

Development of ecotoxicological toolbox for assessing freshwater finfish aquaculture effluent.

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INTRODUCTION

The EcoAqua project focuses on improving production efficiency in Irish freshwater aquaculture. It aims to address critically important needs identified by the industry and aquaculture stakeholders¹. Aquaculture is one of the fastest growing food producing industries in the world². The Irish aquaculture sector was worth €163M, producing 44,000 tonnes of fish in 2016³. Food Wise 2025 predicts that the Irish agri-food industry has the potential to increase exports by €19B per annum by 2025. It proposes that aquaculture production should be increased to 81,700 tonnes by 2023 in order to assist in meeting this goal⁴. However issues with the aquaculture licensing process and the adoption of EU environmental protection directives, e.g. 92/43/EEC, 2009/147/EC and 2000/60/EC, have hampered the growth and development of the industry⁵. Freshwater aquaculture waste-water discharge is currently monitored by Irish Water however current regulations may not be specifically applicable to aquaculture⁶. Hence there is an urgent need to develop an ecotoxicological toolbox consisting of tests representative of the receiving freshwater aquatic ecosystem downstream of fish farms. This aims to assist in improving both the aquaculture licensing process and monitoring of concomitant waste-water discharge.

METHODOLOGY

A standard acute multi-trophic freshwater ecotoxicological test-battery consisting of a producer, consumer and decomposer. *Pseudokirchneriella subcapitata* (algae) and *Daphnia magna* (crustacean) have been validated and *Vibrio fischeri* (luminescent bacteria) is currently being validated. These bioassays will be employed to analyse freshwater aquaculture effluent.

