IHC Lisboa 2010

NTNU – Trondheim
Norwegian University of Science and Technology

Bioforsk · Universitetet i Tromsø · University of Oulu

Assessment of physiological changes and taste quality of European blueberry (*Vaccinium myrtillus*) using metabolite profiling

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INTRODUCTION

- Fruit quality of European blueberry (EB) is determined by taste compounds (sugars, acids, flavour), and health-beneficial phytochemicals and antioxidants (phenolic acids, flavonols, anthocyanins, proanthocyanidins, ascorbic acid).
- Metabolite content and composition is affected by the environment regarding temperature, light, water and edaphic factors.

BIOLOGICAL QUESTIONS

- What is the environmental impact of temperature and day length on berry quality parameters with regard to taste compounds and phytochemicals?
- How do genotypes adapted to Northern and Southern Scandinavian climates respond to environmental variation regarding temperature and day length?

MATERIALS AND METHODS

- Individuals of 4 EB clones originating from Northern (N1, N2) and Southern Finland (S1, S2) were grown in a phytotron at 12° and 18°C in 2008 and 2009.
- Two different light treatments were tested: 24 h (long day) and 12 h (short day). Plants were kept outside during flowering to ensure insect pollination.
- Metabolite profiling (data 2008) was carried out by gas chromatography/ mass spectrometry (GC/MS)[a] to detect nutritional compounds (TCA acids, sugars, polyols, phenols, flavonoids). Total phenols[a], anthocyanins[b] and antioxidant capacity (FRAP)[c] were spectrophotometrically determined (data 2008+2009) .
- GC/MS data was aligned with 'SpectConnect' software (MIT, USA), and analysed with AMDIS deconvolution software. Statistical analyses using ANOVA GLM and Principal Component Analysis (PCA) were based on the selection of 15 detected metabolites (Table 1).

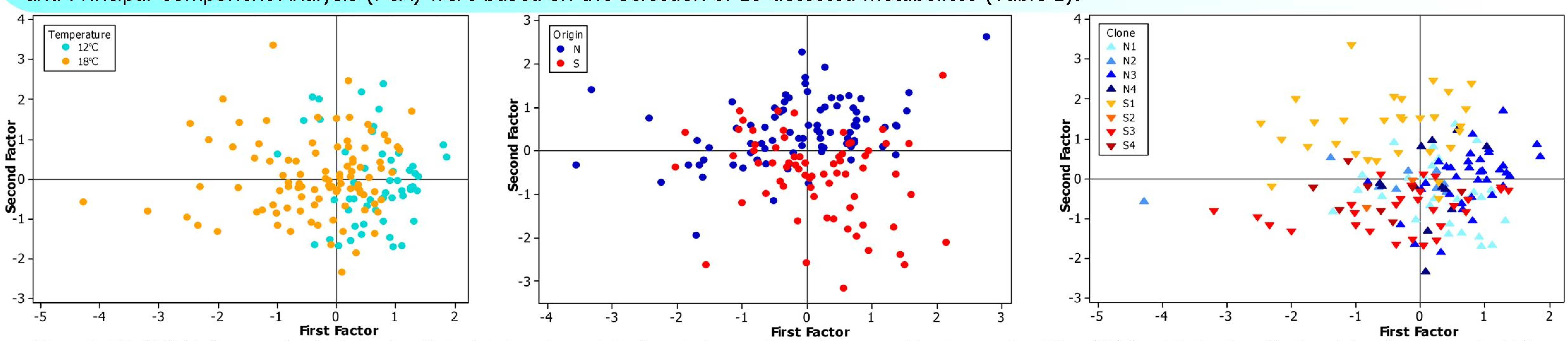

Figure 1. PCA of 151 blueberry samples clearly showing effects of single environmental and genotypic parameters on berry composition: **temperature** (12 and 18°C), **origin** (North and South and **clone** (genotype and origin).

RESULTS AND DISCUSSION

Multivariate statistics (PCA) (Figure 1) and ANOVA GLM analyses (Table 1) clearly indicated a strong effect of growing conditions (temperature) on EB metabolite composition. Also the the clonal origin (South (S) or North (N)) and individual clonal genotypes (S1-4, N1-4) had an obvious impact shown by distinct cluster patterns (Figure 1). Moreover, the effect of clonal origin on delayed plant development of southern clones is emphasized by Figure 2 showing two individual plants (S and N), which had been grown at a temperature of 18°C and long-day conditions (24 h). Berry quality traits such as total phenols, anthocyanins and antioxidants were significantly affected by clonal origin, while effects of temperature and day length were less pronounced (Figure 3).

