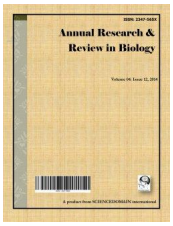

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Caulerpa lentillifera and Sucrose Formulated Diets as Growth Enhancer of Oyster (*Crassostrea virginica*)

Roldan T. Echem[1*] and Ariel Alvarez[1]

[1]College of Science and Mathematics, Western Mindanao State University, Zamboanga City 7000, Philippines.

Authors' contributions

This work was carried out in collaboration with my co-author AA. He designed the study and performed the statistical analysis and analyses of the study. Both authors read and approved the final manuscript.

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ABSTRACT

A total of 200 of *Crassostrea virginica* populations of average weight range from 41.19 ± 3.42 to 47.53 ± 1.06 g were studied to determine the effect of the feed diets of *Caulerpa lentillifera* and sucrose as growth enhancement. Growth rates increased that range from 56.99 ± 3.16 to 61.56 ± 2.87 g for 90 days period using an artificial water tank system. Previous studies conducted that *C. lentillifera* contained high protein and were the most abundant component. This seaweed also contained high amounts of minerals and balanced amino acid and notably very rich in iodine. phosphorus, calcium, magnesium and copper that will contribute to oysters growth. Oysters are known to have the ability to uptake dissolved organic matter as nutrients. In the present study, the effects of culture water supplemented with sucrose were tested on oysters. Results revealed that this organic matter promotes growth to the oysters. Sugars will be metabolized into pyruvate through the glycolysis pathway and will result in the supply of energy. Therefore, supplementation of sugar to oysters may have contributed as an energy source together with the lipid and protein content from the algae diet.

**Corresponding author: E-mail: roldanechem@gmail.com, rtechem@yahoo.com;*

Keywords: Crassostrea virginica; oyster; formulated diets; Caulerpa lentillifera; growth promotion.

1. INTRODUCTION

The decline in oyster abundance by more than 90% has been reported worldwide. The prevailing explanations for the decline include high rates of fishing mortality [1,2,3], habitat degradation [4], poor recruitment [5], and two salinity-related parasitic diseases, *Haplosporidium nelsoni* (MSX) and *Perkinsus marinus* (Dermo) [6]. Oysters create a complex matrix of structured habitat, similar to coral reefs, important to many fish and invertebrate species, which enhance estuarine biodiversity [7,8]. Oyster reefs are known to play an important role in benthic-pelagic coupling and the movement of energy within the ecosystem [9,10].

Oysters are capable of spawning within their first year of life. Larger oysters produce more gametes than smaller oysters. There are many factors that can impact successful oyster spawning. In order for an oyster to spawn, they must eat naturally occurring phytoplankton in the water column and allocated to a gonad, which will be either eggs or sperm. Oysters are filter feeders, drawing water in over their gills through the beating of cilia. Suspended plankton and particles are trapped in the mucus of a gill, and from there are transported to the mouth, where they are eaten, digested, and expelled as faeces or pseudofeces. Oysters diet includes plankton, algae and small food particles that wash over their gills. Oysters feed most actively at temperatures above 10°C. An oyster can filter up to 5 L (1.3 gal) of water per hour [11]. Studies have been conducted to determine the ability of marine invertebrates to uptake dissolved organic matter. Representatives of these soft-bodied marine invertebrates like clams and oysters have this ability. Oysters do not regulate their body temperature or the salinity of their body fluids; thus, their metabolic activity is closely tied to the temperature of their surroundings, and the salt content of their body is the same as that of the ambient water [12]. The ability of oysters to tolerate different environments is species specific.

Studies conducted by [13] evaluated nutritional qualities of *C. lentillifera.* Protein was the most abundant component in this seaweed. *C. lentillifera* contained 21.06% protein based on dry weight. This seaweed contained high amounts of minerals and balanced amino acid. This seaweed was notably rich in iodine. phosphorus, calcium, magnesium and copper.

The purpose of this study was to determine the effect of formulated diets of *C. lentillifera* and sucrose as growth enhancer of oyster (*C. virginica*) in artificial conditions using water tank system. The study will provide empirical information on the effects of sea grapes and sucrose to the wet weight of oysters.

2. MATERIALS AND METHODS

Research locale: The study was conducted at Western Mindanao State University, College of Science and Mathematics, Laboratory Room at Baliwasan Zamboanga City 7000, Philippines.

Research design: For experimental purpose, 4 fish tanks with a density of 50 juvenile oysters each were used. Each tank equipped with an aerator to provide the set up continuous aeration. Each fish tank was filled with 5L filtered seawater. A total of 200 juvenile oysters were placed in the 4 fish tanks and the growth of the oysters was observed and recorded for 90 days. The study used random replication design for the randomization procedure involving three experimental groups and control. From the population, there was a random selection of samples. All samples were subjected to different treatments (treatment 1: fed with *Caulerpa lentillifera,* treatment 2: fed with sucrose and treatment 3: fed with C. lentillifera and sucrose, control group: sea water only).

Preparation of treatments and feeding management: The seagrapes were washed with tap water to remove the dirt. After washing, the sea grapes were cut into smaller pieces and placed in the grinder to extract the liquid material. Treatment 1 contains 5 ml of sea grapes and treatment 2 contains 10 g of sucrose. Treatment 3 was a combination of 5 mL extract of seagrapes and 10 g of sucrose and applied directly to the water tanks at an interval of twice a day. The feeding time was 7:00 A.M. and 4:00 P.M. daily for 90 days period.

