

Geroprotective properties of *Vaccinium uliginosum* L. and *Empetrum nigrum* ssp. *hermaphroditum* L. on the *Drosophila melanogaster* model

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Motivation and Aim: The fruits of *Vaccinium uliginosum* L. and *Empetrum hermaphroditum* L. are excellent sources of anthocyanins [1, 2], which have a wide range of health benefits [3, 4]. The purpose of this work was to study the potential geroprotective properties and mechanisms of action of plant extracts of local flora of Komi Republic on the *Drosophila melanogaster* model. We have estimated the effect of *Vaccinium uliginosum* L. and *Empetrum hermaphroditum* L. extracts on the lifespan, stress resistance, and locomotor activity of *Drosophila*.

Methods and Algorithms: Blueberries and crowberries were collected in the Pechora region near the Kozhva River in 2019. Ethanolic solutions of blueberry and crowberry extracts at concentrations of 0.01, 0.1, 1, 2.5, and 5 mg/mL were added to the surface of the nutrient corn medium at the volume of 30 µL. As a control, 30 µl of 96 % ethanol was applied to the medium. We studied the effect of extracts on lifespan (median and age of 90 % mortality), locomotor activity, and the resistance to adverse environmental factors (oxidative stress, hyperthermia, starvation) according to the method described in this article [5].

Results: Blueberry extract at the concentration of 1 mg/mL increased the median lifespan of females by 5 % ($p < 0.01$, Gehan-Breslow-Wilcoxon test), and that of males by 3 % ($p < 0.0001$). The maximum lifespan of females was increased when exposed to the extract at concentrations of 1, 2.5, and 5 mg/mL by 1 % ($p < 0.05$, Wang-Allisson test), and that of males by 4–6 % ($p < 0.0001$). However, blueberry extract at a concentration of 0.01 mg/mL decreased in maximum lifespan in females by 3 % ($p < 0.0001$), while in males, concentrations of 2.5 and 5 mg/mL decreased median lifespan by 2 % ($p < 0.0001$) and 7 % ($p < 0.01$) respectively.

The crowberry extract at a concentration of 2.5 mg/mL increased the median lifespan of females by 3 % ($p < 0.05$). In males, an increase in median lifespan was observed by 6 % at a concentration of 0.01 mg/mL ($p < 0.001$) and by 4 % at extract at the concentrations of 0.1 and 1 mg/mL ($p < 0.05$). The extract at a concentration of 1 mg/mL led to a decrease in the maximum lifespan of females by 3 % ($p < 0.0001$).

Treatment of *Drosophila* with blueberry extract at a concentration of 1 mg/mL causes a statistically significant increase in the resistance of females to hyperthermia by 21 % ($p < 0.01$, Fisher's test) and to starvation by 17 % ($p > 0.05$). The blueberry extract increased the resistance of males to the action of the oxidative stress inducer paraquat by 9 % ($p < 0.05$), but decreased the resistance to starvation by 38 % ($p < 0.05$). Crowberry

extract at a concentration of 2.5 mg/mL increased the resistance of females to hyperthermia by 14 % ($p < 0.05$) and oxidative stress by 33 % ($p < 0.05$). Crowberry extract increased the resistance of males to hyperthermia ($p < 0.05$) and oxidative stress ($p < 0.01$) by 11 %.

There were no statistically significant effects of extracts on the locomotor activity of *Drosophila*, but blueberry extract reduced locomotor activity in females at the age of 8 weeks by 81 % ($p < 0.01$, Student's t-test), and in males at the age of 4 weeks by 51 % ($p < 0.05$). Our results indicate that the studied extracts do not have a significant effect on the locomotor activity of *Drosophila*.

Conclusion: Ethanolic extracts of *Vaccinium uliginosum* L. and *Empetrum hermaphroditum* L. anthocyanins have positive effects on the lifespan of *Drosophila melanogaster*. The extract of *Vaccinium uliginosum* L. at a concentration of 1 mg/ml increased the resistance of males to oxidative stress, but reduced the resistance to starvation, without affecting the resistance to hyperthermia. In females, dietary blueberry extract increased resistance to starvation and hyperthermia, while the extract had no effect on resistance to the action of the prooxidant paraquat. *Empetrum hermaphroditum* L. extract at a concentration of 2.5 mg/ml increased the resistance of *Drosophila* to oxidative stress and hyperthermia, but had no effect on resistance to starvation. *Vaccinium uliginosum* L. and *Empetrum hermaphroditum* L. extracts have also been shown to have no significant effect on locomotor activity.

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