Health benefits of Aronia berries

Prof. Iwona Wawer
Faculty of Pharmacy, The Medical University of Warsaw, Poland
Aronia or black chokeberry

*Aronia melanocarpa* (Rosaceae)

North American shrub, in the early 20th century aronia was introduced to Europe. Blossoming occurs in the middle of May, berries become dark-blue and ripe after 3 months, and the crops are collected in August /September.

Actually, the largest aronia plantations are in Poland. Polish horticulturists selected the best aronia cultivars with larger edible fruits (*Nero/ Galicjanka/Eggert*), suitable for the machine harvesting and the production of berries on a large scale.
Polish industrial farms produce 25,000 – 50,000 ton of fruits per year.

Aronia berries are used for production of juice, juice concentrate, dried /lyophilized/ berries, jams, fruit-and-herbal teas and alcoholic beverages, like aronia wine or liquor. Fruit waste is also a valuable material, containing dietary fibers, pectins and anthocyanins.
Berries are healthy!

- For millennia people have consumed berries, including bilberry, blueberry, elderberry, cranberry and considered berries as healthy food.
- Health benefits of the fruit-rich diet result from the content of polyphenolic compounds which are stronger antioxidants than the vitamin C and E.
- After consumption, they favorably affect plasma redox homeostasis in humans - increase antioxidant capacity and protect against lipid peroxidation.
Fruits rich in antioxidants

Aronia is a leader among other fruits and berries with the highest content of anthocyanins (3-8 g/kg) and total polyphenols (10-20 g/kg). The berries contain four types of polyphenols:

1. anthocyanins,
2. catechins (procyanidins and tannins),
3. phenolic and hydroxycinnamic acids (chlorogenic and neochlorogenic acid)
4. flavonols (quercetin glycosides).

Due to the presence of several OH groups, polyphenolic compounds exhibit antioxidant and antiradical activity.
Polyphenolic compounds of aronia: anthocyanins, catechins (polymers), chlorogenic acid

\[
\text{R} = \text{galactose, glucose, xylose or arabinose}
\]
Antioxidant and radical absorptive capacity (ORAC assay) of foods indicates how well they can neutralize the effects of free radicals. The highest ever obtained antioxidant capacity ORAC for fruits or berries is 160 µmol TE/g for aronia!

[Graph showing comparison of ORAC values for various berries]
## ORAC values for aronia products
(μmol TE/100 g of dry extract or (μmol TE/100 ml)

<table>
<thead>
<tr>
<th>Aronia anthocyanins</th>
<th>Juice concentrate</th>
<th>Juice</th>
</tr>
</thead>
<tbody>
<tr>
<td>sample</td>
<td>ORAC</td>
<td>sample</td>
</tr>
<tr>
<td>A/2004*</td>
<td>1 770 000</td>
<td>VK/2010</td>
</tr>
<tr>
<td>A/2005*</td>
<td>1 810 000</td>
<td>VK/2011</td>
</tr>
<tr>
<td>A/2009*</td>
<td>2 250 000</td>
<td>VK/2012</td>
</tr>
<tr>
<td>A/2009**</td>
<td>987 000</td>
<td>VK/2013</td>
</tr>
<tr>
<td>A/2012*</td>
<td>673 000</td>
<td>VK/2014</td>
</tr>
<tr>
<td>K/2006</td>
<td>1 119 000</td>
<td>OK/2014</td>
</tr>
<tr>
<td>K/2011</td>
<td>470 810</td>
<td>AG/2014</td>
</tr>
</tbody>
</table>

