

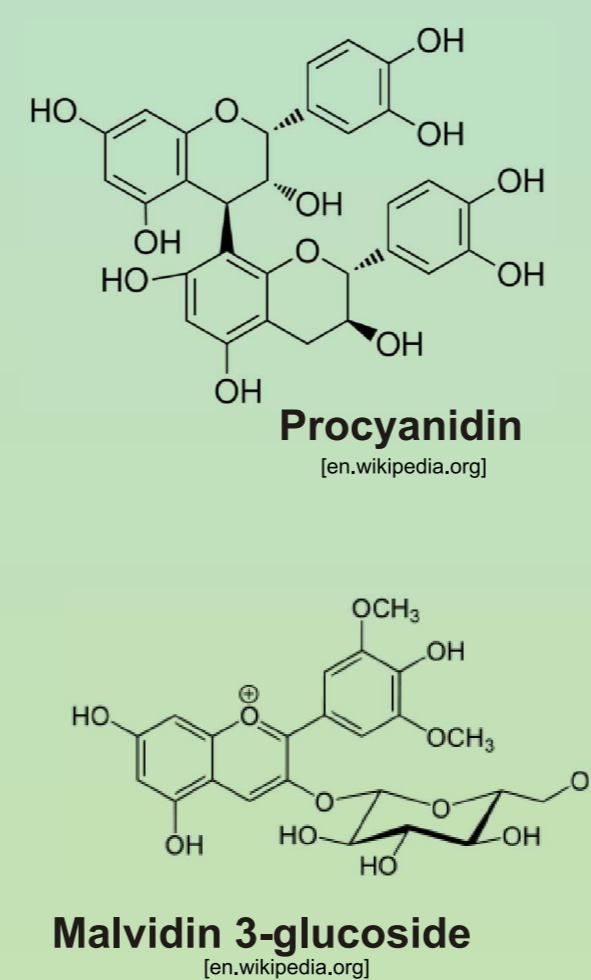
USE OF WASTE FROM BLUE GRAPE POMACE IN THE TEXTILE INDUSTRY: AQUEOUS EXTRACTS SORPTION ON CELLULOSE MATERIALS

Hana KRIZOVA

Grape vine is one of the world's most important crops. The wine production, however, entails a large amount of waste material (skins, seeds, stems etc.) which is after fermentation and maceration still very rich in content of polyphenols, especially in dyes (concerning in blue grape's **anthocyanins**) and **condensed tannins**.

Czech Republic, with its annual production of about 800 000 hectoliters of wine is considered only as a marginal producer, nevertheless the vine waste also makes a significant amount of tens of thousands of tons per year.

Anthocyanins, tannins and other polyphenols in grape vine are created by similar metabolic pathways and therefore their chemical structure are actually a low- or high-variously substituted variations of basic building block which is **flavan-3-ol**, and this arrangement groups them to flavonoids. A representative of the most abundant anthocyanins in blue vine is bound to glucose **malvidin** aglycone and in a mixture of grape tannins dominates **procyanidin** in the seeds. In smaller amounts there are included other phenolic compounds such as resveratrol and quercetin. All these substances have significant biogenic effects, especially as antioxidants and substances able to quench free radicals. Moreover, some as quercetin have also proven antimicrobial effects.



Anthocyanins as textile dyes



Tannins as textile dyes

Polyphenols from grapes can be considered as **functional dyes**, because they maintain strong **antioxidant properties** and the ability to **eliminate free radicals** even after dyeing process.

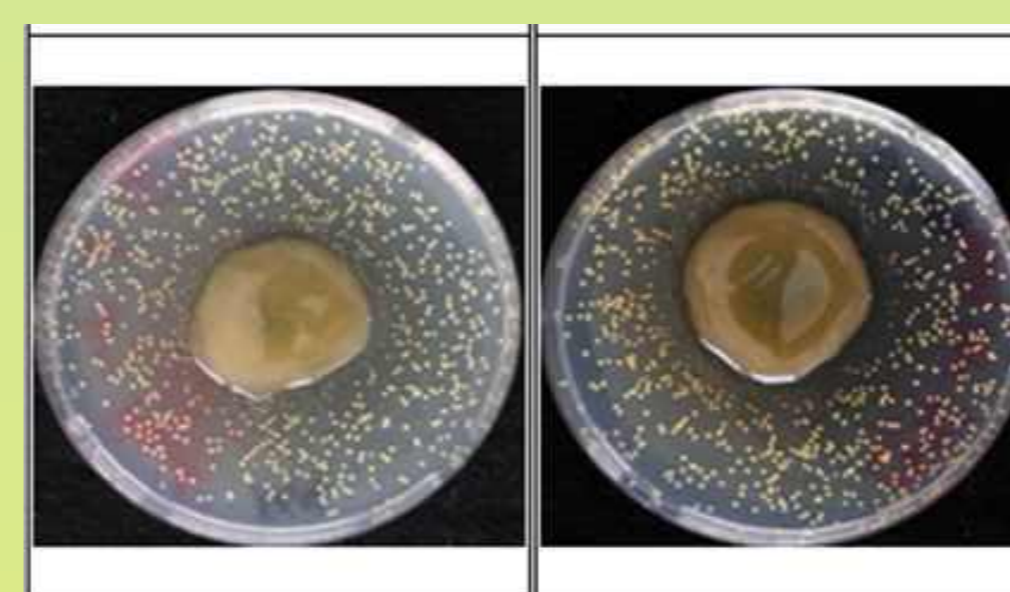
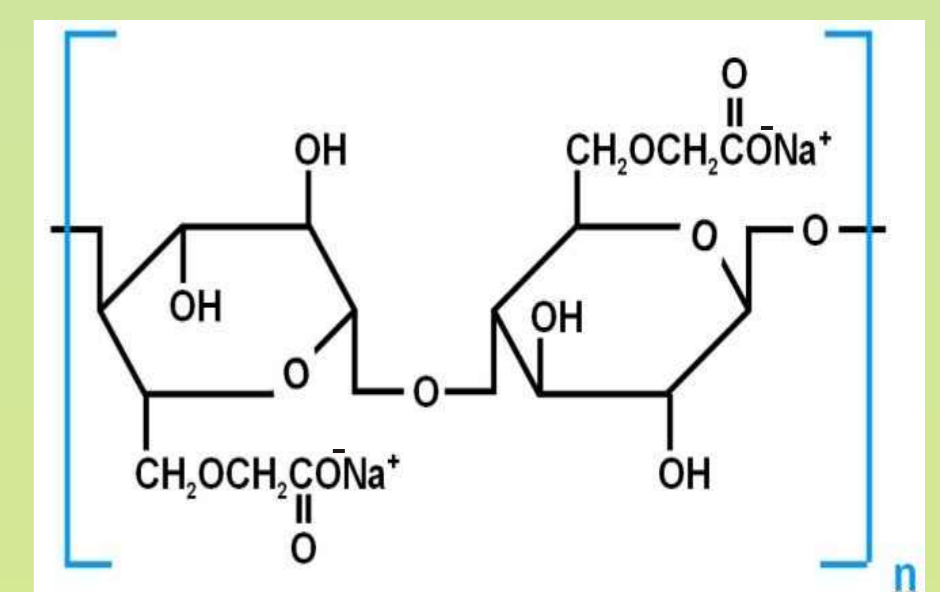
Lightfastness of fabric dyed by anthocyanins is low (grade 1-2 from eight-blue range), only dark shades of blue coloured vines reach level 3 - 4. The loss of colour due to the rapid decomposition of anthocyanins by UV radiation does not mean loss of their functionality. Other polyphenols in the extracts (colourless polyphenols and especially polymeric tannins) continue to have a great ability to destroy free radicals.

