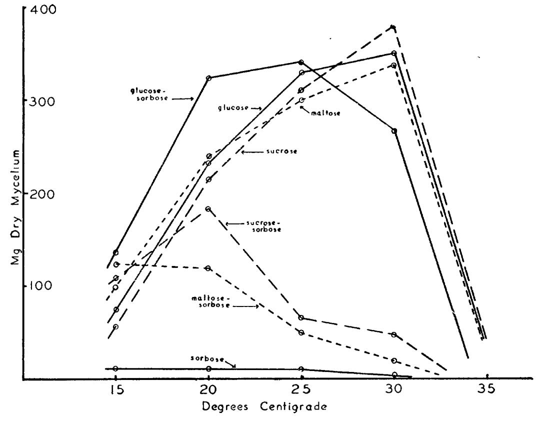

FIG. 1. The effects of temperature and the presence of sorbose on the growth of *C. globosum.*

The growth of *C. globosum* under these conditions is shown in Fig. 1. This figure shows that sorbose alone is not utilized, for no more than a trace of growth was produced at any temperature. There was little or no difference in the utilization of glucose, sucrose, or maltose when used alone. When these three curves are compared with the growth curves in media with these sugars plus sorbose, two general facts are revealed: (1) The inhibition of utilization of sucrose and maltose is greater than that of glucose. In fact, greater growth occurred on glucose-sorbose than on glucose at the lower temperatures. (2) The inhibition is increased with an increase in temperature from 20° to 25° and 30° C.

Other species, including *Sphaeropsis malorum, Sordaria fimicola,* and *Alternaria solani,* showed the same general response to increased temperature, but the degree of inhibition varied with the species. *C. fimbriata* failed to make more than a trace of growth in any medium containing sorbose at any temperature.

Fig. 1 also shows that the optimum temperature for growth of *C. globosum* is definitely dependent upon the sugars in the medium. In the absence of the inhibitory action of sorbose, growth was most rapid at 30° C. The increased inhibition of sorbose at this temperature more than balances, however, the tendency for increased growth. The net result in a mixture of sugars containing sorbose is more rapid growth at 20° C than at 30° C.

The effect of the hydrogen ion concentration of the medium can be considered only briefly. Media were prepared with the initial pH adjusted to 3.0, 4.0, 5.0, 6.0, and 7.0. *C. globosum* and *S. fimicola* grew on maltose media with the initial pH as low as 4.0. On maltose-sorbose media, growth of both fungi occurred at initial pH of 5.0 and above, but not at 4.0 or 3.0. Although the pH limits favoring growth in sorbose media appear to be narrower than those for growth in the absence of sorbose, these limits are not sufficiently narrow to account for the poor growth in the presence of sorbose.

One obvious effect of the presence of sorbose in the medium was the change in the type of growth. In sorbose media the colonies often remained separate, rounded, and even pelletlike, whereas in the absence of sorbose the mycelium was extensive. Microscopic examination revealed that mycelium growing in sorbose media was excessively branched. The most severe inhibition occurred in sorbose media, in which only traces of growth were present. Not only was hyphal extension inhibited, but many of the tips, particularly the apical cells, were killed. Staining the mycelium lightly with phloxine permitted counting the dead and living hyphal tips. *C. fimbriata* showed 77% and 15% dead hyphal tips in sorbose medium and maltose medium, respectively. In the same order and in the same media, 50% and 23% of the hyphal tips of *C. globosum* were dead. *A. solani* showed but few dead tips in sorbose medium, but excessive branching was evident.

It is thus evident that the presence of sorbose, a sugar poorly utilized by many fungi, may inhibit the utilization of a second sugar which alone is readily utilized. The reasons for this inhibition are not clear. The effect of temperature indicates that it might be based on enzyme activity or an absorption process. On the other hand, the killing of a high percentage of the hyphal tips suggests a toxic action of sorbose.

This study of sorbose utilization and inhibition of growth by sorbose is being extended, and further work is in progress. The results will be published elsewhere.

References

1. CHEO, P. C. Ph.D. thesis, West Virginia University (1949).
2. SCHADE, A. L. *Am. J. Botany,* **27**, 376 (1940).
3. SCHADE, A. L., and THIMANN, K. V. *Ibid.,* 659.
4. HAWKER, L. E. *Ann. Botany,* **11**, 245 (1947).
5. HORR, W. H. *Plant Physiol.,* **11**, 81 (1936).
6. MARGOLIN, A. S. Ph.D. thesis, West Virginia University (1942).
7. STEINBERG, R. A. *J. Agr. Research,* **59**, 749 (1939).
8. *Ibid.,* **64**, 615 (1942).
9. TAMIYA, H. *Acta Phytochim.* (*Japan*), **6**, 1 (1932).
10. BERTRAND, G. *Ann.. chim. et phys.,* **3**, 181 (1904).

