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Acceleration of the Aging Process by Oxygen

The frequent use of artificial atmospheres for underwater activities as well as for the purposes of aviation and space travel has focused attention on the toxicity of oxygen to man and experimental animals. The mechanisms by which oxygen becomes toxic to the tissues of man and animals are of interest in the field of experimental gerontology, and a widely accepted theory of mammalian aging suggests that cellular lipid peroxidation plays an essential role in the time-dependent degenerations of living organisms. In a contributory study seeking a better understanding of the aging process and the specific role of oxygen, tissue changes induced by hyperoxia have been compared with those of normal aging. Male flies of the species *Drosophila melanogaster* were used as experimental animals because their simple physiological structure provides many obvious advantages.

At a laboratory temperature of 23°C, control groups of flies were maintained in a normal air atmosphere while other groups were exposed to an oxygen-rich environment (oxygen—nitrogen, 1:1). The "vitality" of both groups was determined weekly by measuring negative geotaxis; the time of death during the experiments was noted.

An accelerated loss of vitality was observed for flies exposed to the oxygen-rich environment; a drastic shortening of life was also noted, i.e., mean life span was only 34.6 days, whereas flies living in the normal air atmosphere had an average life span of 78.1 days. Examination of tissue sections by light microscopy indicated only a marked "sponginess" of the brain after 28 days of exposure under oxygen tension. On the other hand, changes in *all* of the tissues were observable by electron microscopy.

The results of the investigations prompt the conclusion that normal aging, the radiation syndrome, and hyperoxic injury share at least one common feature —lipid peroxidation damage to all membranes resulting in an accumulation of age pigment. However, important differences exist between normal senescence and "aging" accelerated by oxygen or radiation. In normal aging, all the tissues seem to deteriorate at about the same pace, but in hyperoxia (or following exposure to ionizing radiation) the brain becomes the critical organ and, most likely, a fly dies of a "brain syndrome." It has been proposed that the insect nervous system becomes involved after high doses of ionizing radiation; the results of this investigation seem to support the proposal because the neuromuscular coordination of the *Drosophila,* as expressed in mating or negative geotaxis, deteriorates sharply following exposure to the hyperoxic environment.

Note:

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