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# Antioxidant capacity, antioxidant compounds and antioxidant enzyme activities in five date cultivars during development and ripening

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ABSTRACT

Antioxidant capacity, antioxidant compounds and antioxidant enzyme activities in dates of five cultivars during development and ripening were studied in the 2009 and 2010 seasons. Fruit growth followed a smooth sigmoid curve with maximum weight at the bisir stage. Both the antioxidant capacity measured by the 1,1-diphenyl-2-picrylhydrazyl (DPPH) method and the antioxidant compound (phenols, tannins and vitamin C) concentrations decreased from young stages through to the maturation and the ripening stages. The antioxidant capacity was highly positively correlated with the concentration of antioxidant compounds in most cultivars. The activities of the antioxidant enzymes, peroxidase, catalase and polyphenoloxidase (PPO) increased from the hababouk through to the kimri and/or the bisir stage, upon cultivar, and thereafter, declined at the ripening stages. The possible relation of these biochemical changes with fruit maturation and ripening was discussed.



## 1. Introduction

Date palm is the most successful and extremely important subsistence crop in most of the hot arid regions (Chao and Krueger, 2007; Awad, 2007). The consumption of fruit and vegetables is widely regarded as important and good for health. Indeed, date palm fruit possess antioxidant and antimutagenic properties in vitro (Vayalil, 2002) and this is due, partly, to its high content of polyphenolic compounds and vitamins as important dietary constituents (Mansouri et al., 2005; Al-Turki et al., 2010). The fruit of most date palm cultivars passes through five distinct stages of development and ripening. These stages are designated by Arabic terms and used universally. Hababouk, Kimri, Bisir or Khalal, Rutab and Tamer are used to represent, respectively, the cell division, cell elongation or the immature green, the mature firm full colored, the soft brown and the hard raisin-like stages of date palm development. Generally, whole dates are harvested and marketed at three stages of their development mainly bisir or khalal, rutab and tamer depending on cultivar characteristics especially soluble tannin level, climatological conditions and market demand (Glasner et al., 1999; Awad, 2007). Generally, limited consideration being given to the biochemical changes of dates during development and ripening (Awad, 2011). The activities of the pectic and glycanase enzymes such as polygalacturonase, pectinmethylesterase and cellulase have been studied in dates (Hasegawa et al., 1969; Hasegawa and Smolensky, 1971; Mustafa et al., 1986; Awad et al., 2011). While oxygen is fundamental for the survival of all aerobic organisms, it is subject to in vivo activation into toxic forms called reactive oxygen species (ROS) (Abassi et al., 1998). ROS can seriously react with vital biomolecules and were reported to cause peroxidation of membrane lipids, protein denaturation and DNA mutation (Borg and Schaich, 1988). They have also been reported to cause ripening of fruits and senescence of leaf and cut flowers (Lesham, 1992; Chakrabarty et al., 2007). However, an elaborate and highly redundant plant ROS network, composed of antioxidant enzymes and non-enzymatic antioxidant compounds, is responsible for maintaining the levels of ROS under tight control. Catalase, peroxidase, superoxide dismutase and polyphenoloxidase (PPO), and the non-enzymatic antioxidant compounds such as phenols, ascorbate and glutathione have been viewed as a synergistic antioxidant defensive system, whose combined purpose is to protect cells from active oxygen damage (Fridovich, 1988; Agarwal and Pandey, 2004). Because of the chemical nature of fruit phenolics that differ from simple to highly polymerized forms, there is no one satisfactory solvent extraction method for phenolics or even for a specific class of these compounds (Mansouri et al., 2005; Al-Turki et al., 2010). Also, there is no agreement on one ideal method for estimating the antioxidant capacities of food (Wu et al., 2004). DPPH (1,1-diphenyl-2-picrylhydrazyl) and ABTS

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