Effects of temperature on the pupillary response of the butterfly eye

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Published in:
Biological Bulletin

Publication date:
1977

given standard trout feed *ad libitum* by means of a self feeder system showed growth rate 0.54 ± 0.2% body weight per day. Starved fish lost weight at the rate of 0.6 ± 0.2% per day. Analysis of protein synthetic rate in liver *in vivo* was carried out by three methods: first, determination of the fractional rate of incorporation of ^{14}C-leucine at times of 1 to 5 min after hepatic portal vein injection; secondly, determination of polypeptide chain elongation rate and ribosome concentration of liver; and thirdly, incorporation of ^{14}C-tyrosine in liver, gill and muscle following constant infusion of isotope for 6 hr in free-swimming fish. Experiments involving hepatic portal vein injection were carried out at 15° C in fish anesthetized with benzocaine. Constant infusion was done in fish cannulated in the dorsal aorta for infusion and in the caudal vein for blood sampling. No difference in incorporation results was obtained in fish used 2 hr or up to 5 days after cannulation. Cannulated fish showed normal swimming and feeding behavior. Results obtained to date in liver indicate that protein synthetic rates in fed trout are comparable, after correction for experimental temperature, to those observed in liver of toadfish and rat. Average polypeptide chain assembly time at 15° was 6.3 ± 1.0 min (15), corresponding to chain elongation rate of 1.1 amino acid residues/sec. Preliminary results obtained by constant infusion indicate a depression of liver protein synthesis (as per cent liver protein replaced per day) in starved fish but no change in gill protein synthesis. Assay of muscle data is in progress.

Supported by NSF Grant BMS 75-10097.

Effect of sampling time on primary production estimates by the ^{14}C method. PATRICIA D. SMITH AND CLAUDE W. DEPAMPHILIS.

The ^{14}C method of estimating primary production is a sensitive technique and in wide use today. However, there exist unanswered some basic questions concerning what one is actually measuring. These include whether the estimate is of net or gross primary production and whether subtraction of the dark bottle uptake from that of the light is a proper correction for uptake due to nonphotosynthetic carbon-fixation. Unfortunately, these basic problems are coupled with technique problems.

Several studies have been done improving the efficiency of the technique at various steps, such as filtering small quantities of sample to minimize error due to cell rupture and exposing filters to HCl fumes to remove labeled bicarbonate ion adsorbed to the membrane. This study was designed to determine whether the time of sampling has a significant effect on the primary production estimate.

To test the variable sampling time effect, water samples were taken at sunrise, noon, sunset and midnight. At the time of sampling, the water was poured into light and dark bottles and inoculated with ^{14}C-labeled sodium bicarbonate. They were then incubated for 24 hours under conditions of 15 hours light and 9 hours dark.

The results show a significant difference at the 0.01 level in carbon-uptake rate with sampling time in the first run done on a sunny day, whereas no significant difference in carbon uptake rate was observed with sampling time in the second run done on a cloudy day. The difference in result between runs is possibly due to the low light intensity on the second day causing minimal phytoplankton migration.

These preliminary results indicate that the time of sampling may indeed effect the primary production estimate. This would imply the need to standardize the sampling time in the ^{14}C method. This, along with the other revisions, must be incorporated in the technique if the estimates by independent researchers are to be comparable.

Effects of temperature on the pupillary response of the butterfly eye. MANDYAM V. SRINIVASAN, GARY D. BERNARD AND DOEKELE G. STAVENGA.

Pupillary responses were evoked by monochromatic green flashes of light, and recorded by monitoring eyeshine with a deep-red, subthreshold light. At eye temperatures above the ambient 24° C, sensitivity of the pupil is reversibly reduced. A temperature increase of 10° C shifts the intensity-response function of *Nymphalis antiopa* by +0.3 log units, and that of *Eurema nicippe* by +0.5 log units.

Increasing the temperature speeds up closing and opening of the pupil. For example, in *Nymphalis,* a temperature increase of 10° C decreases the half-time of closing by 25%, and that of opening by 15%. In general, closing-speed is more temperature-sensitive than opening-speed. This feature is very pronounced in pierids. For example, in *Eurema,* a temperature increase of 10° C decreases the closing half-time by 55%, but there is no measurable change in the opening half-time. Similar results were obtained in *Picris rapae* and *Colias eurydice.* This differential effect of temperature suggests that closing and opening are mediated by different mechanisms.

It has been hypothesized in the literature that the light-attenuating granules which mediate the pupillary response are in continuous, random motion within the retinular cells, and that this brownian motion mediates opening of the pupil in the dark. We have observed small, random fluctuations in the intensity of eyeshine, which have a power spectrum restricted to the range 0–2 Hz. This observation supports the existence of brownian motion. However, the importance of brownian motion as a mechanism for pupil opening is questionable. The finding that opening-speed is independent of temperature in pierids suggests that other mechanisms must be involved.

Research supported by NEI grants EY-01140 and EY-00785, and by the Netherlands Organization for the Advancement of Pure Research (zwo) and the Rijksuniversiteit Groningen.

Optics of compound eyes and circadian pigment movements studied by pseudopupil observations in vivo. DOEKELE G. STAVENGA.

Important structural and functional qualities of compound eyes can be inferred by studying pseudopupil phenomena. The (principal) pseudopupil of apposition eyes marks the ommatidia that are aligned with the direction of observation. When illumination and observation are not aligned, the oblique illumination pseudopupil, hitherto undescribed and unexploited, marks the direction of illumination. Principal pseudopupil and corneal reflection do not coincide when ommatidial axes are skew to the eye surface, if viewed with epi-illumination. It can be shown, *e.g.,* in damselflies, that skew ommatidia are utilized effectively to construct foveas and to achieve broader visual fields. Circadian movements of distal pigment are easily observed by examining the pseudopupil, *e.g.,* in crab, praying mantis, katydid, and *Limulus.* These pigment movements cause the ommatidial aperture to be enlarged at night. The day-adapted state can be established at night by either illumination or cooling.

The usually black color of the principal pseudopupil is due to the primary pigment cells, which absorb over a wide spectral range, and so act as an optical screen for the photoreceptors. The secondary pigment determines the eye coloring and, when this is different from black, hides the primary pigment from the attentive predator and/or prey. The red primary and secondary pigments of many red-eyed flies provide a means of photoregenerating the visual pigment. Still, the flower fly *Lathyrophthalmus aeneus* seems to follow the general characteristic that the eye's coloring is part of the animal's display features; the head resembles that of a heavily pollinated bee due to a yellowish coating over the red eye pigments.

This study was supported by grants from the Netherlands Organization for the Advancement of Pure Research (zwo) and the Rijksuniversiteit Groningen.

Primary structural differences distinguish cytoplasmic and central pair from outer doublet tubulins. R. E. STEPHENS.

Previous studies of the α and β subunits of sea urchin flagella outer doublet tubulins, utilizing comparative amino acid composition and peptide mapping, showed that the more strongly-associated tubulin of the A-tubule contained 2–3 more (lys + arg) residues in each chain than did the homologous subunits of the B-subfiber, with a correspondingly higher amount of certain small, hydrophilic, cathodic peptides being found in tryptic digests of A-tubulin subunits. This work has been extended to the tubulin of sea urchin sperm flagella central pair, derived by limited, low ionic strength dialysis of the $9 + 2$ axonemes, and to cytoplasmic, vinblastine-precipitated tubulin from unfertilized eggs of the sea urchin *Strongylocentrotus*