

EFFECTS OF RADIATIONS OF COD LIVER OIL

PRELIMINARY NOTE *

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Cod liver oil, egg yolk and other naturally occurring foodstuffs are known to be curative of rickets. The radiations of ultraviolet light bring about the same result. In 1923, Park, Powers and Guy¹ made the statement that "the similarity between the action of cod liver oil and that of radiant energy in rickets is so close that a connection must exist between them." Kugelmass and McQuarrie² demonstrated that this connection existed by reason of the ability of the foodstuffs mentioned above to give off radiations of ultraviolet light. Kramer, Casparis and Howland³ showed that both these agencies caused an increase in serum phosphorus and the deposition of calcium in bone.

It has been noted for some time that animals deprived of vitamin A develop infections of the respiratory tract and very frequently a generalized pyogenic involvement, in which organisms of an avirulent type are the etiologic agents. I⁴ have called attention to many of these infections developing on diets deficient in vitamin A. Other recent evidence of similar nature has been published by Cramer⁵ and by Sherman and MacLeod.⁶

It is well known that ultraviolet light is bactericidal. Gates,⁷ for example, showed the lethal action of ultraviolet radiations on *Staphylococcus aureus*. To me, it

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1. Park, E. A.; Powers, G. F., and Guy, R. A.: Regulatory Influence of Cod Liver Oil on Calcium and Phosphorus Metabolism, *Am. J. Dis. Child.* **26**: 103 (Aug.) 1923.

2. Kugelmass, I. N., and McQuarrie, I.: *Science* **60**: 272, 1924.

3. Kramer, K.; Casparis, H., and Howland, J.: Ultraviolet Radiation in Rickets; Effect on Calcium and Inorganic Phosphorus Concentration in Serum, *Am. J. Dis. Child.* **24**: 20 (July) 1922.

4. Manville, I. A.: Pathologic Changes Occurring in White Rats Raised on Diets Deficient in Vitamin A, *Arch. Int. Med.*, to be published.

5. Cramer, W., and Kingsbury, A. N.: *Brit. J. Exper. Path.* **5**: 300 (Oct.) 1924.

6. Sherman, H. C., and MacLeod, F. L.: *Proc. Soc. Exper. Biol. & Med.* **22**: 75, 1924.

7. Gates, F. L.: *Proc. Soc. Exper. Biol. & Med.* **21**: 61, 1923.

seemed reasonable to assume, in view of the foregoing facts, that the reason rats failed to develop infections when raised on diets containing the fat soluble vitamin was the bactericidal action of the ultraviolet radiations that are now known to characterize such fats.

In order to prove this hypothesis, bacterial cultures were exposed to cod liver oil. During the exposure the cod liver oil, rendered alkaline, was oxygenated. This method has been shown to enhance the ultraviolet radiations.² The results of these experiments strongly indicate an inhibitory action of cod liver oil on bacterial growth. Thus far our work seems to verify the foregoing assumption.

A still further action of cod liver oil and such food-stuffs is seen in the effect the active principle has on cell activity. In the absence of this stimulating influence, the cell remains in a quiescent or resting state.⁸ This seems to indicate that the cell is dependent on this influence for the initiation and maintenance of those processes necessary for its normal activity. Normal body functioning requires that there be enough of this stimulating influence present to act on all the cells in proportion to their need. Anything less than this results in a corresponding decrease in cell activity. A slight excess may result in an increase above normal; but when a marked excess is present, stimulation is replaced by inhibition, if not by actual destruction.

Cell activity is manifested first by multiplication, either for growth or for maintenance, and secondly by normal secretory activity necessary for adequate digestive processes, resistance to infections, and general well-being. It will thus be seen that the results of an experiment will depend on the time in an animal's life during which the test diet is fed. When a deficient diet is fed to an immature animal, growth will be stopped, the secretions will be curtailed, the reproductive organs will remain infantile, and the animal will finally die of undernutrition and the effects of decreased resistance to infection. If a similar diet is fed to an adult animal, its normal functions must be carried on by the residual vitamin its body has stored. As this becomes depleted, the first function to be lost is reproductive ability. Further evidences of the gradual depletion of this reserve are manifested by an increasingly evident

8. Mori, S.: Bull. Johns Hopkins Hosp. 33: 357 (Oct.) 1922.

appearance of ill-being. On the other hand, when the diet contains an excess of this active principle, the most marked result is sterility. As with the roentgen ray and radium, the effect of the radiations seems to be selective—the cells undergoing the most rapid cell division being the most affected.

Besides the action of cod liver oil in curing or preventing rickets, we are led to conclude from the foregoing that there are two other specific actions: (a) There is a stimulation of cell activity and a distinct inhibitory effect on bacterial growth; (b) when these active substances are in excess of the amount producing stimulation, there is exerted a depressing action, the most striking manifestation of which is a lack of fertility. The separation of fat soluble A into two separate vitamins each with a specific action does not seem justified when the effects can be explained as being due to different concentrations of the same principle.

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