Effect of light energy on photoisomerization of acylated anthocyanins for the expansion of their color expression

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INTRODUCTION

Color is an identifying characteristic of food products.[1] In the recent years, consumers have been demanding more colorants derived from plant materials, such as fruits and vegetables.[2] Therefore, research efforts on anthocyanins (ACN) have increased.[3]

Applying light treatment to acylated ACN is a novel way to modulate its color expression, without external addition of stabilizing compounds. Specifically, photoisomerization of ACN acylating group from *trans*- to *cis*-configuration leads to an expansion of their color expression.

AIM

Our objective was to investigate the impact of different light sources on the production of rare ACN pigments with enhanced performance.

METHOD

Anthocyanin Extraction:

- Pigment extraction using acetone:chloroform (1:2)

Sample Purification:

- Solid phase extraction for semi-purification
- Preparation of sample in quartz cuvettes

Light Treatments:

- Irradiation with sunlight, light box, and UV chamber at 365 nm

RESULTS

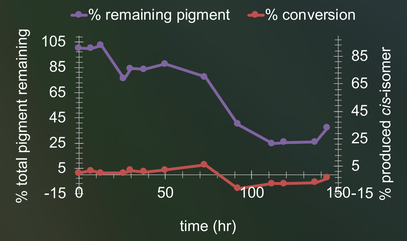


Figure 1. Greatest conversion from *trans* → *cis* was observed after 73 hours when acylated delphinidin was exposed to the sunlight. The % total pigment degradation was much greater than the % photoconversion.

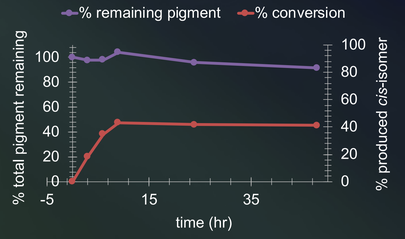


Figure 2. Greatest conversion from *trans* → *cis* was observed after 9.5 hours when acylated delphinidin was exposed to irradiation from the light box, which consisted of D65 lamp (artificial sunlight), tungsten, and fluorescent lamp.

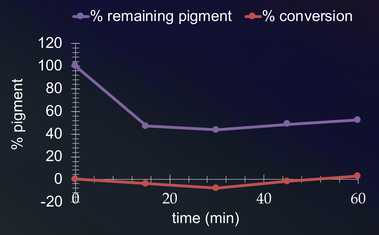
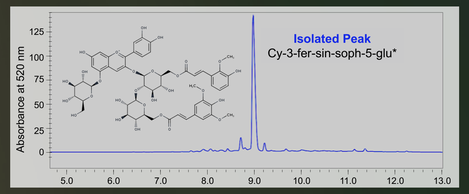
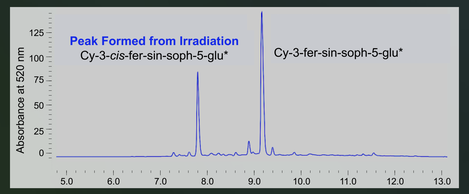


Figure 3. *trans* → *cis*-Delphinidin isomerization was negligible. The total pigment content decreased immediately with UV treatment, most likely due to the concentration of light dispersion inside the chamber. Longer time points need to be tested.





* indicates the need for further experimentation and analysis

Figure 4. HPLC chromatogram of the isolated di-acylated cyanidin (control: no light treatment) and the production of a new peak from 45 min of irradiation with 254 nm UV chamber. This suggests that photoisomerization occurs with di-acylated ACN.

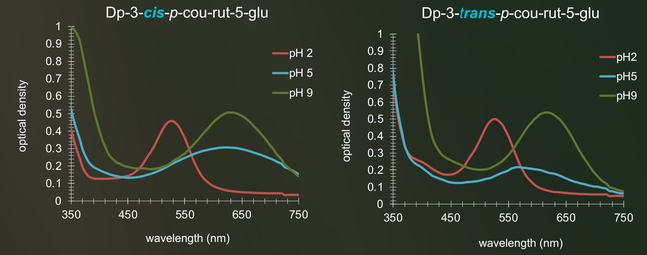


Figure 5. Spectral distribution of *cis*- and *trans*-isomers in acidic, neutral, and alkaline pH (left) and color expression of delphinidin (Dp)-3-*cis*-*p*-cou-rut-5-glu and Dp-3-*trans*-*p*-cou-rut-5-glu (top and bottom) from pH 1 – pH 9 (left to right).

CONCLUSIONS

Light box (D65, tungsten, and fluorescent lamp) produced greatest conversion with minimal total pigment degradation when the semi-purified extract was irradiated for 9.5 hours.

Sunlight generated maximal conversion at 73 hrs with minimal degradation at 13 hrs. Overall, sunlight produced considerable ACN degradation due to its long irradiation time with negligible photoisomerization.

UV chamber irradiation at 365 nm produced negligible conversion with pigment degradation by half. This suggests that longer irradiation times must be tested.

Color characteristics and pigment stability of *cis*- and *trans*-isomer were different. *cis*-Acylated ACN exhibited a distinct color range from its *trans*-counterpart, and in pH ranges typically challenging for ACNs.

In pH 4, *cis*-acylated delphinidin expressed color, whereas its *trans*-isomer bleached.

Diacylated ACN could also form a *cis*-isomer from its initial *trans*-configuration. Further studies must be done to determine the likelihood of photoisomerization based on type of acylating group and position.

ACKNOWLEDGEMENTS

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