*not produced now,
**repeated after 5y
## Comparison of aronia and açai fruits

<table>
<thead>
<tr>
<th>Sample</th>
<th>Anthocyanins /mg/100 g/</th>
<th>Total polyphenols /mg/100 g/</th>
<th>OR AC /μmol TE/100 g/</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Aronia, lyophilized</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WUM</td>
<td>2 176</td>
<td>6 610</td>
<td>66 890</td>
</tr>
<tr>
<td>LYO</td>
<td>2 710</td>
<td>10 400</td>
<td>121 000</td>
</tr>
<tr>
<td>ELE1</td>
<td>1 890</td>
<td>10 600</td>
<td>132 000</td>
</tr>
<tr>
<td>ELE2</td>
<td>2 280</td>
<td>9 000</td>
<td>123 000</td>
</tr>
<tr>
<td>PAU</td>
<td>1 210</td>
<td>7 880</td>
<td>99 980</td>
</tr>
<tr>
<td><strong>Açai lyophilized</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WUM</td>
<td>673</td>
<td>2 650</td>
<td>17 110</td>
</tr>
<tr>
<td>(Schauss, 2006)</td>
<td>319</td>
<td>1 289</td>
<td>-</td>
</tr>
<tr>
<td>SAMB</td>
<td>135</td>
<td>1 790</td>
<td>47 000</td>
</tr>
<tr>
<td>NAV</td>
<td>164</td>
<td>3 200</td>
<td>79 000</td>
</tr>
</tbody>
</table>
Polish company Agropharm S.A. developed a technology for obtaining dry anthocyanin-rich extract from aronia berries. In 2002 this extract appeared on Polish market as “Aronox”. The extract (dietary supplement “Aronox”) contained anthocyanins (25%), monomeric and oligomeric procyanidins (50%) and phenolic acids (9%). Investigations of its biological and therapeutical properties, including clinical studies, carried out in Poland confirmed that this extract displays health-promoting activity in many diseases of free-radical ethiology.
Evidence based medicine (EBM) and nutrition (EBN): foods have a medical value

A majority of nutraceutical products does not have health claims and urgently need basic (in vitro) and clinical research. In Europe, the results of these studies have to be presented at the scientific forum (EFSA) and after acceptance (EC) - communicated to physicians and consumers.

There are no clinical studies on large groups of consumers, in which berries have been administrated.
Why do we need antioxidants?

- Antioxidants are substances that protect cells against the effects of free radicals - produced when the body breaks down food or is exposed to environmental toxins, stress, radiation (UV, medical x-rays) and even exercise.
- Antioxidants could help protect or even treat many health problems: hypertension and heart disease, cancer, inflammations, arthritis, infections, neurodegeneration (memory impairment).
Anthocyanin-rich products of aronia

The most important potential health effects of *Aronia* have been considered on the basis of *in vitro* studies and the studies with animals (rats). Human clinical studies on aronia products are limited.

Pharmacological effects of the anthocyanin-rich dry extract from aronia or aronia juice result from their composition and can be multidirectional.
Anthocyanin-rich extract of aronia

Studies on rats. Numerous cases where the application of the anthocyanin-rich extract may be beneficial have been recognized by the Polish scientists. The list includes: gastric ulcer, inflammation of pancreas, diabetes, cadmium intoxication, military gases intoxication or radiation sickness.

Clinical studies: anthocyanins from aronia (Aronox) have been administrated for two months in personnel of gasoline stations, who have to inhale petrol products for several hours per day. Result: the indicators of oxidative stress were reduced.
Aronia juice and cardiovascular system

The aim of the study performed in 2007 was to estimate the influence of aronia juice on arterial blood pressure, lipid parameters and inflammatory state parameters in 54 healthy men with mild hypercholesterolemia. Regular aronia juice drinking for 6 weeks resulted in reduction of total cholesterol level, LDL and triglycerides, increased HDL level and significant hypotensive effect.

Drinking of aronia fruit juice may have a beneficial effect on reduction of cardiovascular risk.
Clinical study (2007)*: the patients (44) who survived infraction and have received statin therapy were given either aronia extract (Aronox) or placebo for 6 weeks. Significant lowering of systolic and diastolic blood pressure by an average of 11.0 and 7.2 mmHg was observed in supplemented persons. The ox-LDL, interleukin-6 and CRP levels were reduced, probably related to a reduction of oxidative stress. Aronia extract can be used clinically in combination with statins!

Aronia extract and metabolic syndrome

The aim of the study (2007) was to estimate the influence of anthocyanins of Aronia (Aronox) on blood pressure, concentration of endothelin-1(ET-1), serum lipids, fasting glucose, uric acid and membrane cholesterol in erythrocytes of patients with metabolic syndrome (MS). The study comprised 22 healthy volunteers and 25 patients with MS treated with anthocyanins (3x100 mg/d) for 2 months. After therapy, a significant decrease was observed of: systolic and diastolic blood pressure, triglycerides, LDL-C and membrane cholesterol and endothelin-1 level.

Anthocyanins from aronia may be of benefit to patients with MS.

Aronia for diabetics

• Type-2 diabetes is a part of metabolic syndrome. The consumption of a diet low in fat and rich in antioxidants reduces the risk of obesity and insulin resistance. Antioxidants protect liver and pancreatic beta-cells from oxidative stress. They have the ability to reduce diabetes.

