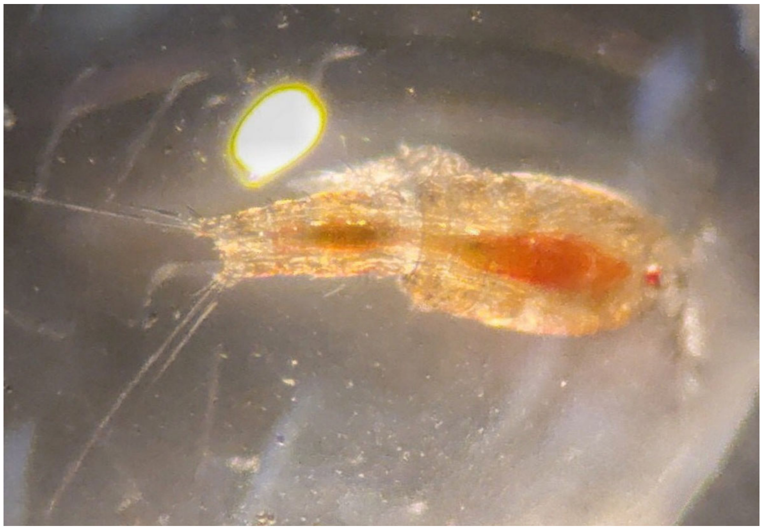
INSIDE JEB

Mitochondria directly boost copepods' rosy hue



A red *Tigriopus californicus* copepod. Photo credit: Matthew Powers.

In the search for the ideal mate, many creatures keep an eye out for the brightest and best. 'The colourful displays of an animal often tell us how strong, successful and healthy that animal is', says Matthew Powers from Auburn University, USA. But for an animal to truthfully convey its inner strength through beauty, there must be a direct link between an attractive characteristic and their physiological prowess: enter the mitochondrial power houses of the cell. These minute organelles, tucked away inside almost every animal cell, consume glucose and oxygen to generate most of the chemical energy that powers life. The power structures also produce the ideal environment for converting colourful yellow pigments (carotenoids, consumed by creatures in their diets) into redder shades, which could trumpet the honest truth about an animal's suitability as a mate. But proving the direct link between the cellular power sources and a creature's attractiveness is tricky, because mitochondria also produce toxins that could blanch vibrant hues, diminishing the message. However, Powers and Geoffrey Hill, from Auburn University, knew of an alternative strategy, which could speed up the mitochondria, affecting an animal's hue in turn if the two were linked, so they focused their attention on a tiny rose-coloured copepod, *Tigriopus californicus*.

The minute crustaceans dine on algae containing yellow carotenoids, which they then convert into the red keratinoid astaxanthin, so Powers, Alex Baty (Auburn University) and Hill bathed the miniature crustaceans in a drug known as DNP, which increases the mitochondria's oxygen consumption. If the copepods' colour and the powerfulness of their mitochondria were linked directly, then increasing the organelles' oxygen consumption could, in turn, speed up conversion of the yellow pigment into the more vivid astaxanthin, resulting in redder copepods.

After collecting the tiny crustaceans after a week of bathing in the mitochondrial energising drug, Powers and Baty discovered that the male copepods were producing 70% more red astaxanthin than the copepods that did not receive the mitochondrial boosting drug. And, when the duo took transparent copepods that had been raised on colourless yeast for the whole of their lives and switched their diet to the colour-creating plankton, the female copepods that received a DNP boost produced 23% more astaxanthin than the copepods fed on the plankton alone. The team also measured how much oxygen individual copepods consumed, an indication of how active their mitochondria are, and compared that with the animals' astaxanthin levels, discovering that the crustaceans with the most power-hungry mitochondria were also the reddest, directly linking the copepods' mitochondrial power to their rosy hue. 'These data support Hill's hypothesis that ketocarotenoid and mitochondrial metabolism are biochemically intertwined', says Powers.

But why do *T. californicus* go to such vivid lengths if they are not trying to make their appearance as alluring as possible? After all, copepods are immune to the appeal of their mates' lustrous tint. Powers and colleagues explain that the red pigment behaves effectively as sunscreen, shading the animal from damaging UV rays. Instead of communicating their suitability as a mate, the crustaceans are simply benefiting from the protective properties of a side effect of their powerful energy-generating mitochondria.

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