TABLE 1

THE PROTECTIVE EFFECT OF URACIL AGAINST ULTRAVIOLET RADIATION (2537 A)* DAMAGE ON ALASKA PEA SEEDLINGS

Variance analyses						
Variability due to	D/F†	Sums of squares	Mean squares	Observed F	Required F .05	.01
1. Control (sprayed with distilled water and irradiated) —Treatment (500 μg uracil)						
Totals	23	6.098				
Between treatments	1	1.402	1.402	6.56	4.30	7.94
Within treatments	22	4.696	0.213			
Standard deviation = 0.46 Standard error = 0.42						
Mean growth for control = 2.41 cm; and for treated = 2.93 cm, with a difference of 0.52 cm						
Minimum difference required for significance at .05 level, 0.39; at .01 level, 0.53						
2. Control (sprayed with distilled water and irradiated) —Treatment (1000 μg uracil)						
Totals	23	11.311				
Between treatments	1	3.700	3.700	10.70	4.30	7.94
Within treatments	22	7.611	0.346			
Standard deviation = 0.59 Standard error = 0.17						
Mean growth for control = 2.41 cm; and for treated = 3.23 cm, with a difference of 0.82 cm						
Minimum difference required for significance at .05 level, 0.50; at .01 level, 0.68						

* A 30-w GE germicidal tube No. G-30, T-8 (mercury arc) at a distance of 20 cm. This tube operates on the principle of the fluorescent tube, but the glass of the tube is clear and of a special type which passes a particular wavelength of ultraviolet. About 95% of this ultraviolet energy is in the region of 2537 A—the most effective germicidal energy.

† D/F = degrees of freedom.

ment of the effect of uracil in protecting 6-day-old etiolated Alaska pea seedlings against ultraviolet radiation (2537 A, Table 1).

Seedlings were sprayed with solutions of uracil and irradiated for 30 min. Approximately 25 ml of spray was used on each lot of 60 seedlings. Each lot consisted of 12 bands containing 5 seedlings each, making a total of 60 plants per lot. Three types of controls were used. One was sprayed with distilled water and irradiated, one not sprayed but irradiated, and one sprayed with 1000 μg of uracil but not irradiated. Details are given in Table 1 and in the following discussion. Height measurements before and 48 hr after treatment were used as a measure of the effectiveness of uracil as a protector against ultraviolet radiation damage.

The variance analyses show that 500 μg of uracil sprayed on pea seedlings significantly protected them from ultraviolet radiation damage at the 5% level and that 1000 μg of uracil significantly protected them at the 1% level. Uracil at the rate of 200 μg gave no significant protection.

When comparisons were made between the following two control lots, one receiving no uracil, no irradiation, and no water spray, the other receiving 1000 μg of uracil spray but no irradiation, differences were not significant. This demonstrated the lack of phytotoxicity of uracil at this level.

These results are in accordance with the results previously observed by Puleston on *Streptococcus faecalis* R. The present work suggests that uracil has a similar protective action for a higher plant.

References

1. HINSHELWOOD, C. N. *Chemical Kinetics of the Bacterial Cell.* Oxford: Clarendon Press, 232 (1946).
2. NICKERSON, J. *Nature,* **162**, 241 (1948).
3. LIMPEROS, G., and MOSHER, W. A. *Science,* **112**, 86 (1950).
4. RAPPORT, D., and CANZANELLI, A. *Ibid.,* 469.
5. SINSHEIMER, R. L., and HASTINGS, R. *Ibid.,* **110**, 525 (1950).
6. PULESTON, H. S. Ph.D. thesis, Dept. Chemistry, Univ. Colorado (1950).

Manuscript received November 5, 1951.

Metabolic Relationship between *Meso*-Inositol and Lindane

A. S. Srivastava[1, 2]

Department of Economic Entomology, University of Wisconsin, Madison

A close relationship of the spatial configuration of *meso*-inositol and lindane (γ-benzene hexachloride) molecules was reported (*1*) in 1945, and following this observation workers (*2–8*) have investigated the mechanism of this interrelationship on a variety of organisms. In insects (*9–10*), however, no inhibition of the γ-isomer by *meso*- or *m*-inositol has been found after the simultaneous administration of these compounds.

The purpose of this note is to determine whether there exists any metabolic relationship between *meso*-inositol and lindane in the German cockroach, *Blattella germanica* Linn. For this investigation one female roach carrying the egg pod was placed in each of 16 battery jars containing roach food (*11*) (10 parts whole wheat flour, 9 parts dried skim milk powder, and 1 part dry baker's yeast) mixed with *meso*-inositol in percentages of 0, 0.5, 1–10, 15, and 25. The hatching date of each pod was noted, and the nymphs were allowed to feed in the battery jars for 38 days.

A group of 10 roaches bred on each concentration of inositol was placed in three Petri dishes separately containing the same roach food (*11*), mixed with 0.1% γ-, 10% α-, and 10% β-isomers of benzene hexachloride, respectively. Each dish contained a cir-

[1] State Scholar of the government of India. Permanent address: 464, Subash Nagar, Allahabad 2 (U. P.), India.

[2] Grateful acknowledgement is made to H. F. Wilson, University of Wisconsin, for his valuable helpful suggestions. Thanks are expressed to the government of India for the award of a State Scholarship to continue this work.

