancer; prevents free radical damage; antimicrobial; and increases metabolic rate, which burns fats. Great for eye health and strength

Conclusions

These fruits can be used to improve the bioactive compounds into food products to health pro motion. The use of all these biological activities presented in this review related to berry and tropical red – black berry bioactive compounds might promote the development of alternative berry compounds for the prevention and control of various diseases and disorders.

Identification and quantification of phenolic composition in different fruits will help to reveal the impacts of different compounds/compound classes on the sensory and/or nutritional properties of these fruits, as well as their roles in plant protection and development.

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