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Tissue-dependent antioxidant response to UV-C irradiation in carrot root slices

Valerga, L.1, 2*; Gonzáles, R. E.3; Mauricci, T.M.1, 2; Cavagnaro, P.1, 2 ,4

1CONICET, Argentina; 2INTA E.E.A. Mendoza, Luján de Cuyo, Mendoza, Argentina; 3INTA E.E.A. La Consulta, La Consulta, Mendoza, Argentina; 4Instituto de Horticultura, Facultad de Ciencias Agrarias, Universidad Nacional de Cuyo, Lujan de Cuyo, Mendoza, Argentina.

*e-mail: valerga.lucia@inta.gob.ar

INTRODUCTION & AIM

Carrots (Daucus carota L.) are among the most consumed vegetables worldwide and a valuable source of health-promoting phytochemicals, including carotenoids and phenolic compounds such as chlorogenic acid (CGA). While orange-rooted cultivars are rich in α- and β-carotene, purple carrots also accumulate anthocyanins, responsible for their distinctive color and additional antioxidant properties. Postharvest UV-C irradiation (254 nm) has been shown to enhance the phenolic metabolism in fresh-cut carrots by inducing reactive oxygen species (ROS) that act as signaling molecules for the phenylpropanoid pathway. However, most studies have focused on orange carrots, and the response of cultivars with different pigment profiles remains unclear.

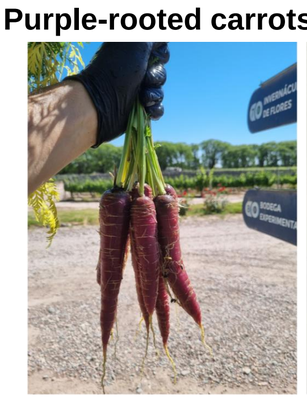
This study **evaluated the tissue-specific antioxidant response to UV-C in orange and purple (cv. Purple Elite) carrots**, considering the distinct localization of anthocyanins in the outer tissues of the purple roots.

METHOD

1. ***Plant material:*** orange (OR) and purple (cv. Purple Elite or PE) rooted carrots.

Orange-rooted carrots

Purple-rooted carrots (cv. Purple Elte)



1. ***UV-C treatment and storage***: carrot root slices were exposed to UV-C light at a dose of 8 kJ/m² and then stored at 20 °C for up to 5 days.

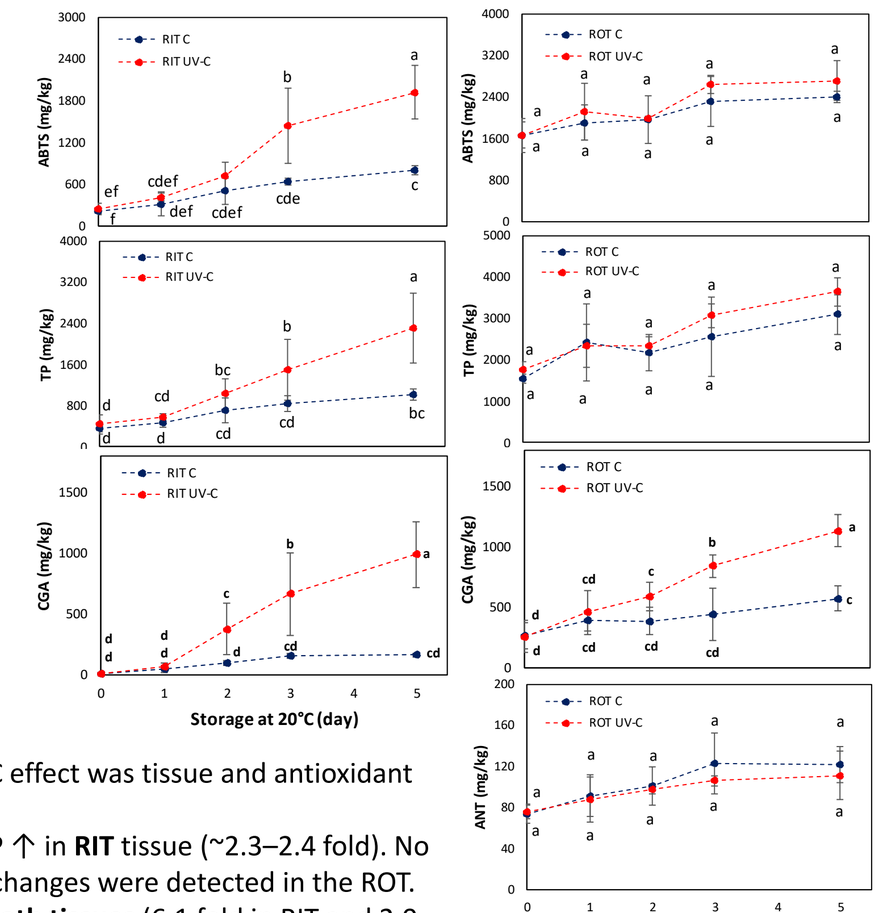
2. ***Extraction and analyses*:** inner (RIT) and outer (ROT) tissues were separated, ethanolic extracts (80% ethanol + 1% HCl) were prepared individually. The following determinations were performed:

- **Antioxidant capacity (AOX)**: ABTS (Arnao et al., 2001).
- **Total phenols (TP):** Folin–Ciocalteu (Singleton & Rossi, 1965).
- **Total anthocyanins (ANT):** pH differential method (Giusti & Wrolstad, 2001).
- **Chlorogenic acid (CGA):** HPLC analysis (Soto et al., 2018).

