

the years, more and more experimental results indicate that the true mechanisms of the “antioxidant prophylaxis” are to be studied using the ways of systems biology instead of free-radical chemistry. Last years, such terms as “polyphenols”, instead of “antioxidants”, and “redox regulation/redox signaling pathways”, instead of “oxidative stress”, came into use.^{83–85} Moreover, the Society for Free Radical Biology and Medicine has recently been renamed to the Society for Redox Biology and Medicine. As said in ref. 86, “it is harder to overcome old ideas, rather than create the new ones.”

8.5 Conclusions

The systems approach, based on the engineering theory of reliability, integrates the concept of the aging program and the free-radical theory of aging in a unified pattern. The universal features of aging, such as the exponential growth of mortality rate with time and the correlation of longevity with the species-specific resting metabolism, are naturally explained on this basis. From the systems reliability standpoint, aging is a stochastic consequence of the genetically preprogrammed limits of bioreliability at all functional levels, from biomolecular nanoreactors to the organism as a whole. The stochastic malfunctions of the mitochondrial electron transport nanoreactors, which produce the oxygen anion-radicals (“superoxide radicals”) as by-products of respiration, seem to be of first importance. The free-radical redox-timer, presumably located in the specialized neurons of the central nervous system, serves as the effective stochastic mechanism of realization of the preset deficiency in bioreliability. As a consequence, the oxidative-stress products and other metabolic slag accumulate with the resulting impetus to autophagic or apoptotic cell death accompanied with age-associated clinical disorders. Some antioxidants, both natural and synthetic ones, extend the life span of animals when added to food or drinking water. However, the antioxidant power of such compounds is negligible *in vivo* because their rate constants and concentrations are too small to compete with the specialized antioxidant enzymes for the reactive oxygen species. The so-called antioxidants provide a preventive protection against ROS, *i.e.* the prophylactic reliability maintenance operating *via* their beneficial effects on the organism’s neuro-hormonal system and/or microbial cells of the body. Thus, the systems reliability approach serves as a heuristic methodology in searching for realistic mechanisms of aging and anti-aging therapy.

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