Effects of nitrogen level on purslane antioxidant activity

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Abstract

The high antioxidant activity of purslane, *Portulaca oleracea*, gives it a high nutritional and functional value. The commercial production of purslane has increased in Portugal, giving rise to the need for finding out the effects of inputs, mainly nitrogen, on antioxidant activity. An experiment with four levels of N application (0, 30, 60 and 90 kg N ha^{-1}) was carried out. Golden-leaf purslane plants were grown in styrofoam boxes filled with substrate and were fertigated twice a week, over four weeks, with ammonium nitrate solution (16.9% NO_3^--N and 16.7% NH_4^+-N). Increase in nitrogen level led to decrease in water-soluble proteins content. However, ascorbic acid and phenols content, as well as antioxidant activity measured by the FRAP method, were not affected by nitrogen level. Shoot antioxidant activity, measured by the DPPH method was lower at 90 kg N ha^{-1} (26.20 mg GAE g^{-1} FW). On the other hand, shoot antioxidant activity mediated by peroxidases was higher at 30 kg N ha^{-1} treatment (0.459 µmol min^{-1} mg^{-1} prot.). The application of 60 kg N ha^{-1} allowed a vigorous plant growth without disturbing antioxidants and conservation properties.

Keywords: *Portulaca oleracea* subsp. *sativa,* ammonium-nitrate, ascorbic acid, phenols, FRAP, DPPH, peroxidases

INTRODUCTION

Purslane, *Portulaca oleracea*, is an edible herb used frequently in the traditional gastronomy of some regions of the world, such as the Alentejo, Portugal, where it is consumed either fresh, as a salad constituent, or cooked in soups and stews (Oliveira et al., 2009; Valagão, 2009). Purslane develops very well in temperate climates and drained soils with high sun exposure, factors that contribute to its appearance in backyards, driveways, and open land (Uddin et al., 2014). The literature attributes it a high content of omega-3 fatty acids, vitamins A, C and B complex, the minerals magnesium, calcium, potassium and iron, and also phenolic compounds, glucose, fructose and sucrose (Simopoulos et al., 1992; Uddin et al., 2014; Petropoulos et al., 2016).

Phenolic compounds and ascorbic acid or vitamin C (AAC) are included in the chemical structures that usually play a role in the defence of the plant species against environmental damage of different types. These compounds act as antioxidants, due to their ability not only in the donation of electrons but also in the formation of stable intermediate radicals which prevent the oxidation of some food constituents, mostly lipids (Gülçin, 2012; Liu, 2013). Ascorbic acid is an effective ROS scavenger, appearing as superoxide anion radical, hydroxyl radical and hydrogen peroxide. However, ascorbic acid can sometimes behave as an oxidant, because in the presence of metals such as Fe^{2+} and Cu^{2+} it can generate hydroxyl radicals and trigger lipid peroxidation (Du et al., 2012; Pisoschi and Pop, 2015). Broccoli, Brussels sprouts, tomatoes, and peppers are among the main vegetable sources of ascorbic acid, while red cabbage, spinach, kale, endives and broccoli stands are the main vegetable sources of phenolic compounds (Giada, 2013; Vainio and Weiderpass, 2006). However, purslane has higher ascorbic acid content than the major cultivated vegetables (Liu et al., 2000).

Though peroxidases (EC1.11.1.7) catalyse the reduction of hydrogen peroxide or other organic peroxides to water or to corresponding alcohol, such enzymes may also play a role in