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EFFECTS OF ULTRAVIOLET RADIATION ON TRITIATED THYMIDINE UPTAKE IN FERTILIZED EGGS OF Echinarachnius parma

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Unfertilized eggs of Echinarachnius parma exposed to ultraviolet and subsequently fertiliz have the same rate of H^3TDR uptake as non-radiated controls between fertilization and 31 min post-fertilization. The rate of incorporation becomes significantly more rapid after this point i the radiated population, which however has a 24 min cleavage delay. If the zygotes are irradiat 65 min post-fertilization, the immediately following H^3TDR uptake peak (70 min) and cleavage (83 min) are not delayed. The following or second cleavage occurred at 154 min (radiated) and min (non-radiated) with the peak H^3TDR incorporation at 145 min and 125 min respectively. Th is a delay of 21 min for cleavage for 20 min for peak H^3TDR uptake, this latter being the synth sis for the third cleavage. In these experiments the DNA synthetic period in immediate prepara tion for a subsequent cleavage was not delayed by the irradiation even though a delay in cleavag occurred. This suggests that the ultraviolet was not affecting the DNA synthesis directly but wa deleterious to other processes in preparation for the cell division. The increased rate of H^3TD uptake in eggs radiated pre-fertilization cannot be clarified at present.

The ultraviolet dose of 5.72×10^{-3} ergs/cm^2 from a polychromatic Hanovia high pressure mercury arc was such that recovery would occur spontaneously in the dark and the ensuing development was normal in all aspects. Photorecovery in these phenomena was not studied.

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GAS EXCHANGE IN BIOLOGICAL SYSTEMS

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There is a bimodal distribution of CO_2 tensions in biological forms. PCO_2s are generally less than 5 mmHg and $[HCO_3^-]$ less than 10 meq/L in aquatic gas exchangers. PCO_2s are generally greater than 15 mmHg and $[HCO_3^-]$ greater than 20 meq/L in terrestrial gas exchangers. This distribution may be explained by considering the quantitative relationship between O_2 and CO_2 tensions in body fluids in the steady state.

A general relationship may be derived for the relationship between PaO_2 and $PaCO_2$ as follows:

$$PaO_2 = P_{I_{O_2}} - K_1 - \left[\frac{\alpha CO_2}{\alpha O_2} \times \frac{1}{R} (PaCO_2 - P_{I_{CO_2}} - K_2)\right]$$

where PaO_2 : arterial O_2 tension

$P_{I_{O_2}}$: ambient O_2 tension

R	:	respiratory exchange ratio
$^{\alpha}CO_2$	:	solubility coefficient CO_2
$^{\alpha}O_2$	:	solubility coefficient O_2
$PaCO_2$	:	arterial CO_2 tension
$P_{I_{CO_2}}$	:	ambient CO_2 tension
K_1	:	concentration gradient arterial blood - mean expired water/air O_2 tension
K_2	:	concentration gradient arterial blood - mean expired water/air CO_2 tension

This general relationship may be utilized to explain a wide variety of biological phenomena. For example the mode of gas transport may be characterized in a given system in terms of the parameters K_1 and K_2 as follows:

	Mode of gas exchange
K_1 zero; K_2 zero	simple passive diffusion
K_1 positive; K_2 positive quantitatively consistent	diffusion limitation v-p imbalance in gas exchange unit
K_1 negative; K_2 negative	counter current exchange
K_1 positive; K_2 zero	"active transport" of O_2
K_1 zero; K_2 positive	"active transport" of CO_2

The bimodal distribution of PCO_2 is based on the difference between $\frac{^{\alpha}CO_2}{^{\alpha}O_2}$ in air as compared to water. In air this ratio is 1 and PO_2s of 100 mmHg result in PCO_2s that are greater than 10 mmHg. In water, however, $\frac{^{\alpha}CO_2}{^{\alpha}O_2} > 20$ and PO_2s of greater than 20 mmHg result in PCO_2s of less than 5 mmHg.

Since hydrogen ion concentration and HCO_3^- concentration vary as functions of PCO_2, forms with high PCO_2s will have high bicarbonate concentration, and those with low PCO_2s will have low concentrations.

As oxygen dependent metabolism developed an obligatory requirement for PO_2 was established. Since the primary mode of gas transport is diffusion, PO_2 in turn establishes the level of PCO_2 and bicarbonate. The values for PCO_2 and bicarbonate found in biological systems reflect diffusion as the gas transport mechanisms, but under certain circumstances these levels can be modified by specific transport mechanisms. This bimodal distribution of CO_2 and bicarbonate results from the obligatory requirement for oxygen to subserve oxygen dependent metabolism.