• Some reports indicate that anthocyanins stimulate insulin secretion*. Chlorogenic acid slows carbohydrate absorption by inhibiting intestinal glucose transport.

Aronia and diabetes

Pregnancy complicated by diabetes is an important medical and social problem which may increase with the epidemic of obesity. The experiment* involving a group of 105 pregnant women with intrauterine growth retardation was conducted to determine the influence of the anthocyanin extract from aronia (Aronox).

The results showed that the extract could be useful in controlling oxidative stress during pregnancies complicated by diabetes.

Aronia and cancer of the digestive tract

It is reasonable to consume cancer protective substances from plant foods: vegetables, fruits and berries. The anthocyanin-rich extracts from grape, bilberry, and aronia were investigated for their potential chemopreventive activity in rats treated with a carcinogen. All extracts inhibited the growth of cancer cells, with the aronia extract being the most potent inhibitor.

- These findings should initiate the development of anthocyanin-rich functional foods.
Neuroprotective activity of aronia constituents

Oxidative stress contributes to neurodegenerative disorders, including Alzheimer’s disease, Parkinson’s disease and the age-related cognitive decline.

Studies on animals performed at the Tufts University, USA, suggested that berries might be important for maintaining brain health. Old rats were fed with extracts prepared from spinach, strawberry and blueberry.

- **Blueberry extracts rich in anthocyanins were the most effective in reversing age-related deficits in the neuronal and behavioral parameters.**
Healthy eyes in computer society

During World War II the pilots of British RAF consumed bilberry jam in order to keep proper vision. The hypothesis that anthocyanosides improve night vision is not supported by evidence from rigorous clinical studies. Healthy subjects with normal or above average eyesight were tested in 11 of the 12 trials. However, it is not rational to expect any significant influence on the eyesight in young car drivers or pilots. Despite the conflicting findings: school children as well as adults watching fast changing images at a monitor or a TV screen can drink a glass of aronia juice with positive effect to health.

Anthocyanins from aronia may be beneficial for persons who work with computers and for car drivers frequently traveling long distances by night.
Radioprotection: aronia for Japanese

Generation of free radicals is a major result of irradiation. The effects were studied in rabbits and mice by Polish scientists from the Military Medical Academy*. Animals absorbed a 4 Gy dose. Considering all examined biochemical and morphological parameters, it was concluded that the anthocyanin extract and juice can protect against radiation-induced damage, through the antioxidant mechanism.

On March 11, 2011 the tsunami that followed the earthquake devastated Japan's north-east coast and the nuclear power plants at Fukushima. People and animals exposed to radiation need antioxidants!

Radioprotection: aronia for pilots

Airline crews are exposed to elevated levels of cosmic radiation. This radiation should concern not only airline pilots but everyone who frequently steps on a plane. The biomarker of cumulative DNA damage in airline pilots increased significantly with an increase in the duration of their flight experience in years*.

An adequate intake of antioxidant-rich food is essential to prevent free radical-related disorders as well as an efficient function of the immune system.

Aronia for men and sportsmen

• Aronia berries may help by infertility problems (study in 2001). Aronia anthocyanins were given to 38 male subjects with low sperm counts. The improvement of semen quality was found in the supplemented group.

• Aronia juice offered protection against oxidative stress after intense exercise (sportsmen: cyclists, rowers*). The athletes were randomly assigned to receive 150 ml of aronia juice daily, containing 23 mg/100 ml of anthocyanins.

Products from aronia berries

- Aronia can be placed near blueberry in the superfruit category. Foods like aronia and blueberries, which are associated with the benefits of antioxidants, became must-haves in people’s everyday diets.

- Products from aronia: aronia juice, jam, dried and sweetened aronia berries, fruit teas, aronia wine and infusion, cosmetics.
Anthocyanins of aronia in the diet

The daily intake of anthocyanins with typical diet was estimated at 180-215 mg which is approximately ten times more than the intake of other flavonoids (flavonols: 23 mg/day).

• The health potential of berries is remarkable: just a half-cup of aronia or blueberries can provide as much antioxidant power as 5 servings of other nutritious fruits and vegetables.

• Neither anthocyanins of aronia nor other polyphenols are “magic bullets” against diseases. However, they may decrease a risk of disease development and may support endogenous defense systems. So, half-cup of berries, a glas of juice or a spoonful of liquid aronia concentrate daily is highly recommended.
Products from aronia