Elevated CO_2 Improves Both the Quantity and Quality of Two Lettuce Cultivars

Paper Reviewed

Sgherri, C., Pérez-López, U., Micaelli, F., Miranda-Apodaca, J., Mena-Petite, A., Muñoz-Rueda, A. and Quartacci, M.F. 2017. Elevated CO_2 and salinity are responsible for phenolics-enrichment in two differently pigmented lettuces. *Plant Physiology and Biochemistry* **115**: 269-278.

Writing as background for their work, Sgherri *et al*. (2017) say that lettuce (*Lactuca sativa* L.) is "the most important salad vegetable consumed worldwide," with some 25 million tons being produced annually across the globe. They also note that lettuce is "an important source of phytochemicals such as phenolic compounds," which compounds (including antioxidants), "have been recognized as phytonutrients able to lower the incidence of some types of cancer and cardiovascular diseases (Hooper and Cassidy, 2006)." What is more, Sgherri *et al*. state that plant phytochemical composition and antioxidant activity can be altered by environmental factors, such as rising atmospheric CO_2 and salinity stress, making it important to document and understand how such factors might impact plant phytonutrients in the future. Thus, it became the aim of their study to investigate the singular and combined effects of elevated CO_2 and salinity stress on the phytochemical composition of two differently pigmented lettuce cultivars, Blonde of Paris Batavia (a green leaf cultivar) and Oak Leaf (a red leaf cultivar).

In conducting their research, Sgherri *et al*. grew the two lettuce cultivars under either ambient (400 ppm) or elevated (700 ppm) CO_2 for 35 days after sowing. Then, from this date forward, they subjected a portion of plants in each CO_2 treatment to salt stress by adding Hoagland's solution supplemented with 200 mM NaCl each day until harvest. Upon harvest, the scientists conducted a number of measurements to ascertain plant growth and phytonutrient differences. And what did those measurements reveal?

Under ambient CO_2 growth conditions, Sgherri *et al*. report that salinity stress caused yield reductions, amounting to 5 and 10 percent in the green and red lettuce cultivars, respectively, whereas under normal salt conditions, elevated CO_2 *stimulated* yields, inducing gains of 29 and 38 percent in the green and red cultivars, respectively. And while actual percentages were not given in their paper, the authors note that in the combined treatment of elevated CO_2 and salinity stress, the positive impacts of elevated CO_2 ameliorated the negative impacts of salt stress.

With respect to phytochemicals, as shown in the figure below, both salt stress and elevated CO_2 increased plant antioxidant capacity, total phenols and total flavonoids. These findings led Sgherri *et al*. to conclude that "the application of moderate salinity or elevated CO_2, alone or in combination, can induce the production of some phenolics that increase the health benefits of lettuce." Thus, it would appear that the ongoing rise in atmospheric CO_2 will not only increase the growth and yield of lettuce, but also the *quality* of that growth by stimulating the production of certain health-promoting plant constituents. And, it will do so even in the face of environmental obstacles such as salinity stress. Now that's a finding worth celebrating!

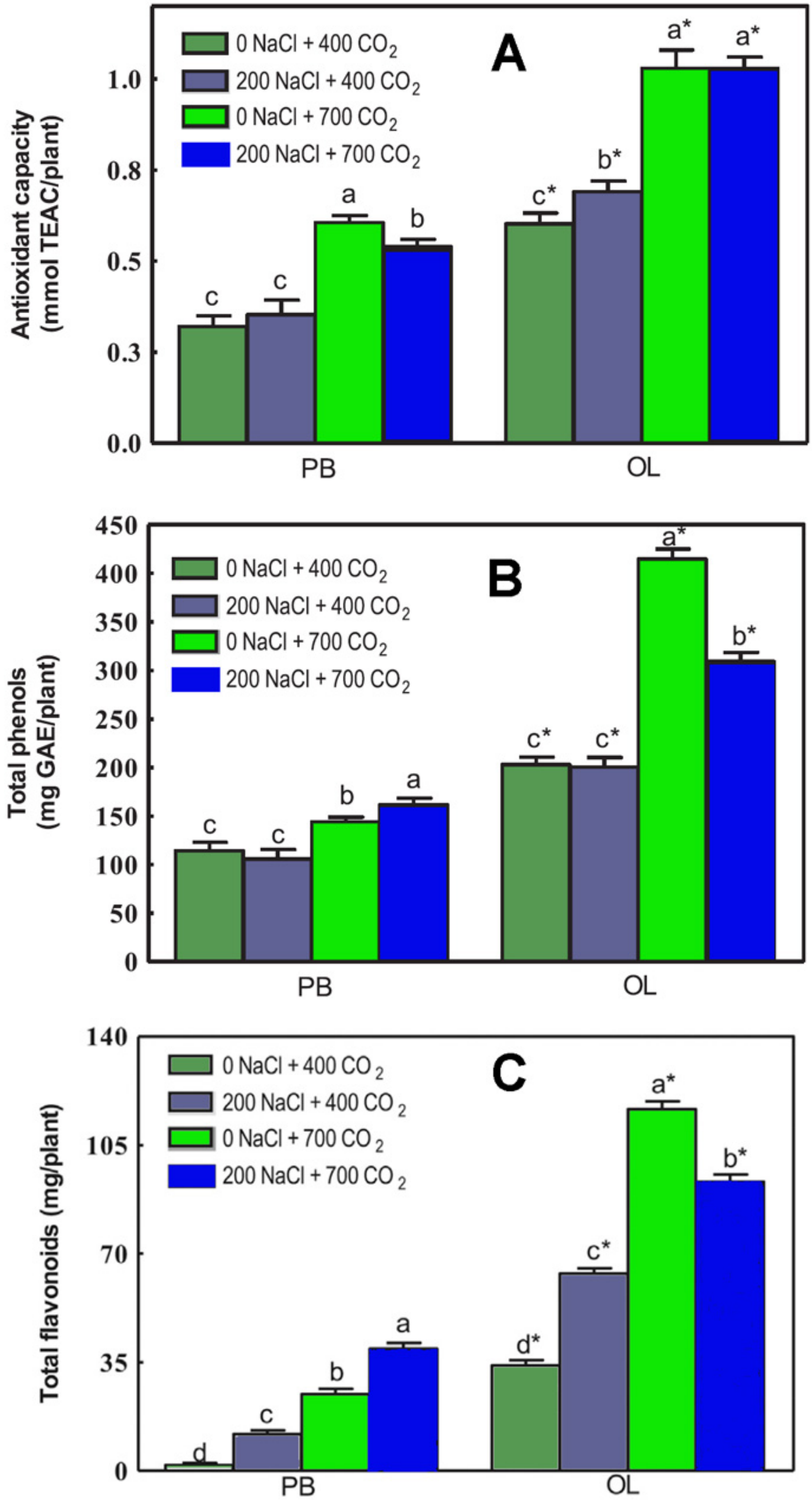

Figure 1. *Antioxidant capacity (Panel A), total phenols (Panel B) and total flavonoids (Panel C) in two lettuce cultivars (PB, Paris Batavia and OL, Oak leaf) subjected to salt treatment under ambient or elevated CO_2.*

*Each value represents mean ± standard error (n = 6). Within each cultivar, significant differences (at P < 0.05) are indicated by different letters. * shows differences between cultivars; TEAC, trolox equivalent antioxidant capacity; GAE, gallic acid equivalent. Adapted from Sgherri et al. (2017).*

Reference

Hooper, L., Cassidy, A., 2006. A review of the health care potential of bioactive compounds. *Journal of the Science of Food and Agriculture* **86**: 1805-1813.

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