Carnosic Acid and carnosol (rosemary derivatives) provide protection against gamma-ray induced chromosomal damage to human lymphocytes in-vitro. Carnosic acid and carnosol demonstrate significant antimutagenic activity both before and after gamma-irradiation, with pre-treatment providing the greatest benefit, compared to rosmarinic acid, L-ascorbic acid and DMSO.

Del Bano MJ, Castillo J, and Benavente-Garcia O, et. al. ***Radioprotective-antimutagenic effects of rosemary phenolics against chromosomal damage induced in human lymphocytes by gamma-rays****. J Agric F*ood Chem. 2006 Mar 22;54(6):2064-8.

The antimutagenic protective capacity of several compounds against genotoxic damage induced by exposure to X-rays is studied. Pre-treatment with rosmarinic acid dissolved in water provided the greatest magnitude of protection (57.7%). Carnosic acid dissolved in 5% DMSO also provided significant protection (50%), which was equal to the protective effects of alpha-tocopherol in 5% DMSO and apigenin in water.

Alcaraz M, Armero D, Marťinez-Beneyto Y, and Castillo J, et.al. ***Chemical genoprotection: reducing biological damage to as low as reasonably achievable levels.*** *Dentomaxillofacial Radiology. 2011 Jul 40(5), 310-314.*

The lipo-antioxidants carnosic acid, carnosol and alpha-tocopherol provide significant anti-mutagenic protection after the application of gamma-ray induced damage. This protective effect relies on the ability of these compounds to reduce react oxygen species within cells, lipoperoxy radicals, which are responsible for the majority of continuous chromosomal oxidative damage. Water soluble antioxidants can provide protection when applied prior to radiation, via superoxide anion scavenging activity, but do not offer protection post-treatment like these lipo-antioxidants.

Alcaraz M, Acevedo C, and Castillo J, et. al. ***Liposoluble antioxidants provide an effective radioprotective barrier.*** *The British Journal of Radiology. Jul 2009 82: 605-609*.

Rosmarinic acid acts as a photo-protective agent both via the reduction of reactive oxygen species and as an inducer of endogenous defense mechanisms (regulating tyrosinase activity and stimulating melanin production.

Sanchez-Campillo M, Gabaldon JA and Castillo J, et al. ***Rosmarinic acid, a photo-protective agent against UV and other ionizing radiations.*** *Food and Chemical Toxicity. 2009 47: 386-392.*