Optimizing Sea Urchin Gonad Enhancement with Newly-designed Formulated Feeds and Assessing Benthic Impacts of Commercial-scale Sea Urchin Farming to Ensure Environmental Sustainability

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INTRODUCTION

Figure 1. Green sea urchin

Figure 2. Red sea urchin

Sea Urchins

- Ecologically-important species [2,3,5,8]
- Over-population creates sea urchin barrens [2]

Sea Urchin Barrens [5,6,8]

- Devoid of macroalgae
- Urchins remain in barrens for long periods of time
- Prevent re-growth of macroalgae in area
- Low gonad-yield urchins

Sea Urchin Market

- Fished/cultivated for their gonads ("roe"/"uni")
- Size, colour, texture, firmness, and taste are important [1,3]
- Gonads are main organ for nutrient storage [4,7]
- Diet is directly related to size and quality of the gonads [4,7]
- Poor quality gonads – undesirable for fishery

Sea Urchin Aquaculture (Gonad Enhancement)

- Can make "empty" sea urchins commercially viable
- Remove sea urchins from barren grounds
- Feed urchins a prepared diet for 8–12 weeks
- Promote re-growth of macroalgae

OBJECTIVES

Objective 1: To assess the effects of two prepared diets and a natural feed (kelp) and three temperatures (8, 12, and 16°C) on gonad yield and gonad quality (colour, texture, taste, and firmness) in the green and red sea urchin held under laboratory conditions.

Objective 2: To assess the effects of two prepared diets and a natural feed (kelp) and three temperatures (8, 12, and 16°C) on gastrointestinal parameters in the green and red sea urchin held under laboratory conditions to model potential impact of farm.

METHODOLOGY

1. Experimental Design

- 12-week feed trial
- Green urchins (*Strongylocentrotus droebachiensis*)
- Red urchins (*Mesocentrotus franciscanus*)
- 3 diets (2 prepared, 1 kelp), 3 temperatures (8, 12, 16°C)
- 6 sea urchin replicates/treatment (54 in total)

2. Objective 1

2.1. Gonad Yield and Quality

- Gonad yield (%)
- Degree of colour difference

3. Objective 2

3.1. Faeces and Uneaten Feed Analysis

- Ingestion rate, organic matter, assimilation efficiency

3.2. Faecal Pellet Settling Rate

- Length, width, settling velocity

Figure 3. Prepared diets

PRELIMINARY RESULTS

Green Urchins (*Strongylocentrotus droebachiensis*)

- **Objective 1: Gonad Yield and Quality (Week 9)**

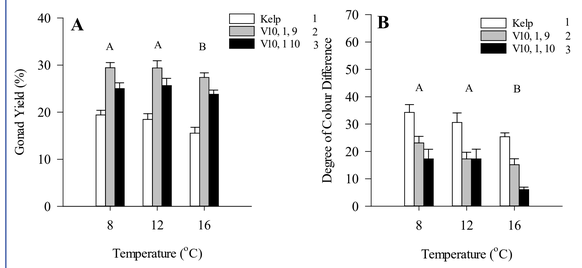


Figure 4. Mean (+SE, *n*=6) (A) gonad yield (%) and (B) degree of colour difference for the interaction between diet and temperature for *Strongylocentrotus droebachiensis*. Different letters above the bars and numbers beside the feed treatments indicate the results of an ANOVA (followed by Tukey test) showing significant (P<0.05) differences among the treatments.