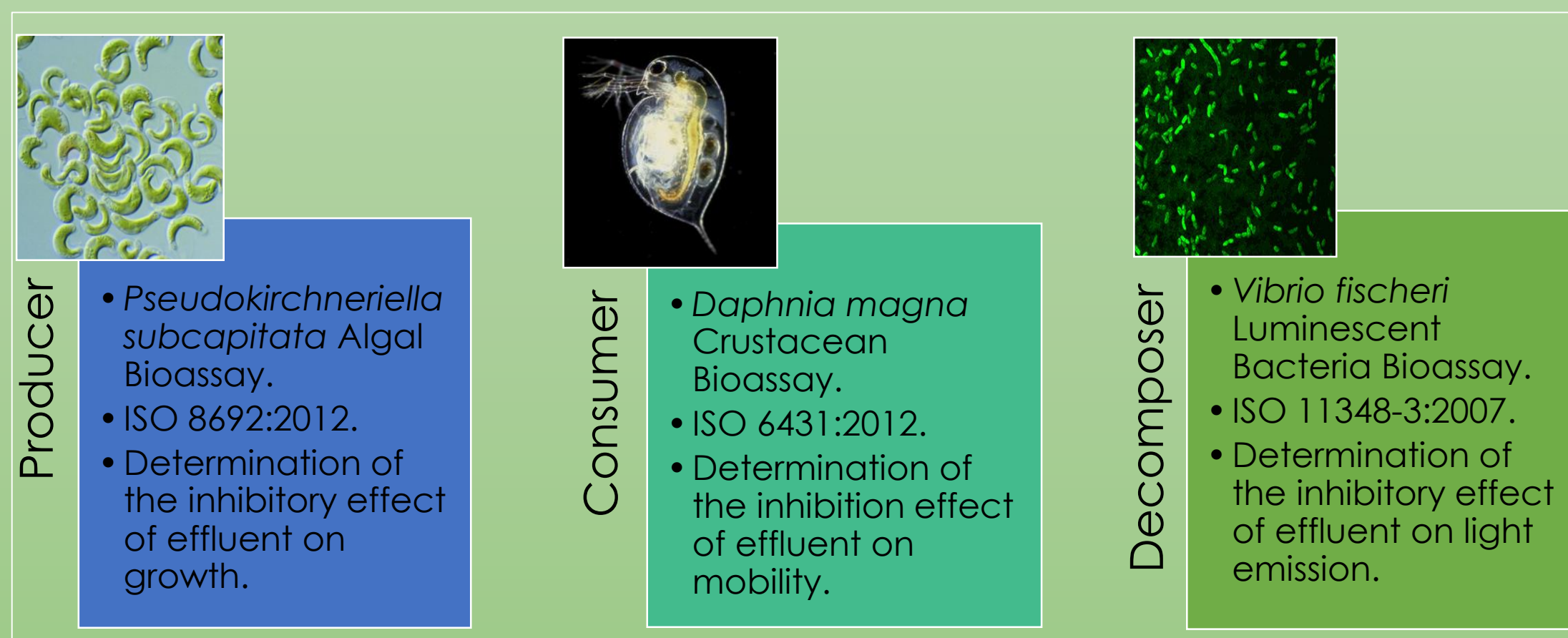


Figure 1: Schematic of multi-trophic test battery methodology.

Physico-chemical analysis to be performed will be in line with requirements set out by the EPAs Irish aquaculture licensing guidelines and will include; biochemical oxygen demand, chemical oxygen demand, dissolved oxygen, total nitrogen, total phosphate, total suspended solids, pH, and conductivity. Physico-chemical tests are currently being validated.

RESULTS

Algal growth inhibition assay

The toxicological response (E_rC_{50}) of the reference substance 3,5-Dichlorophenol after 72 hours was determined to be 3.09 mg/L (Figure 2). As per ISO 8692:2012, an E_rC_{50} value of 3.38 mg/L \pm 1.30 mg/L is required for the assay to be deemed valid. As the determined concentration fell within this range, this assay was deemed valid and ready for the analysis of the freshwater aquaculture effluent.

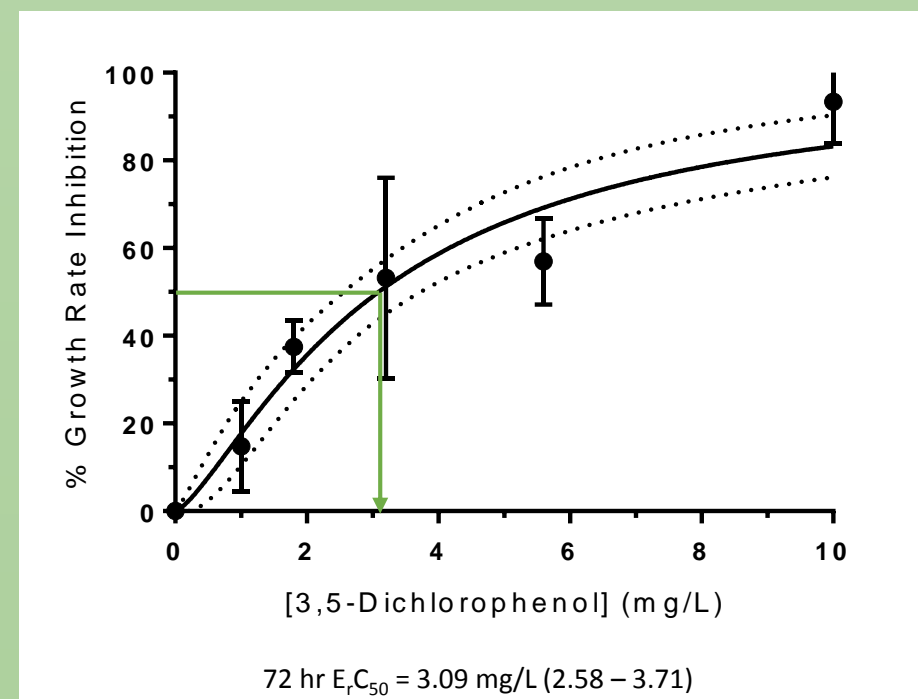


Figure 2: Dose response curve for *Pseudokirchneriella subcapitata* exposed to 3,5-dichlorophenol for 72 hours under static conditions. S.D. & 95% C.I. indicated.

Crustacean mobility inhibition assay

The toxicological response (EC_{50}) of the reference substances potassium dichromate and zinc sulphate after 24 hours were determined to be 1.06 mg/L and 2.53 mg/L, respectively (Figure 3). An EC_{50} value between the range 0.6 - 2.1 mg/L for potassium dichromate and 0.93 - 3.48 mg/L for zinc sulphate is required for the assay to be deemed valid. As the determined concentrations fell within this parameters, this assay was deemed valid and ready for the analysis of the freshwater aquaculture effluent.

