贝类养殖中的隐性碳汇：代谢与微生物相互作用驱动RDOC 形成

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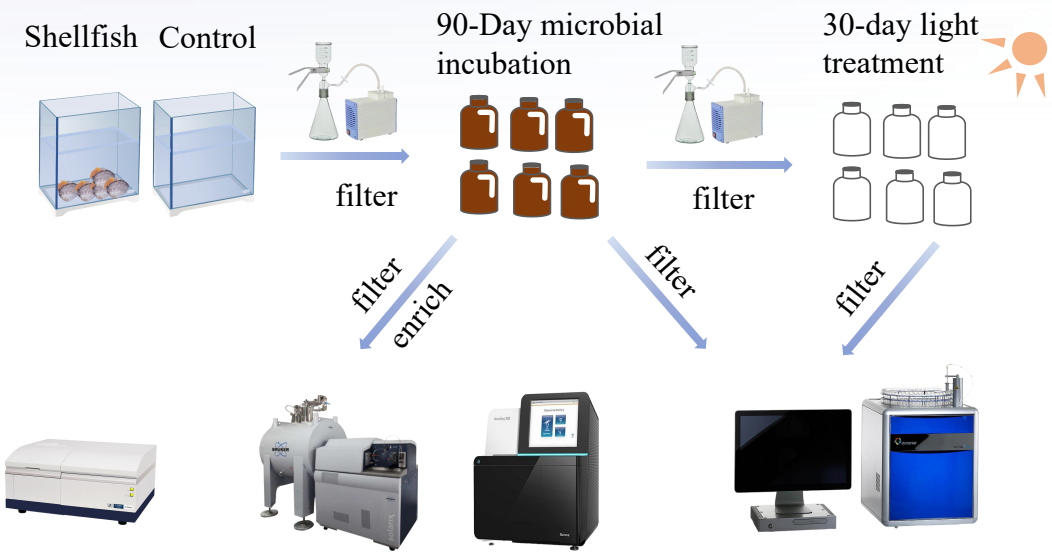
Introduction

- The ocean, Earth's largest active carbon pool, stores ~700 Gt dissolved organic carbon (DOC), ~95% of which is refractory dissolved organic carbon (RDOC)—stably sequestered for ~6,000 years and critical for carbon neutrality.
- Shellfish farming increases the DOC storage in seawater and enhances the degree of seawater humification.
- Microbial activity drives marine DOC transformation, utilizing seawater DOC to generate RDOC via pathways like the mevalonate and specialized metabolic pathways.
- To analyze the impact of shellfish farming on the marine RDOC pool, it is necessary to understand the molecular composition and bioavailability of DOC produced by shellfish.

