SPECIALIA

Shock Effects on *Euglena gracilis*: The Effect of the Pressure Duration

There is some evidence to support the view that both the magnitude of the pressure and its duration are of significance in assessing the relation between pressure variation and biological response[1–4]. Further evidence supporting this view is presented below.

Materials and methods. Fresh cultures of *Euglena gracilis* were used. 5 ml of euglenas in liquid nutrient were pipetted into 7 small vials so that each culture contained approximately the same concentration of organisms. There were thousands of euglenas in each vial, but the nutrient appeared colorless, indicating an excess of nutrient.

Two shock levels, 20 and 40 pounds per square inch (ψ; 1.21 and 2.41 kg/cm^2, respectively) and 3 pressure durations, 25 μsec, 4 and 10 sec, were studied. An air-loader, previously described[4], was used to deliver the shock. The photo-thermal-tropic response for each culture was studied immediately after shock.

A dissecting microscope with sub-illumination provided the light and heat source. The cultures were viewed at 10 and 30 magnifications. A stop-watch was used to measure the length of time it took for the culture to respond to light and heat. Cultures were allowed to cool about 15 min between measurements.

Table I. The relation between the pressure magnitude and its duration

		Control	Shock Level (ψ) 20	40
Pressure	0.25 μsec		16.300 ± 0.008	15.85 ± 0.012
Duration	4	22.5 ± 2.2	11.360 ± 0.008	12.91 ± 2.58
(sec)	10		14. 90 ± 0.01	11.74 ± 4.03

The means, in sec, along with the 99% confidence limits are indicated.

Table II. Analysis of variance

Source of variation	Degrees of freedom	Sums of squares	Mean squares	Variance ratios
Control vs. treatment	1	385.3	385.3	183.5[a]
Pressure level	1	4.3	4.3	2.0
Pressure duration	2	97.8	48.9	23.3[a]
Interaction	2	33.6	16.8	8.0[b]
Between groups	6	521.0	86.8	41.4[a]
Within groups (error)	35	73.0	2.1	
Total variation	41	594		

[a] Significant, $P < 0.001$. [b] $P < 0.01$.

Results. The cultures displayed a random movement at first. The bottom of the vial, near the light source, was the first to get warm, followed by the sides of the vial. As the bottom of the vial warmed, euglenas moved toward the top. As the sides warmed, the euglenas moved toward the center. As soon as the random movement of the culture became directional toward the top and center, the time, in sec, was recorded.

Shocked cultures were quicker to respond to warmth and/or light than the controls (Table I). Since the controls behaved similarly, it is apparent that the negative tropic response is normal for euglenas. The shock pulse must have rendered them more sensitive to warmth and possibly light. The shock effect was significant, but there was no significant difference between the shock levels (Table II).

Depending on the pressure duration the negative tropic response for shocked cultures occurred in 52–72% of the time required for a normal response. The variations between the pressure level groups and pressure durations indicate that both pressure level and pressure duration are determinate factors in assessing tropic responses of euglenas. The highly significant pressure level × pressure duration interaction supports this hypothesis (Table II). The slowest response was for the 25 μsec pressure duration for both shock levels (Table I). However, euglenas shocked at 40 ψ responded more quickly than those at 20 ψ for a 25 μsec pressure duration. Responses to longer pressure durations were distinct only for 20 ψ, whereas when both shock levels are considered responses for longer pressure durations were about the same[5].

Résumé. Les cultures d'*Euglena gracilis* ont été soumises à des chocs de 20 et 40 ψ (1.21 et 2.41 kg/cm^2). La pression engendrée par une pulsation durait de 25 μsec, 4 et 10 sec. La durée de la pression servit de critère pour évaluer les effets des niveaux élevés du choc atmosphérique sur le photo-thermotropisme d'*Euglena gracilis*.

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