

Effect of feeding and light on the nitrogen isotopic composition of a zooxanthellate coral

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INTRODUCTION

Coral are 'mixotrophic' organisms: they are able to fix inorganic carbon and nitrogen through the photosynthetic activity of their zooxanthellae. They also derive a fraction of their energy through the predation of bacterioplankton, and zooplankton or the use of dissolved organic matter. This heterotrophic nutrition is likely to be predominant in deep or turbid waters, where rates of photosynthesis are low. The relative importance of autotrophy and heterotrophy in the nutrition of corals has been a source of considerable controversy. Stable isotope analysis can bring new insights into this problem. Nitrogen isotopes are useful in tracing terrestrial inputs, identifying nutrient sources in reefs and determining the degree of heterotrophy. By measuring $\delta^{15}\text{N}$ within coral components, it may be possible to determine proportions of photosynthetic versus heterotrophic derived nutrients. The $\delta^{15}\text{N}$ of coral tissue and zooxanthellae decreases when photosynthesis decreases (Muscatine & Kaplan 1994), whereas it increases together with heterotrophy (Heikoop et al. 1998), because zooplankton is enriched in $\delta^{15}\text{N}$. Muscatine and collaborators (Muscatine et al., 1989; Muscatine & Kaplan, 1994) were the first to investigate the effect of depth and availability of particulate organic matter on the nitrogen stable isotopes of coral tissue and zooxanthellae. They reported a depletion in heavy isotopes with depth and suggested that deep corals were more heterotrophic than corals living in shallow waters. From a few subsequent studies it appears that several environmental parameters can affect the $\delta^{15}\text{N}$ of coral tissue, such as inorganic nitrogen uptake (Yamamoto et al. 1995), terrestrial nitrogen loads (Sammarco et al. 1999), eutrophication and zooxanthellae population dynamics (Heikoop et al. 2000), but also light, which affects nitrogen fractionation during photosynthesis (Heikoop et al. 1998). The aim of this paper was to investigate, under controlled experimental conditions, the effect of light and feeding on the $\delta^{15}\text{N}$ of the zooxanthellae and coral tissue.

MATERIALS & METHODS

12 weeks

Stylophora pistillata
 $T^{\circ} = 26^{\circ}\text{C}$

Copepods + copepodites = 94% of freshly collected plankton

Small size of polyps

Ingestion : 0.03 - 1 prey. polyp⁻¹. h⁻¹

$\delta^{15}\text{N} = 6.75\text{‰}$

Pellets of zoox. were re-suspended, washed (3 times with filtered seawater) and freeze-dried

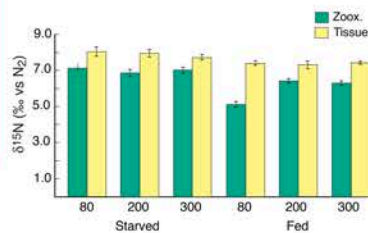
$\delta^{15}\text{N}$ analysis in tissue and zooxanthellae fractions (ISOPRIME, MICROMASS)

$\delta^{15}\text{N} = \left[\frac{^{15}\text{N}/^{14}\text{N}}{^{15}\text{N}/^{14}\text{N}} - 1 \right] \times 10^3$

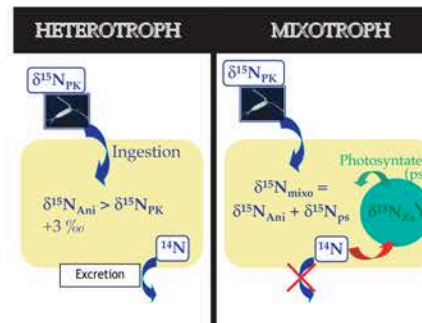
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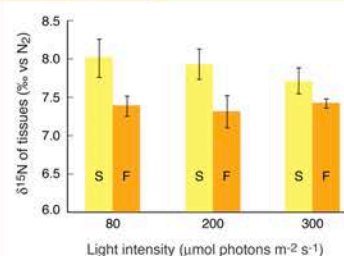
RESULTS & DISCUSSION



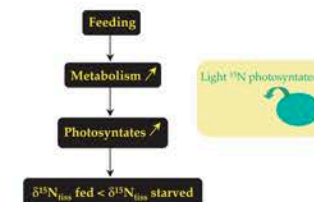
$\delta^{15}\text{N}_{\text{zoox}} = 7.65 \pm 0.09\text{‰}$
 $\delta^{15}\text{N}_{\text{tiss}} = 6.46 \pm 0.10\text{‰}$
 No correlation between $\delta^{15}\text{N}_{\text{tiss}}$ and $\delta^{15}\text{N}_{\text{zoox}}$



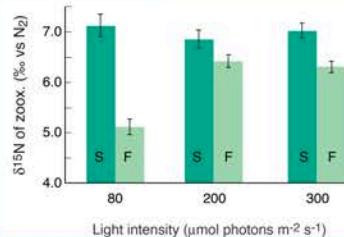
Tissues



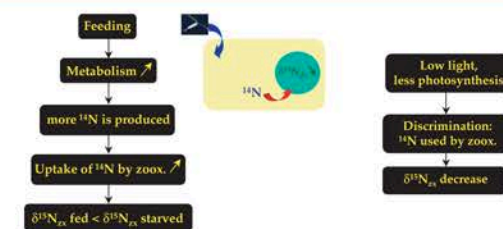
$\delta^{15}\text{N}_{\text{tiss}} = 7.36 \pm 0.11\text{‰}$ (fed)
 $\delta^{15}\text{N}_{\text{tiss}} = 7.88 \pm 0.12\text{‰}$ (starved)
 No effect of light



ZOOX.



$\delta^{15}\text{N}_{\text{zoox}} = 5.95 \pm 0.12\text{‰}$ (fed)
 $\delta^{15}\text{N}_{\text{zoox}} = 7.00 \pm 0.11\text{‰}$ (starved)
 Effect of light for fed corals



Acknowledgements

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