Methods



Results

1. Molecular composition and FDOM composition of DOMs and DOMc

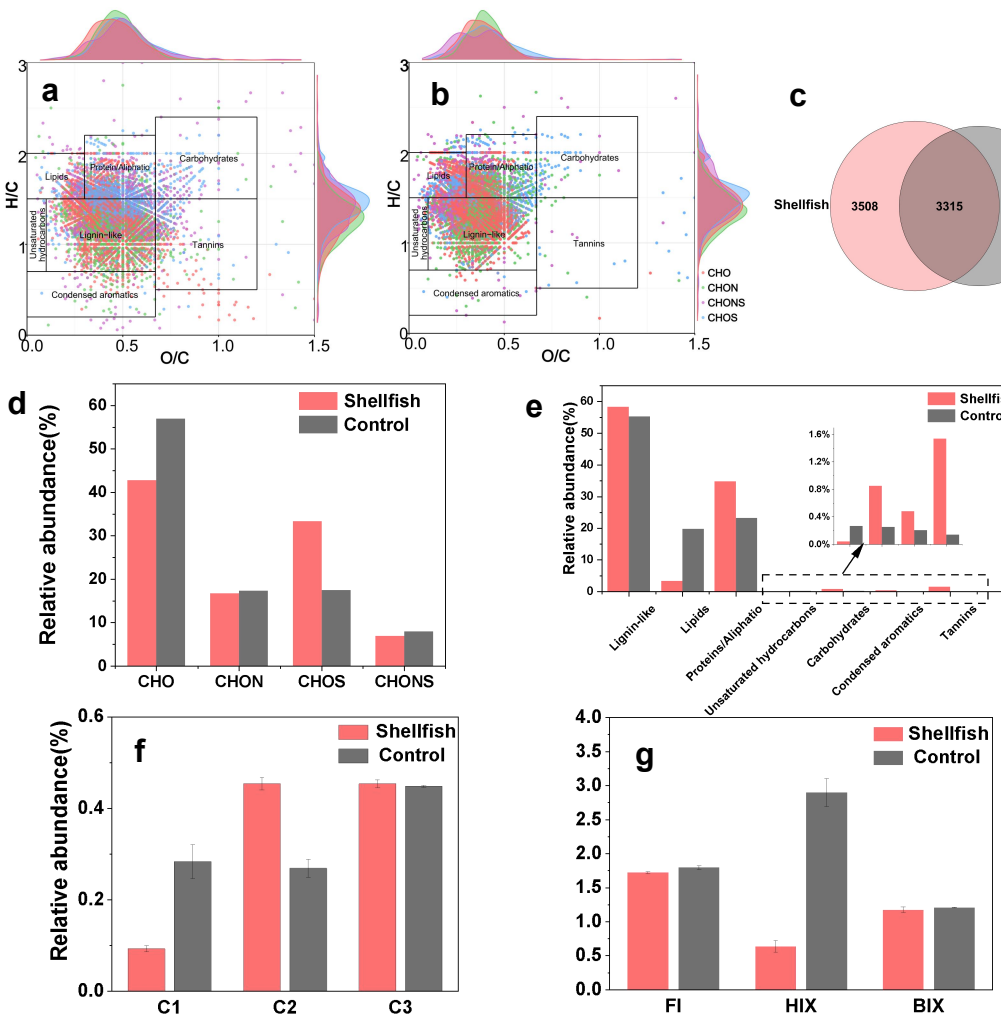


Figure 1. (a-e) The differences in molecular composition between DOM_S and DOM_C; (f,g) Differences in FDOM composition between DOM_S and DOM_C

- There are differences in composition between aquaculture water and natural seawater,with the degree of humification in aquaculture water being significantly lower than that in natural seawater (P<0.05).
- The molecules increased by Scapharca subcrenata farming are mostly lignin-like and proteins/aliphatics.

2. Laboratory microbial incubation and light treatment of DOMs and DOMc

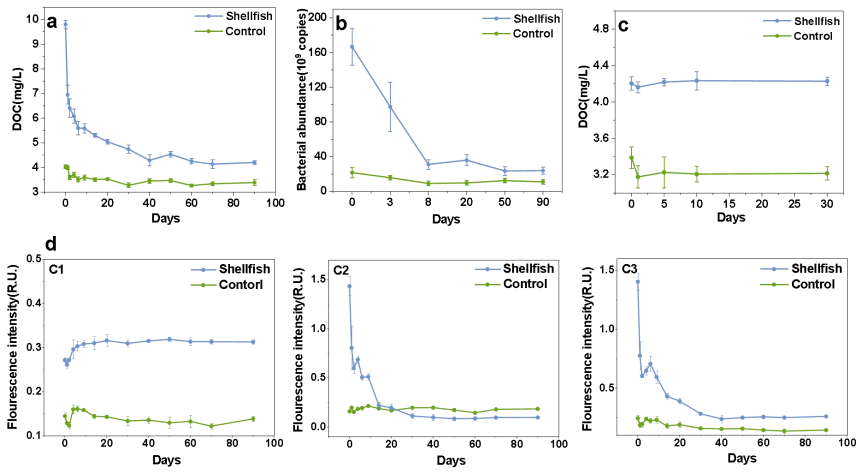


Figure 2. Changes in DOC(a,c), microorganisms(b) and FDOM(d) during incubation

- Approximately 14.12% of the DOC produced by *S. subcrenata* is RDOC,which can contribute to the marine RDOC pool.
- Microbial activity has a more significant impact on DOMs than light treatment.

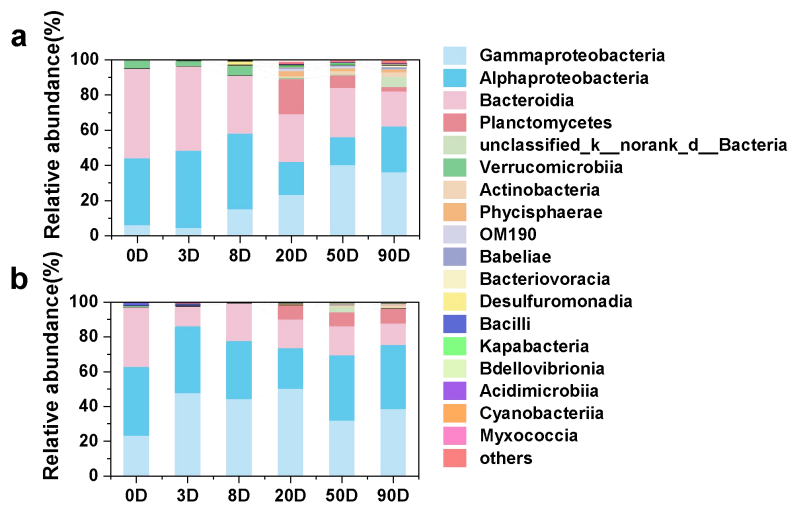


Figure 3. Microbial community changes during the incubation of DOMs(a)and DOMc(b)

- Significant community succession of microorganisms occurred during the dark microbial incubation.

Summary

- This study focused on Scapharca subcrenata, measuring DOC release rates across growth stages under laboratory conditions. Aquaculture water and non-cultivated natural seawater were subjected to 90-day microbial incubation and 30-day light treatment to systematically quantify RDOC from *S. subcrenata* farming.
- Microbial interaction with shellfish-released DOC alters DOC concentration and molecular composition. These bacterial communities drive labile-to-refractory DOC transformation, ultimately determining the fate of shellfish-derived DOC.

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