Metabolite	Temp.	Light	Origin	Clone	Temp × Light	Temp × Origin	Temp × Clone	Light × Origin	Light × Clone	R^2
malic acid	0.000	0.002	0.000	0.000	0.962	0.474	0.102	0.102	0.803	66.87
citric acid	0.009	0.365	0.543	0.079	0.622	0.470	0.361	0.869	0.529	15.80
quinic acid	0.000	0.000	0.000	0.036	0.313	0.013	0.490	0.377	0.091	80.38
fructose	0.000	0.296	0.028	0.000	0.261	0.260	0.147	0.369	0.220	46.75
glucose	0.000	0.367	0.017	0.000	0.475	0.411	0.305	0.389	0.173	43.78
sucrose	0.000	0.103	0.000	0.000	0.516	0.160	0.174	0.735	0.087	67.26
chiro-inositol	0.311	0.008	0.000	0.000	0.002	0.341	0.395	0.013	0.000	64.82
myo-inositol	0.000	0.245	0.000	0.004	0.975	0.040	0.748	0.718	0.001	43.79
ascorbic acid	0.007	0.241	0.228	0.919	0.464	0.765	0.976	0.746	0.783	13.10
gallic acid	0.295	0.582	0.311	0.002	0.268	0.725	0.656	0.501	0.400	16.89
catechin	0.000	0.788	0.003	0.043	0.231	0.121	0.009	0.877	0.017	37.90
epigallocatechin	0.013	0.602	0.800	0.000	0.724	0.235	0.648	0.731	0.044	31.71
catechin derivate	0.000	0.409	0.000	0.000	0.144	0.042	0.998	0.043	0.217	54.30
chlorogenic acid	0.000	0.195	0.000	0.000	0.032	0.000	0.003	0.347	0.000	76.45
quercetin	0.679	0.280	0.079	0.493	0.080	0.451	0.796	0.555	0.979	10.87

Table 1. Statistical analysis based on ANOVA GLM of GC/MS data from phytotron trials (2008).

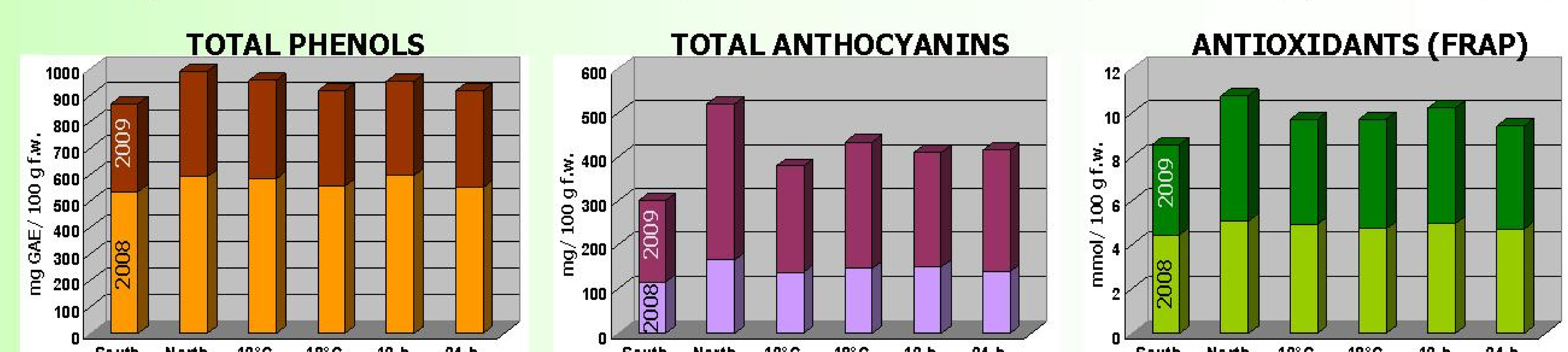

Figure 3. Effect of clonal origin (South and North), temperature (12° and 18°C), and day length (12 and 24 h) on total phenols, anthocyanins and antioxidants based on EB berry samples from phytotron trials in 2008 and 2009.

Figure 2. Growth performance of southern (S) and northern clones (N) under 18°C and long-day treatment (24 h).

LITERATURE CITED

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ACKNOWLEDGEMENTS: Financial funding from Norden/ Nordic Innovation Centre (NICe), New Nordic Food Program, and the Research Council of Norway (RCN), The Food Research Program, is highly appreciated.

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