Characterization of the effluent from an intensive marine recirculating system for the culture of finfish, and studies on effluent based culture of microalgae

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Journal Page

Table of Contents

Abstract

Intensive recirculating aquaculture systems (RAS) routinely discharge effluent that, while relatively small in volume, is particularly enriched in nutrients. The objectives of this study were two-fold; to characterize the wastes produced by an intensive marine RAS for southern flounder, and to evaluate the effluent as a nutritive base for marine algal production.

Effluent from UNCW's pilot scale RAS, containing a population of southern flounder (*Paralichthys lethostigma*) was collected monthly for a period of one year and analyzed for total phosphorous, total nitrogen, phosphate, ammonia, nitrate/nitrite, solids and biological oxygen demand. The results of this characterization revealed an effluent high in dissolved phosphorous and dissolved nitrogen concentrations.

Secondary to this characterization, studies were performed to determine if this effluent would support the growth of microalgae, and if this microalgae growth would reduce the nutrient concentrations within the effluent. Laboratory-scale experiments were performed utilizing this effluent as a nutrient base for the production of *Isochrysis galbana* and indigenous plankton from the coastal waters of southeastern North Carolina. Four different nutrient media were used to compare the marine RAS effluent in 50 and 100% strengths to a commercial media (Guillard's f/2) and a nutrient free seawater control. These cultures were monitored for algal growth as well as reduction in nutrient concentrations over time. The effluent proved to be a better nutrient source for the production of *I. galbana* and indigenous plankton than the commercially available media producing higher cell densities and a marked reduction of dissolved nutrients with phytoplankton growth. In addition to these laboratory studies, trials were performed in 1200-L outdoor bioreactors utilizing effluent from the marine RAS for the production of *I. galbana* and

indigenous plankton. Algal growth and nutrient concentrations were measured over time and an increase in algal densities with a concurrent reduction of nutrients was observed.

These studies confirmed that the effluent from a marine recirculating aquaculture system for the production of southern flounder provides an excellent nutrient source for the production of the microalgae *I. galbana* as well as indigenous plankton, and that microalgae was an effective means of reducing the inorganic nutrient loads associated with these fish rearing systems.

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Dedication

I would like to dedicate this thesis to my wife, Mariska, and to my children; Morgen, Aidyn, Christopher and Shane.

Lists of Tables

List of Figures

Figure Page