# From forest to pharmacy:
# Studies of pharmaceutically valuable compounds in wild black crowberry (*Empetrum nigrum*)


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## Background

Black crowberries (*Empetrum nigrum*) are higher plants distributed mostly in a circumboreal area of the Northern Hemisphere, including forests of Latvia. Although crowberries are described to be useful in ethnomedicine due to antioxidative, antimicrobial, antiinflammatory and diuretic activity, their chemical composition at scientific level has not been studied widely [1].

## Objectives

The aim of this study was to identify pharmaceutically active compounds in berries and foliage of wild *Empetrum nigrum* collected in Latvia to promote their use in new pharmaceutically valuable products.

## Methods

Berries and foliage of black crowberries were hand-picked in the end of summer, 2015, in nature reserve Moorland of Cena (Latvia). Juice and pomace were obtained and lyophilised to dry remain; foliage was dried. Extracts from berries were obtained using different methods, but 5% solution of formic acid in 96% ethanol enhancing extraction by ultrasound was assessed as the most effective; extract of foliage was obtained using chloroform. UPLC, GC-MS analysis of extracts were performed to detect anthocyanins, lipids and flavonoids. Antiradical activity was detected using DPPH, total polyphenols – with Folin-Ciocalteu reagent, carbohydrates – by phenolic-sulphuric acid method [2].

## Results

Total content of polyphenols in *Empetrum nigrum* berries after analysis of pomace extract was 2.80-8.32 g/100 g (expressed as gallic acid equivalent, GAE); total flavonoids: 0.77-11.57 g/100 g (expressed as quercetin dihydrate equivalent, QDE); sum of carbohydrates: 4.20-8.82 g/100 g (expressed as glycose equivalent); antiradical activity varied from 12% to 15% depending on extraction method. Concentrated extract of black crowberries contained 36.20 g/100 g (as GAE) of flavonoids 36.25 g/100 g (as QDE), thus resulting in 69.5% antiradical activity.

Concentrated extract of polyphenols contained 48.7 mg/g of anthocyanins. It was possible to identify 13 anthocyanins, predominantly of those delphinidin-3-O-galactoside, cyanidin-3-O-galactoside which are more stable than arabinosides [3] and peonidin-3-O-arabinoside (**Fig. 1**).

In total, 17 lipid compounds were detected after esterification of the extract, and 15 of them were identified, predominantly linoleic acid, linolenic acid, oleic acid and nonacosane (**Fig. 2**).

9 compounds were identified in extract of foliage (mostly dihydrochalcones and flavanones) indicating potential antibacterial and antifungal activity [4] (**Fig. 3**).

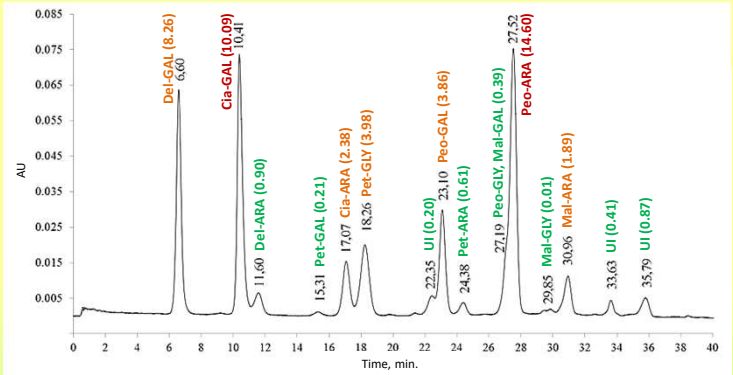


**Fig. 1.** UPLC chromatogram of detected anthocyanins in pomace of *Empetrum nigrum* berries, indicating their content in brackets as follows: >10 mg/g, 1.0-9.9 mg/g, <1.0 mg/g.
*Abbreviations: delphinidin (Del), cyanidin (Cya), petunidin (Pet), peonidin (Peo), malvidin (Mal), galactoside (GAL), arabinoside (ARA), glycoside (GLY), unidentified (UI).*

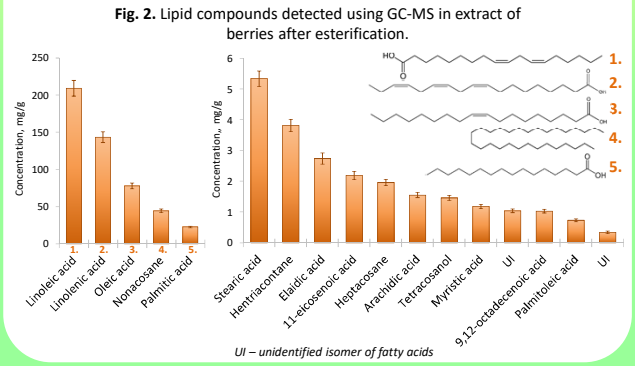


**Fig. 2.** Lipid compounds detected using GC-MS in extract of berries after esterification.
*UI – unidentified isomer of fatty acids*

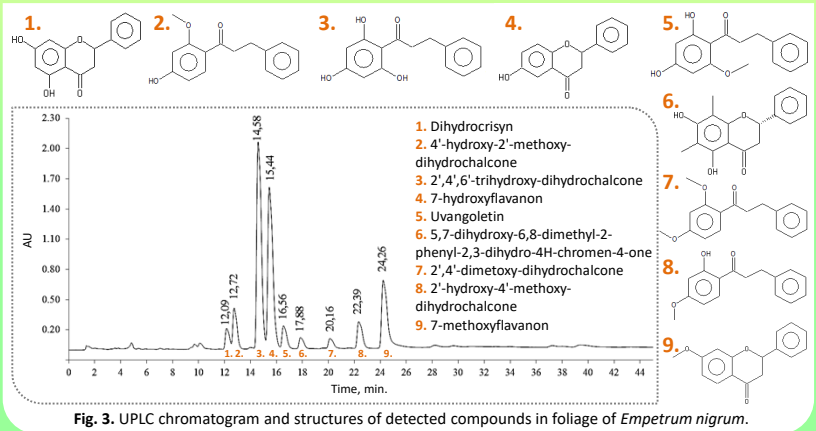


**Fig. 3.** UPLC chromatogram and structures of detected compounds in foliage of *Empetrum nigrum*.

## Conclusions

Optimised extraction of *Empetrum nigrum* resulted in obtaining of high level of polyphenols, especially anthocyanins (from 15 anthocyanins detected by UPLC 13 were identified) with elevated antiradical activity. Furthermore, black crowberries were assessed as a good source of phytosterols and unsaturated fatty acids. Thus, use of *Empetrum nigrum* berries, foliage and especially pomace for production of phytopharmaceutical products is promising.

## References


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