Estuarine, Coastal and Shelf Science 254 (2021) 107329

Contents lists available at ScienceDirect

Estuarine, Coastal and Shelf Science

journal homepage: http://www.elsevier.com/locate/ecss

Contrasting fatty acids with other indicators to assess nutritional status of suspended particulate organic matter in a turbid estuary

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ARTICLE INFO

Keywords:
Estuaries
Fatty acids
Microorganisms
Phytoplankton
Trophic value
Salinity

ABSTRACT

Achieving a precise nutritional characterization of suspended particulate organic matter (SPOM) is key for understanding the efficiency of bottom-up trophic fluxes in estuaries. Assessing the nutritional status of SPOM in turbid estuaries is challenging due to the complex mixing and degradation dynamics of the autotrophic, heterotrophic and detrital sources configuring SPOM. Using a recently described index based on fatty acids (FA), SPOM nutritional value was quantitatively characterized in the Guadalquivir River Estuary (GRE). Over a two-year study, this FA-based nutritional index (FANI) discerned changes in the nutritional value of SPOM to a greater extent than other nutritional indices. Spatiotemporal results of FANI in the GRE indicated SPOM nutritional quality was 2.2-fold higher in the 20–35 salinity range respecting to the 0–5 salinity range and that SPOM in summer was 1.5-fold nutritionally richer than in winter. A mixing model using bacterial FA estimated a maximum 40–60% range of variation for a complementary contribution of autotrophs and heterotrophs to microbial biomass and was in agreement with results of carbon-based estimates of phytoplankton and total microbes. In the spatiotemporal scale, and referred to particulate organic carbon (POC), phytoplankton represented from 9.3% (winter) to 31.0% (summer), and from 15.0% in lower salinity (0–20) to 24.5% in higher salinity reaches (20–35). Phytoplankton was positively correlated with SPOM nutritional value. Specific FA markers indicated a low contribution of land plants to POC. The lipid-based approach here described can improve understanding of the nutritional status of basal food resources in turbid estuaries.

1. Introduction

The suspended particulate organic matter (SPOM) in estuaries consists of a complex mixture of different biological and detrital sources that is also affected by important biochemical degradation processes (Canuel and Hardison, 2016). Understanding the nature of such complex SPOM is particularly difficult in estuaries due to the mixing of freshwater materials, collected and transported through diverse watersheds, and seawater from different tidal forces incorporating particles of different nature (Bianchi and Bauer 2012; Snedden et al., 2013). In estuaries, the SPOM pool is a mixture of allochthonous and autochthonous particles (Middelburg and Herman 2007), with phytoplankton representing a minor but highly relevant component from the nutritional perspective (Dickman et al., 2008). Given that estuarine SPOM supports coastal food webs, improving its nutritional characterization is key to understanding how it fuels production in consumers. Despite notable research efforts, achieving a more complete knowledge about SPOM nutritional quality in estuaries remains a challenge (Canuel and Hardison, 2016). Traditional studies on SPOM nutritional quality have been principally based on the use of elemental stoichiometry, stable isotopes and/or chlorophyll *a*. This methodology has long contributed to qualitatively advance in the knowledge of partitioning and nutritional status of SPOM. However, it has also produced ambiguous results and has a limited ability to discern more specific and quantitative changes in SPOM composition and nutritional status. Therefore, these methods have been progressively complemented with others implementing biochemical markers (Bianchi and Canuel, 2011). There is current agreement accepting that the inference of SPOM quality can be improved in aquatic ecosystems with

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https://doi.org/10.1016/j.ecss.2021.107329
Received 29 May 2020; Received in revised form 12 March 2021; Accepted 14 March 2021
Available online 26 March 2021
0272-7714/