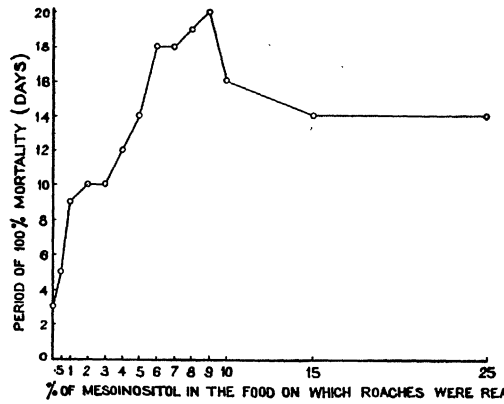

FIG. 1. Extent to which *meso*-inositol inhibits the action of the γ-isomer. Curve showing the period of 100% mortality of roaches when fed food containing 0.1% γ-isomer. The roaches were previously allowed to feed for 38 days from the time of hatching in food containing various concentrations of *meso*-inositol. Av temp, 80° F; relative humidity, 60%.

cular piece of white paper occupying the whole area, and two small vials, one filled with poisoned food and the other containing water plugged with cotton wool. The period of 100% mortality of roaches was then recorded for each dish. Controls were also run. The results of the experiment in which the roaches were tested on 0.1% of the γ-isomer have been plotted in Fig. 1.

It is evident that the roaches reared on 9% *meso*-inositol have maximum resistance, with 100% mortality occurring only after 20 days on food with 0.1% γ. As the concentration of the inositol was decreased from 9%, the period for 100% mortality was also decreased. If, on the other hand, the concentration of inositol was increased above 9%, the survival period also decreased. The results with 10% α-isomer in the food were quite inconsistent in relation to the inositol concentration. The β-isomer at the 10% level was nontoxic.

The maximum inhibition of the γ-isomer was shown at 9% *meso*-inositol concentration, but even at this level it did not completely neutralize the toxic action. It is suggested that there may be several metabolites affected in the cells by the γ-isomer, and *meso*-inositol may perhaps be one of these, although there does not appear to be a direct metabolic relationship between the two and the inhibition shown in these insects may be due to resistance acquired or developed by them after feeding on this vitamin. Moreover, the γ-isomer molecule is not isomorphous with that of *meso*-inositol (*12*).

References

1. SLADE, R. E. *Chemistry & Industry*, (40), 314 (1945).
2. BUSTON, H. W., JACOBS, S. E., and GOLDSTEIN, A. *Nature*, **158**, 22 (1946).
3. KIRKWOOD, S., and PHILLIPS, P. H. *J. Biol. Chem.*, **163**, 251 (1946).
4. LANE, R. L., and WILLIAMS, R. J. *Arch. Biochem.*, **19**, 329 (1948).
5. FISCHER, E. H., and BERNFELD, P. *Helv. Chim. Acta*, **32**, 1146 (1949).
6. SCHWIMMER, S., and BALLS, A. K. *J. Biol. Chem.*, **179**, 1063 (1949).
7. FULLER, R. C., BARRATT, R. W., and TATUM, E. L. *Ibid.*, **186**, 823 (1950).
8. SARMA, P. S. *Current Sci.* (India), **19**, 315 (1950).
9. METCALF, R. L. *J. Econ. Entomol.*, **40**, 522 (1947).
10. DRESDEN, D., and KRIJGSMAN, B. J. *Bull. Entomol. Research*, **38**, 575 (1948).
11. SRIVASTAVA, A. S. *Indian Med. Record*, **71**, (2), 43 (1951).
12. VAN VLOTEN, G. W., *et al. Nature*, **162**, 771 (1948).

Manuscript received July 30, 1951.

Serological Differentiation of Fish Bloods

John E. Cushing

Department of Biological Sciences,
Santa Barbara College of the University of California
Santa Barbara, California

The need for methods by which separate breeding populations can be readily distinguished within single species of fish has prompted the present investigation of the serological properties of fish bloods. The purpose has been to discover individual variations in the blood of fishes analogous to those that have been studied by anthropologists interested in the evolution and migrations of human populations (*1, 2*). If such variations could be discovered in fish, it might be hoped that further work would produce information of value in separating races within such fishes as the tunas, the salmons, and the Pacific sardines. In addition, it is possible that these serological variations could be used as markers by which the movements of fish populations could be followed in the sea.

The present note is prompted by the discovery of individual variation in the agglutinin content in the bloods of yellow fin tuna, *Neothunnus macropterus* (Temminck and Schlegel), and skipjack, *Katsuwonus pelamis* (Linnaeus).[1]

Whole blood samples were frozen immediately upon collection from living fish and were shipped frozen to this laboratory. Investigation has shown that the large amount of hemoglobin that is released by the lysed erythrocytes in blood treated in this way apparently has no significant effect on such observations as those reported below.

The bloods were found to be separable into four distinct groups on the basis of their agglutinin content (Table 1). Absorption experiments have revealed that the agglutinins that differentiate these types include one specific for human antigen B, one specific for all human cells tested, and one specific for sheep cells.

In addition to these agglutinins, an antigen in tuna blood similar to the human A substance is indicated by the fact that rabbit antituna serum agglutinates human A cells specifically and that tuna serum specifically inhibits human anti-A typing serum. As yet, no individual variations in this inhibiton have been

[1] Bloods of individuals of the two species of tuna referred to were obtained through the efforts of John L. Kask and Fred C. June, Pacific Oceanic Fisheries Investigations, U. S. Fish and Wildlife Service, Honolulu. The author is indebted to them for the careful preparations that have made this study possible.