From bacteria to zooplankton, the impact of food-limitation on their physiology and biochemistry


Marine Ecophysiology Group EOMAR
Universidad de Las Palmas de Gran Canaria

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The impact of food-limitation

Starvation

Let’s have a look into a key metabolic pathway,

The Krebs Cycle
Substrates
ETS controls the ATP production.
What happens to respiration when organisms pass from well-fed to starvation conditions?
From bacteria to zooplankton
Physiological experimentation
Marine enzymology
Three basic enzymatic tools

- FORMAZAN (ETS ASSAY)
- NADPH (IDH ASSAY)
- NADH (GDH ASSAY)

Maximum capacity
Our first investigation was in batch cultures of marine bacteria.

Let’s start from the beginning!
A protein in vitro ETS respiration pyruvate.
Exploring a first-principles-based model for zooplankton respiration

Ted T. Packard and May Gómez

Modelling respiration
Respiration predicted from an Enzyme Kinetic Model and the Metabolic Theory of Ecology in two species of marine bacteria

Borja Aguiar-González, Ted T. Packard, Elisa Berdalet, Sylvie Roy, May Gómez

The EKM predicts respiration under starvation conditions and MTE doesn’t
Can we see the same patterns in marine eukaryotes?
Respiratory metabolism and pyridine nucleotides levels in the marine dinoflagellate *Oxyrrhis marina* during starvation.

N. Osma, I. Fernández-Urruzola, M. Aristizabal T.T. Packard, M. Gómez
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First time Pyridine nucleotides have been measured in plankton
Respiration decreases during food-limitation by a third and displays a circadian rhythm.

ETS activity is constant during food-limitation.
Starvation causes NH4+ excretion to decrease however GDH activity remains constant.
What happen to the R/Q during starvation?
Respiration quotient variability: bacterial evidence

V. Romero-Kutzner\textsuperscript{1,*}, T. T. Packard\textsuperscript{1}, E. Berdalet\textsuperscript{2}, S. O. Roy\textsuperscript{3}, J.-P. Gagné\textsuperscript{4}, M. Gómez\textsuperscript{1}

Romero-Kutzner et al., 2015
Respiration quotient variability: bacterial evidence

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Romero-Kutzner et al., 2015
Conclusion:

1.- **Starvation** decreases respiration and ammonia excretion, but not their enzyme-based potentials.

2.- Metabolic Theory of Ecology can not predict respiration under conditions of **starvation**.

3.- **Starvation** decreases the energy currency molecule needed for carbon synthesis.

4.- **Starvation** can cause R/Q to increase 10-fold.
Marine Ecophysiology Group: EOMAR

Thank you!

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