4. Complementary experiment:

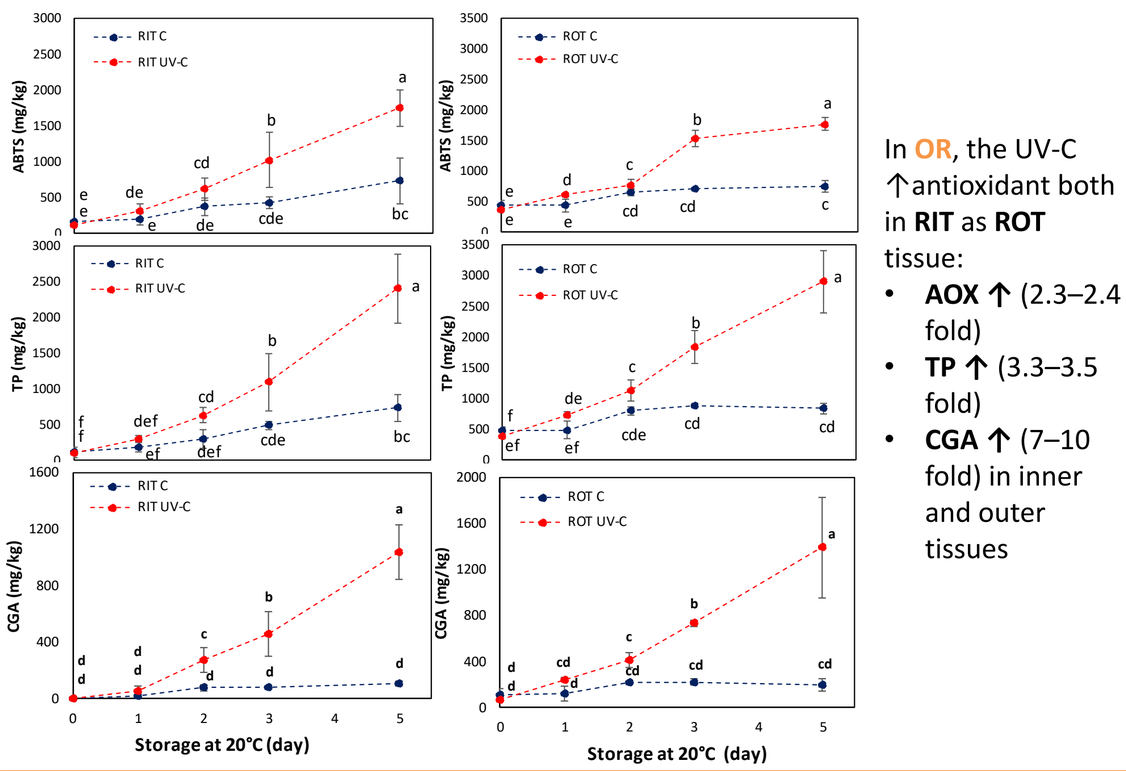
OR root slices were coated with anthocyanin solutions (40 and 137 mg/ L) extracted from fully purple carrots prior to UV-C exposure (8 kJ/m²). AOX and TP were measured as described in Section 3.

RESULTS & DISCUSSION



In **PE**, the UV-C effect was tissue and antioxidant dependent:

- **AOX** and **TP** ↑ in **RIT** tissue (~2.3–2.4 fold). No significant changes were detected in the ROT.
- **CGA ↑ in both tissues** (6.1 fold in RIT and 2.0 fold in ROT).
- **ANT no affected**.



In **OR**, the UV-C ↑antioxidant both in **RIT** as **ROT** tissue:

- **AOX ↑** (2.3–2.4 fold)
- **TP ↑** (3.3–3.5 fold)
- **CGA ↑** (7–10 fold) in inner and outer tissues

Complementary experiment:

OR carrot slices coated with anthocyanin extracts before UV-C exposure showed a **concentration-dependent reduction in AOX and TP**, confirming the **photoprotective effect of anthocyanins**.

CONCLUSION

UV-C enhances antioxidant capacity in a pigment- and tissue-dependent way, with anthocyanins acting as natural photoprotectors.

FUTURE WORK / REFERENCES

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Singleton, V. L., & Rossi, J. A. (1965). Colorimetry of total phenolics with phosphomolybdic-phosphotungstic acid reagents. American journal of Enology and Viticulture, 16(3), 144-158.

Soto, V.C.; Caselles, C.A.; Silva, M.F.; Galmarini, C.R. Onion hybrid seed production: Relation with nectar composition and flower traits. J. Econ. Entomol. 2018, 111, 1023–1029.