Popular scientific result summary for project funded by Ekhagastiftelsen

Popular scientific result summary is to be submitted by e-mail within 3 months of project end.

Application number:	2015-76
Project title:	Research into nutritive value and anticancer properties of blueberry and raspberry fruit from biodynamic, organic and conventional production
Receiver of grant (name, address):	Warsaw University of Life Sciences Nowoursynowska 166 02-787 Warsaw, Poland
Contact / project manager:	Prof. Ewa Rembiałkowska
Project start (yyyy-mm-dd):	2016-04-01
Project end (yyyy-mm-dd):	2018-09-30
By Ekhagastiftelsen granted sum:	1 280 000 SEK

Result summary: (max 900 words)

The summary should not be longer than 900 words and contain:
» Background and aims of the project

Demand for organic and biodynamic foods is strongly driven by consumers' perception that they are more nutritious and can help them to maintain good health. However, the scientific evidence about the nutritional quality of organic foods is still not sufficient and very sparse for biodynamic foods.
Therefore the aim of project was to investigate the levels of bioactive compounds and sensory values of fruits (raspberries, blueberries and blackcurrants) produced in biodynamic, organic and conventional agricultural systems. Moreover in the case of blueberries and raspberries their anticancer properties have been analysed.

» Theory and method
The recent meta-analysis comprising 343 peer-reviewed studies of organic and biodynamic *vs.* conventional foods have concluded that organic crops are characterized by significantly higher concentrations of antioxidants, lower concentrations of cadmium and 4 times lower incidence of pesticide residues than their conventional counterparts. However, the huge between-studies heterogeneity is observed, so there is evident need for the further studies to understand and confirm up-to now results.
Following the anthroposophic, holistic approach, not necessarily the concentrations of individual chemical compounds, but product as a whole determines the health-related quality of food. Such concept has been presented by Steiner and developed by the successive authors into the inner quality concept and growth-differentiation balance hypothesis, trying to explain the higher content of bio compounds in the organically vs conventionally grown crops. The systemic approach assumes that it is not possible to distinguish the separate factors responsible for the nutritive quality of crops, because many aspects of agricultural management are influencing together; in case of biodynamic system special anthroposophic practices may have additional effect enhancing soil and crop quality.

Fruit samples of 1.5 kg were collected from biodynamic, organic and conventional farms in July-September 2016 and 2017. All management farm types were located in the same vicinity in case of every fruit. Fruits were collected in their full maturity phase to provide the highest level of bio compounds. The collected fruit samples were immediately refrigerated & transported to the laboratory of the Chair of Organic Food (WULS). Part of each sample (0.5 kg) was immediately used for sensory analyses. All the rest (1.0 kg) was freeze-dried, ground in a mill and stored in -80^{o}C for further analyses, to prevent loss of biologically active compounds. The standard methods have been used for

chemical analyses: total and reducing sugars (by Luff-Schoorl method), vitamin C (by spectrophotometric method), phenolic acids (by HPLC), flavonoids (anthocyanins, flavanols, flavonols) (by HPLC), proanthocyanidins (by HPLC), carotenoids (by HPLC), antioxidant activity (with a spectrophotometric method using ABTS synthetic cation radicals), dry matter content (by gravimetric method), acidity (by titration). Each sample was analyzed in 3 replications. In addition sensory assessment of all fruits has been conducted with the Quantitative Descriptive Analysis (QDA®) method in the accredited sensory laboratory of WULS.

The study of anticancer properties of raspberry and blueberry extracts was based on: a/ direct effect on the level of proliferation and apoptosis of human colon carcinoma cell line, b/ indirect effect on the modulation of surface markers expression and cytokine production of human monocyte cell line. To examine the modulating effect of blueberry and raspberry extracts on the biological activity of anti-cancer drugs: 5-Fuorouracil and Erbitux the cancer cell line THP-1 has been used. For the examination of blueberry and raspberry effect on the proliferation potential of cancer cells and apoptosis and necrosis-inducing activity the *in vitro* method of treatment has been applied using cancer cell lines HT-29 and Caco-2.

» Results from the project

Organic fruits exhibited higher nutritional value than conventional ones only in one study year, 2016. In the year 2017 this result was not repeated. The level of bio compounds was higher in biodynamic vs organic fruits, but only in the second study year 2017. The levels of bio compounds and anti-oxidative activity were different in both study years. The highest levels of bio compounds and anti- oxidative activity were found in blackcurrants; the levels in blueberries and raspberries were lower and similar to each other. The sensory overall quality of all fruits was generally better for organic than conventional fruits and better for biodynamic than organic fruits. Basing on the results from the cancer line HT – 29 a trend is visible that only extracts from biodynamic fruits can provide a constant biological effect hampering the proliferation of the cancer cells. The studies on biological markers connected with macrophages indicated also that organically grown raspberries have possible beneficial role of diet supplementation with the extracts during anti-cancer therapy with 5-FU and Erbitux. It is necessary to verify with good statistical tools a relation between the concentration of certain groups of bioactive compounds in fruits and their sensory and anticancer properties.

»Conclusions

1. Preliminary results indicate better sensory values of organic vs conventional fruits and biodynamic vs organic fruits.
2. The advantage of particular farming systems in terms of nutritional quality of fruits is different in the subsequent study years, so the impact of farming practices on nutritional quality of fruits is not clear.
3. Only extracts from fruits grown in biodynamic farms could provide a constant biological effect hampering the proliferation of the cancer cells.
4. Organically grown raspberries may have possible beneficial role of diet supplementation with the extracts during anti-cancer therapy with special medicines.
5. The further long lasting studies are needed in order to standardize the methodology and to understand the main factors influencing studied biological processes.

»List of publications created by the project

Średnicka-Tober D., Kazimierczak R., Hallmann E., Drela N., Kozłowska E., Rembiałkowska E. 2017: Research into nutritive value and anticancer properties of berries from biodynamic, organic and conventional production: Project funded by Ekhagastiftelsen. Innovative research for organic 3.0. Vol. 2, Proceedings of the scientific track at the Organic World Congress 2017, November 9-11 in Delhi, India [eds. Gerold Rahmann i in.]. - S. 592-595.