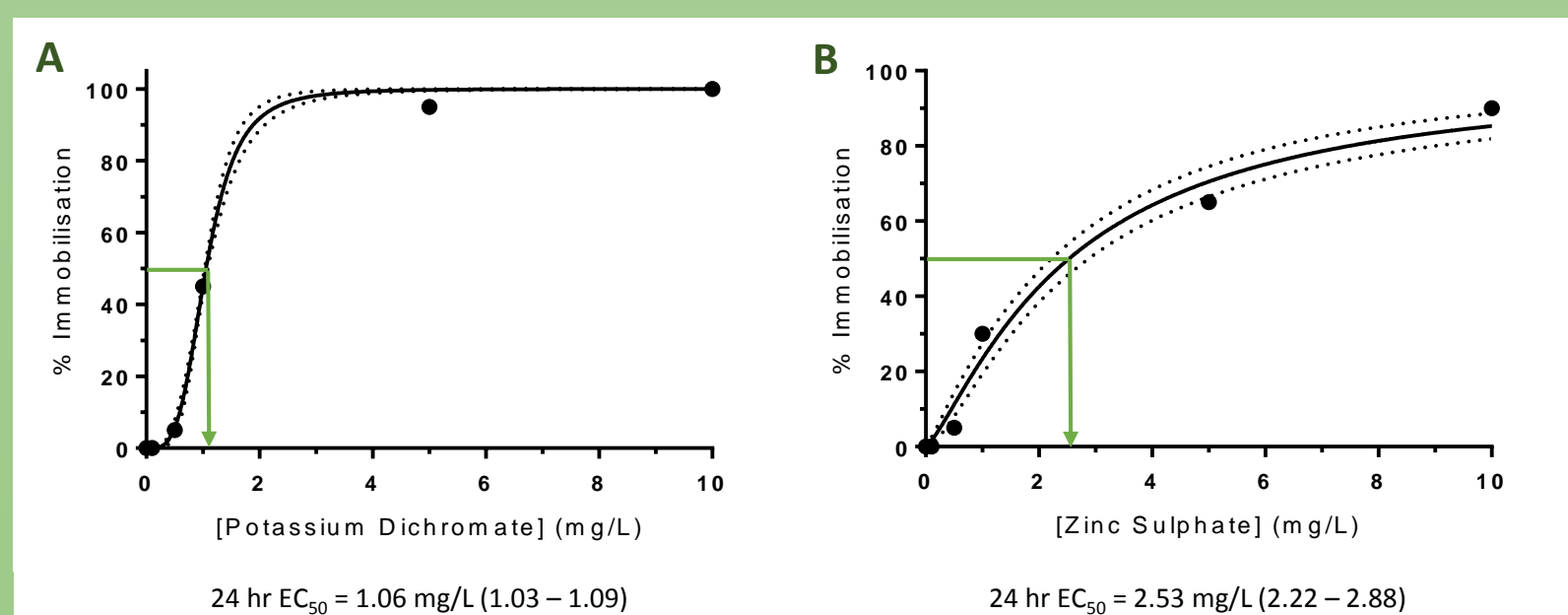


Figure 3: Dose response curves for *Daphnia magna* exposed to potassium dichromate & zinc sulphate for 24 hours. S.D. & 95% C.I. indicated.

DISCUSSION & FUTURE WORK

Upon validation of all bioassays and physicochemical tests, influent and effluent from a selected aquaculture site will be assessed every two weeks for approximately six months. Validation of all tests is expected to be completed by the end of March and testing will commence at the start of April.

Pseudokirchneriella subcapitata and *Daphnia magna* will only be used for validation purposes. An algae and micro-crustacean species representative of Irish freshwater aquatic ecosystems are currently being investigated and will be used for the monitoring process.

Correlations between the ecotoxicological bioassays and physicochemical data will then be established with the hope of providing an early warning system for any issues arising from aquaculture effluent discharge.

The main aim of this toolbox is to develop ecologically relevant test species for use in bioassays for EIAs (required for aquaculture licensing process) and for monitoring of aquaculture waste water discharge.

REFERENCES



An Roinn Talmhaíochta, Bia agus Mara
Department of Agriculture, Food and the Marine



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