Tannins are used as colorants and as mordants (due to their ability to form complexes with proteins, metals, sugars etc.). Their exposure to UV radiation leads even to deeper shade.

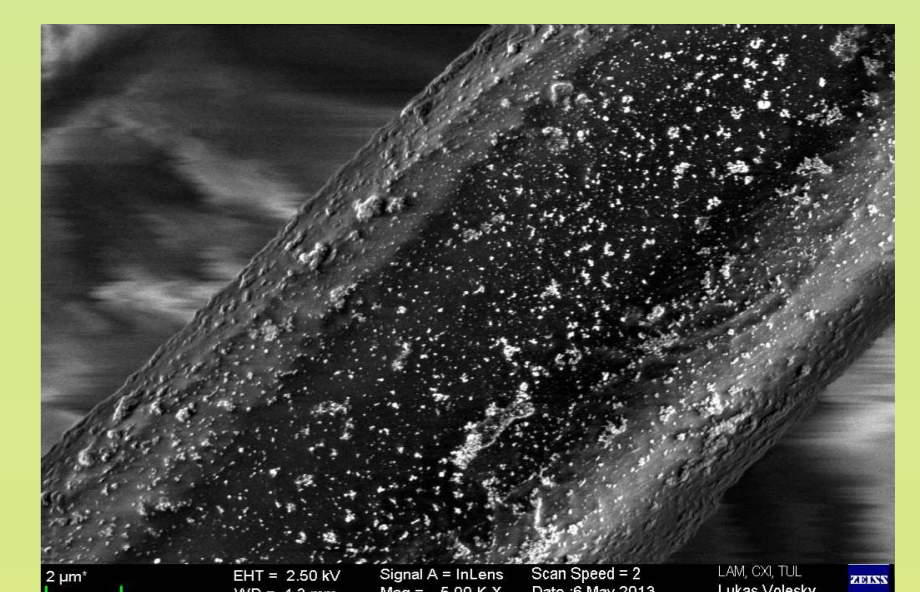
Carboxymethyl cellulose (CMC) is a cellulose derivative, because some of its hydroxyls are substituted by carboxymethyl groups. CMC is safe to health, hypoallergenic and highly swellable, so its connection with biogenic properties of polyphenols appears to be ideal for the development of medical textiles for healing of wounds.

The ability of **tannins binding metals**, acting as antioxidant and destroying free radicals, can be also used in other industrial applications: for example tannin gel immobilized on a textile substrate is an excellent **sorbent of heavy metals** from contaminated waters.

The elimination of free oxygen radicals that are formed during photocatalysis of titanium dioxide by exposure to UV radiation or **preparation of metal nanoparticles** via nontoxic biogenic reduction are ones of many possible applications of these



Antimicrobial properties of polyphenols sorbed into carboxymethyl cellulose film



Silver nanoparticles reduced by condensed tannins on the CMC fiber.

Substances contained in the grape pomace may find many uses such as textile or food dyes, antioxidants and anti-inflammatory drugs in cosmetics and pharmaceuticals and feedstock in other industries (e.g. condensed tannins for the manufacture of resins, binders and chipboards). The rest can serve as a fuel with great heating value in the form of briquettes and pellets.

The main reason to pay attention to this waste is environment protection and economic benefit because the grape pomace is a cheap source of phenolic compounds with large use.

This study is a part of several projects, to which is currently focused the **Platform of sorption processes and active surfaces** at the Department of Material Engineering at the Technical University of Liberec: use of vegetable waste in the textile dyeing, development of medical textiles and development of photocatalytic coatings.