- **Objective 2: Faeces and Ingestion Rate Analysis**

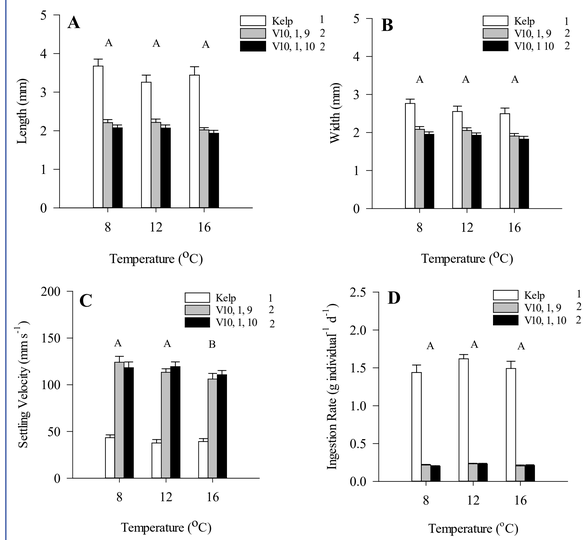
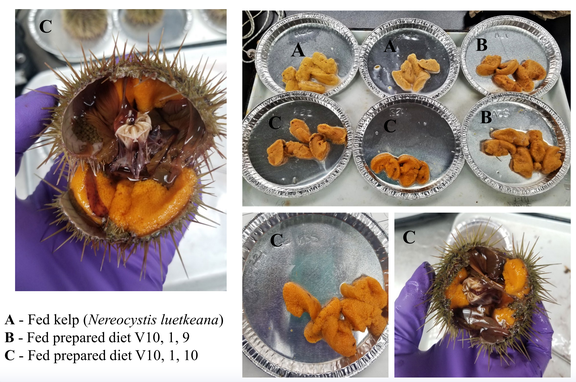


Figure 5. Mean (+SE, *n*=6) (A) faecal pellet length, (B) width, (C) settling velocity, and (D) ingestion rate for the interaction between diet and temperature for *Strongylocentrotus droebachiensis*. Different letters above the bars and numbers beside the feed treatments indicate the results of an ANOVA (followed by Tukey test) showing significant differences among the treatments.

Green Urchins

- Final gonad sampling



A - Fed kelp (*Nereocystis luetkeana*)
B - Fed prepared diet V10, 1, 9
C - Fed prepared diet V10, 1, 10

PRELIMINARY RESULTS

Red Urchins (*Mesocentrotus franciscanus*)

- **Objective 1: Gonad Yield and Quality (Week 0)**

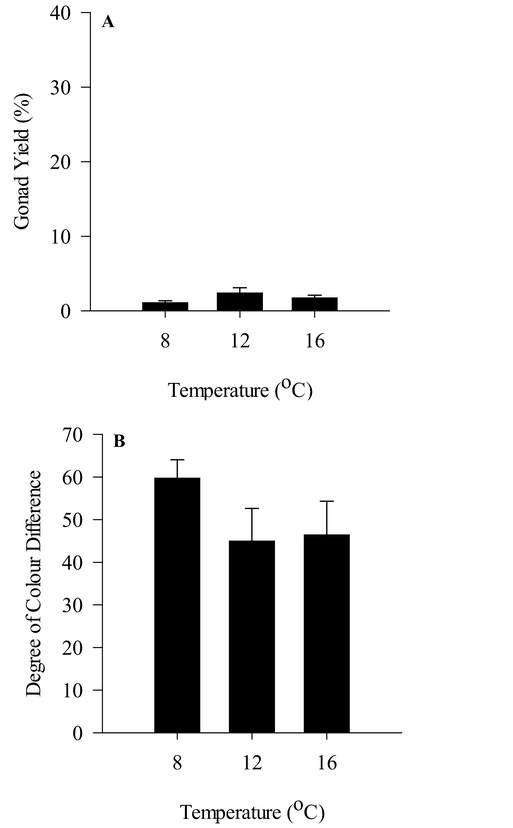


Figure 6. Mean (+/SE, *n*=5) (A) gonad yield (%) and (B) degree of colour difference for the three temperature treatments for *Mesocentrotus franciscanus*.

Red Urchins

- Week 0 gonad sampling

IMPLICATIONS

Optimizing gonad enhancement in aquaculture

- Bulk sea urchins up in 8–12 weeks – high yields/good quality
- New aquaculture industry for BC
- Potential for multi-trophic aquaculture

Reforestation of kelp beds

- Remove excess sea urchins from the environment
- Promote re-growth of macroalgae

Important to know environmental impact of sea urchin farming

- Site planning, monitoring, management, mitigation

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