Rapid Acclimatization of Insects to Anoxia, with Special Reference to the Housefly

F. W. Stemler and W. A. Hiestand

Department of Biological Sciences,
Purdue University, Lafayette, Indiana

In studying the effects of rapid ("explosive") decompression on insects and certain related forms, the writers have observed that insects form a tolerance to anoxia when repeatedly decompressed. Acclimatization appears to be an anoxic response, as is shown by the fact that repeated exposures to a nitrogen atmosphere also effectively produce a tolerance. Moreover, it has been observed that a cross-tolerance can exist between nitrogen anoxia and decompression anoxia such that a preliminary exposure to either influence will create tolerance to the other. Thus, if a housefly (or possibly any insect) is exposed for 3 min to explosive decompression at 0.2–0.15 mm Hg pressure and 10 min later is exposed to an atmosphere of nitrogen, it will survive longer in the nitrogen than it would if exposed to nitrogen without having been previously decompressed. The reverse is likewise true; i.e., if the housefly is first exposed to nitrogen for 3 min and 10 min later is exposed to decompression, it will survive longer under decompression than if it were only decompressed without being previously exposed to nitrogen. By "survival" we mean the time from the beginning of exposure until the last visible movement of any part of the insect's body or appendage.

We have measured survival to repeated decompression in 5 orders of insects, Diptera, Hymenoptera, Coleoptera, Hemiptera, and Lepidoptera, and have found that each order showed acquired tolerance to anoxia. Larvae of insects as well as adults show acclimatization. All adult species show some tolerance in 10 min time—i.e., with the second decompression. Tolerance to anoxia persists apparently for hours, for we have found that the housefly, *Musca domestica,* still retains some acquired tolerance for as long as 48 hr (Table 1).

Further evidence that the tolerance is produced by anoxia is shown by submerging houseflies under water. If flies are kept submerged for 3 min after all movement has ceased and then removed and dried and allowed to recover, they will survive the first explosive decompression about 3 times as long as will flies not submerged under water. In fact, the average survival time of flies previously submerged for 3 min is 23 sec as contrasted to 7.8 sec for the controls.

TABLE 1

SURVIVAL TIME IN SECONDS OF 6 *M. domestica** EXPLOSIVELY DECOMPRESSED AT 25° C AT PRESSURES OF 0.2–0.15 MM HG AT INTERVALS OF 0, 10, 20, AND 30 MIN

Fly No.	0 min	10 min	20 min	30 min
1	7	11	27	23
2	6	21	20	33
3	8	31	40	37
4	15	20	27	22
5	4	23	26	24
6	8	27	30	30
Average	8.0	25.5	28.3	28.1

* The housefly is characteristic of other insects in showing developing tolerance to repeated decompressions. These 6 flies represent a random sample, not being chosen for similarity.

Detached legs of insects placed in the decompression chamber occasionally showed slight movements, although these were rarely seen and did not appear to be the same type of movements as those of the intact insect. They were much slower and required a longer period of decompression for their appearance.

The decompression chambers in which the flies were placed were the rounded bottoms of culture tubes cut off at appropriate lengths to accommodate the insects. Through a rubber stopper placed in the open end of the chamber a glass stopcock was connected with a vacuum pump. The stopcock shut off the insect chamber until time for explosive decompression. With the vacuum pump running, the stopcock was quickly opened, causing sudden decompression. With the pump in operation, time was determined to the closest second until the last visible movement was seen.

In spite of investigations of the effects of reduced barometric pressures on insects (*1–6*) it appears that no one has reported the acquisition of tolerance to anoxia. The authors offer no explanation for acquired tolerance in insects. It probably is a cellular adjustment and it appears to be anoxic, as it results from either the anoxic anoxia of nitrogen or explosive decompression. It occurs if the interval between the first and second decompression is only 10 min or several hours.

References

1. JOUSSET DE BELLESME, G. L. M. F. *Assoc. franç. avance. sci. compt. rend.,* **9**, 710 (1880).
2. COLE, F. J. *J. Econ. Biol.,* **1**, 63 (1906).
3. NAGEL, W. *Z. angew. Entomol.,* **7**, 340 (1921).
4. BACK, E. A., and COTTON, R. T. *J. Agr. Research,* **31**, 1035 (1925).
5. LUTZ, F. E. *Natural Hist.,* **29**, 160 (1929).
6. WELLINGTON, W. G. *Can. J. Research,* **24**, 105 (1946).

The Antihypertensive Influence of Certain Sulfhydryl Compounds[1]

Henry A. Schroeder

Hypertension Division, Department of Internal Medicine,
Washington University School of Medicine,
St. Louis, Missouri

During an investigation of the effects on blood pressure of various compounds, it was noticed that certain substances containing sulfhydryl groups appeared to exert a specific depression upon the hypertension of rats (*1*). A differential action was observed in that the blood pressure of normotensive rats was not lowered. In addition, the response to a number of natural pressor agents was abolished or markedly diminished.

Rats were made hypertensive by partial constriction of one renal artery, a method which in our hands has been effective in two thirds of animals. Systolic blood pressure was measured in unanesthetized animals by the foot-cuff method (*2*), a photocell being used as an indicator. After hypertension had become established (3 weeks), blood pressure was measured under anesthesia directly with a Hamilton optical manometer while the test substances were injected intravenously (*3*). To evaluate the discriminative effect of a compound, depression of diastolic pressure 12 mm Hg or more 20 min after injection was chosen as the criterion. Table 1 shows the action of various sulfhydryl compounds when tested in this manner. Apparently those with a straight chain of 3 carbon atoms were antihypertensive in the sense that they lowered blood pressure acutely in hypertensive animals but did not in normotensive ones. The maximum effect developed slowly, contrary to the usual rapid action of most depressor drugs, and lasted for the duration of the

---

[1] Work performed under a grant-in-aid from the National Heart Institute of the National Institutes of Health, USPHS.