Acyanic white-tipped yellow dahlia unexpectedly expresses a full set of anthocyanin pathway genes in the white tips

Daria Nitarska, Silvija Miosic, Benjamin Walliser, Stephanie Steinberger, Karl Stich, Heidi Halbwirth

Dahlia (*Dahlia variabilis*) is popular garden plant with more than 20.000 cultivars available. The colour of dahlia petals depends on the prevalent type of pigments present, which is anthocyanins in a purple, anthochlor pigments (aurones and chalcones) in a yellow and a mixture of those two groups in red/orange cultivars [1]. In this study, we used a cultivar, which showed white tips on otherwise yellow petals as a model to investigate which transcription factors are the most important in the process of pigment formation. It is intriguing that a plant is able to diverge pigment synthesis in separate parts of one tissue.

We analysed the expression of genes involved in flavonoid and anthochlor biosynthesis including transcription factors. Unexpectedly, we observed in the white tips a higher expression of the full set of genes of the anthocyanin pathway: chalcone synthase 1 (*CHS1*), flavanone 3-hydroxylase (*FHT*), dihydroflavonol 4-reductase (*DFR*) and anthocyanin synthase (*ANS*) [2]. As described [3], expression of *CHS1*, *DFR* and *ANS*, is regulated by the IVS transcription factor that belongs to the bHLH family. Gene expression data was supported by measurements of CHS, FHT and DFR activity that showed a significantly higher activity in the white part. HPLC analysis, in contrast, did not indicate the accumulation of large amounts of flavonoids in the white parts of the petals, whereas in the yellow base high amounts of anthochlors and flavonols were formed. The absence of flavonoid formation despite high gene expression and presence of enzyme activity is a mystery that could be explained by an event early in the pathway, which reduces the availability of early precursors. Otherwise, redirection of the pathway by substrate competition or a lack of exchange of molecules between cell layers could also provide an explanation. The absence of anthocyanins in tissues that are principally equipped with the complete machinery for anthocyanin biosynthesis including the expression of regulatory genes has been previously reported [4]. Further investigations will be performed to better understand this phenomenon in the bicoloured dahlia.

We acknowledge funding from the European Union's Horizon 2020 research and innovation program under the Marie Skłodowska-Curie grant agreement No 675657 and from the Austrian Science Fund (FWF): P 26468-B16

[1] McClaren *Encyclopedia of dahlias. Timber Press, Portland* (2009): 161-166.

[2] Ohno et al. *Planta* 234 (2011):945-958.

[3] Ohno et al. (2011): err216.

[4] Rosati et al. *PlantMolBiol* 35(1997):303-311.