



MINUTE COST 863, WG1 + WG4 Joint Meeting

Bioactive compounds in berry fruits: genetic control, breeding, cultivar, analytical aspects and human health

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The Joint Meeting was held in the frame of the EU-COST Action 863 “Euroberry Research: from Genomics to Sustainable Production, Quality and Health”. About 50 researchers and representatives of the berry industry from 20 countries (Europe, USA, New Zealand) attended the meeting, which was organised by Christoph Carlen, Pamela Crespo and their team at the Agroscope Changins-Wädenswil Research Station ACW, Conthey-Switzerland. The meeting was held at the Swiss Federal Institute of Technology in Zurich from the 3rd to the 5th December 2008.

The objective of the joint meeting was to discuss the relation of bioactive compounds in *Fragaria*, *Rubus*, *Ribes* and *Vaccinium* with genetic control, breeding, cultivars, analytical aspects and human health. Different aspects were treated such as:

- How do genetics and genomics contribute to a better knowledge on bioactive compound in berry fruits? (Session 1)
- Does variability exist in germplasm or collections and how can this variability be used for breeding programmes?
- Analysis to measure bioactive compounds in berry fruits and their agronomic improvement?
- How may bioactive compounds benefit human health?

To have a general international overview on breeding strategies and the importance of bioactive compounds for human health following experts were invited to give a presentation:

- Prof. Dr Kevin Folta, Plant Molecular and Cellular Biology Program on berries, Horticultural Sciences Department, University of Florida, USA (Strawberry genomics new impacts in basic biology and crop science).
- Dr. Jean Francois Hausman, Centre de Recherche Public – Gabriel Lippman EVA, Luxembourg (Investigating genetic diversity, nutritional quality and bioactive compounds of berry species collection grown in Russia).
- Dr Rodger Hurst, Leader of the Healthy Berry Programme, HortResearch, Auckland, New Zealand (Bioactive compounds in Berries: Factors influencing bioactive compounds in berries).

- Prof. Dr. Gary Williamson, Functional Food, Department of Food Science, University of Leeds, England (Bioactive compounds: Bioactive compounds: absorption and effects on human health).

Main achievements

In one of the sessions the presentations were focused on the contribution of genetics and genomics to a better knowledge on bioactive compounds in berry fruits. The findings for strawberries, a rapidly growing and early fruit-setting plant, on gene functions should translate well to other *Rosaceae* species, where such studies are more difficult to realise. So strawberry can be considered as a model plant for other important fruits species of the *Rosaceae* family.

Analysis of cultivated strawberry gene and genome structure reveal that the haploid strawberry genome is remarkably small, containing characterisable repetitive regions and gene structures similar to *Arabidopsis*. The analysis of the haploid genome helps to get a better understanding of the octoploid genomic system. Gen expression studies have characterised the spatial and developmental pattern of the expression of genes of the flavonoid pathways, in parallel to biochemical investigations on enzyme activity and main metabolites. Such studies on genotypes with different polyphenol composition grown in different environmental conditions may help to understand better the regulation of the different pathways of polyphenols. Furthermore, the investigation of quantitative trait loci (QTL) will help to have better knowledge of the inheritance and thus improve the breeding efficiency for fruit quality traits. QTLs were detected for these traits, but they were mainly different from one year to another. Other tools for breeder mentioned in some presentation were molecular markers such as AFLP and SSR.

Quite a lot of oral presentations and posters showed that there is a big variability in polyphenol content and composition of the fruits between cultivars, wild populations, progenies derived from different crosses, accessions in collections of strawberries, raspberries, blackberries, blueberries and *Ribes* species. This variability is an important source for breeding programs. In some presentations it was shown that wild populations have higher content of polyphenols in the fruits than cultivars. The environmental conditions such as altitude and production system (greenhouse to open field, drought stress, BHT treatments, dipping fruits in hot water) had quite a big influence on the content of polyphenols and the antioxidant capacity of the berryfruits.

Methods to analyse antioxidant capacity were shown aiming to get results in a quicker way with less reagents and solvents (micro plate method and short column abbreviated mass spectroscopic (SCAMS) techniques).

The aim of the last session was to develop and extend the knowledge and understanding of the berryfruit phytochemicals and how they may contribute to enhancement of human health and well-being. Health attributes of berries being investigated include regulation of inflammation and how this affects digestive health and physical fitness. Another topic presented was the understanding of the absorption and metabolism of such health related compounds. The small intestine is the major site of absorption for intact polyphenols, the colonic microflora plays a major role in metabolism of larger polyphenols to smaller compounds, which can then efficiently be absorbed. This combination of intact and metabolised polyphenols give a much higher concentration than any individual chemical compound. This consideration is important for berries where a large number of compounds are present. The neuroprotective antioxidant activity of *Rubus* species was analysed in

an oxidative stress-induced model of neurodegeneration cells. The results correlated well with the ORAC/total polyphenols ratio. The *Rubus* fruits revealed to be a promising source of natural antioxidants. Another presentation confirmed the important role of polyphenols in relation to strawberry consumption by enhancing red blood cells resistance to oxidative stress, in vitro and in vivo.

Progress and open questions

The final discussion highlighted the needs for further research and collaborations. Concerning the benefits for human health, an important question for breeders and agronomists is on what compounds they should focus. There are still lacks on this aspect and up to now it is not possible to give a clear answer for berries. Clinical studies with berries differing in their polyphenol compounds can help to answer such questions. Further studies are also necessary on the bioavailability of polyphenols, their absorption and their importance for health and well-being such as the reduction in inflammatory effects. Another question was, if it is possible to reach a toxic level of polyphenols by eating fruits. It seems that by eating fruit and vegetables this is not possible. It is more a risk with functional foods, i.e. when polyphenols are added to foods.

Different studies showed that there is a high variability in fruit polyphenols between berry species, cultivars, wild populations, progenies derived from different crosses and accessions in collections of strawberries. However, there is still a high unexplored potential. Furthermore, the influence of pre- and post-harvest factors on polyphenol compounds is not sufficiently documented.

Functional genomics are already an opportunity to better understand the underlying mechanisms of the pathway of different interesting compounds. Functional genomics combined with transgenic could be an alternative for solving problems, specifically for increasing some quality aspects in the fruits as well as for low input and sustainable productions. Cisgenic approach could help to reduce public fears together with better information of the public of such techniques and related risks.

In conclusion, it is important for the future to merge expertise on health related compounds. Knowledge on socio-economical aspects, consumer behaviors, marketing, beneficial effects of the consumption of berryfruits on health and well-being, variability due to genotypes, growing and shelf life conditions and on adapted breeding procedures in combination with functional genomics should be put together and discussed in order to develop a common strategies with all the stakeholders.

The organisers acknowledge all the participants for their presentations and the fruitful discussions during the meeting. Abstracts of the papers given at this meeting are available at <http://www.euroberry.it/documents/wgm08/Book%20of%20abstractsZurich08.pdf> , on the COST863-Euroberry-website.

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