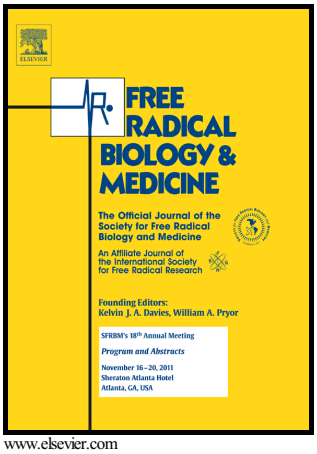
Ascorbic acid metabolism and functions: a comparison of plants and mammals

Nicholas Smirnoff



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Nicholas Smirnoff

Biosciences, College of Life and Environmental Sciences, University of Exeter, Geoffrey Pope Building, Stocker Road, Exeter EX4 4QD, UK

N.Smirnoff@exeter.ac.uk

ABSTRACT

Ascorbic acid is synthesised by eukaryotes, the known exceptions being primates and some other animal groups which have lost functional gulonolactone oxidase. Prokaryotes do not synthesise ascorbate and do not need an ascorbate supply, so the functions that are essential for mammals and plants are not required or are substituted by other compounds. The ability of ascorbate to donate electrons enables it to act as a free radical scavenger and to reduce higher oxidation states of iron to Fe^{2+}. These reactions are the basis of its biological activity along with the relative stability of the resulting resonance stabilised monodehydroascorbate radical. The importance of these properties is emphasised by the evolution of at least three biosynthetic pathways and production of an ascorbate analogue, erythroascorbate, by fungi. The iron reducing activity of ascorbate maintains the reactive centre Fe^{2+} of 2-oxoglutarate-dependent dioxygenases (2-ODDs) thus preventing inactivation. These enzymes have diverse functions and, recently, the possibility that ascorbate status in mammals could influence 2-ODDs involved in histone and DNA demethylation thereby influencing stem cell differentiation and cancer has been uncovered. Ascorbate is involved in iron uptake and transport in plants and animals. While the above biochemical functions are shared between mammals and plants, ascorbate peroxidase (APX) is an enzyme family limited to plants and photosynthetic protists. It provides these organisms with increased capacity to remove H_2O_2