Increases in plasma lycopene concentrations change the antioxidant activity of the plasma as measured by ORAC but has no effect on two other ex vivo total plasma antioxidant assays

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Antioxidants have been suggested to have a role in the prevention of cardiovascular disease and some cancers. Quantifying the action of antioxidants or the amount of oxidative stress of cells and tissues, before and after a dose is becoming of increasing interest in medical research. Methods have been developed to quantify the antioxidant capacity of total and fractionated plasma, such as the FRAP (ferric reducing antioxidant power), ORAC (oxygen radical absorbance capacity) and TBARS method (thiobarbituric acid reactive substances). This study investigated the effect of the addition of lycopene to total plasma, at biologically relevant concentrations, and the resultant ex vivo plasma antioxidant activity or production of pro-oxidants.

Lycopene (98% trans isomer, Hoffmann LaRoche, Switzerland; dissolved in DCM then nitrogen evaporated) was added to a pooled sample of human plasma (n=12), obtained at fasting, to give plasma concentrations between 0.28 and 1.87 µmol/L. The antioxidant capacity was measured by ORAC, a singlet oxygen assay (SOA) and lipid peroxidation was measured by TBARS, after 1 h and 24 h of incubation of the plasma at 37°C and 5% CO2 (n = 6 at six different concentrations of lycopene). There was no change in the ex vivo antioxidant capacity or lipid peroxidation of the plasma at the 1h and 24h periods measured by TBARS (P = 0.179 and P = 0.369, respectively) and SOA (P = 0.338 and 0.311, respectively) at increasing lycopene concentrations in plasma. However, the ORAC assay showed a dose-dependant increase in the antioxidant capacity after 1h (P = 0.002) of incubation but not after 24h (P = 0.207).

We speculate that the lack of effect at 24 h was due to isomerisation of trans to cis lycopene under the incubation conditions, the failure of the exogenously added lycopene to partition into the appropriate plasma lipoprotein fractions (eg LDL) or the loss of other antioxidants in the plasma.

This data shows that addition of trans-lycopene to plasma across the range which could be encountered physiologically, leads to an increased antioxidant capacity but that there was no effect of the increased lycopene on lipid peroxidation or singlet oxygen quenching. This research suggests that some ex vivo antioxidant capacity assays may not be sufficiently sensitive for the prediction of antioxidant action in vivo.

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