Sanitation and maintenance: The salinity, temperature, pH of the seawater in the tanks was maintained. The salinity was maintained at 33 psu, water temperature was maintained at 27^0C-30^0C and a pH level of 6-7. The seawater in the 4 fish water tanks were continuously replaced every 48 hours.

Data collection: After acclimatization, the initial weights of the oysters were recorded. The gain weights were recorded every 7 days for 90 days period using digital analytical balance.

Statistical analysis: Data were statistically analysed using means and standard deviation. The significant effects of means of treatments and wet weight were determined using One-Way ANOVA at 0.05 level of confidence.

3. RESULTS

The *Crassostrea virginica* in modified experimental set-up fed with *Caulerpa lentillifera* and sucrose has higher gain wet weight (61.56 ± 2.87) than those in treatment 1 (58.99 ± 4.20) and treatment 2 (56.99 ± 3.16) respectively after 90 days (Table 1).

Table 1. Means ± SD of wet weight of oysters after treatments (T1=fed with *C. lentillifera*, T2=fed with sucrose solution, T3= fed with a mixture of sugar solution and *C. lentillifera*)

Treatment	Initial weight (g)	Final weight (g)
T1	41.19 ± 3.42	58.99 ± 4.20
T2	45.97± 2.53	56.99 ± 3.16
T3	47.53 ± 1.06	61.56 ± 2.87

One-way ANOVA revealed that there was a significant effect (P = 0.01) of the treatments on the final wet weight of the oysters (Table 2).

Fig. 1 shows that the means ± SD of the final wet weight of *Crassostrea virginica* fed with *Caulerpa lentillifera* and sucrose supplementary diets was highest than the means ± SD of the final wet weight of the oysters fed with *C. lentillifera* and fed with sucrose respectively.

Table 2. One-way ANOVA of wet weight of oysters after treatments (T1=fed with *C. lentillifera*, T2=fed with sucrose solution, T3= fed with a mixture of sugar solution and *C. lentillifera*)

Source of variation	Sum of square	df	Mean of square	*F value*	Remark
Between	166	2	83	0.01497	Sig
Within	33,252	6	5542		
Total	44,336	8			

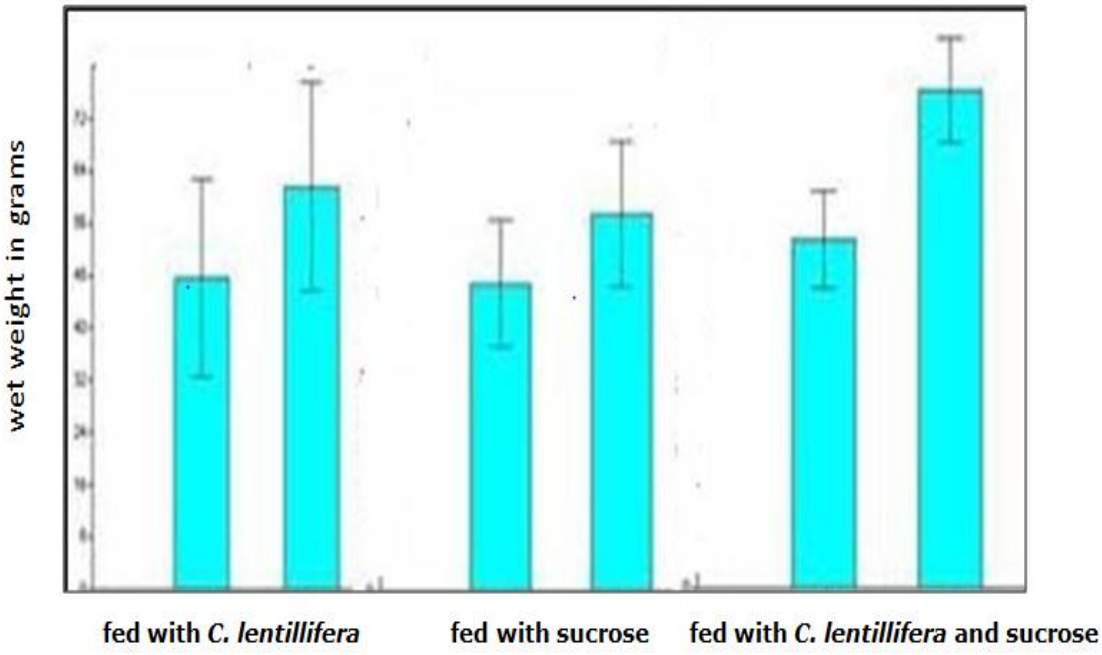

Fig. 1. Means ± SD of the initial and final wet weight of *Crassostrea virginica* fed with *Caulerpa lentillifera* and sucrose supplementary diets

4. DISCUSSION

Results revealed that there was a highest weight gain of *Crassostrea virginica* when fed with sucrose and *Caulerpa lentillifera* indicating optimum growth capacity. In addition, there was also a weight increase of the *C. virginica* when fed with *C. lentillifera* and sucrose separately. [14] explained that uptake of dissolved organic matter as nutrients from seawater by marine invertebrates is known to be accomplished through epidermal tissue located in the mantle and gills. However, only low molecular organic compounds are reported to be absorbed through the epidermal tissue of marine invertebrates. Significant growth promotion of glucose was also observed for soft tissue growth rate in the study by Motoharu et al. [15].

Glucose, once absorbed in the body of marine invertebrates can be predicted to be metabolised into pyruvate through the glycolysis pathway, then, further transformed to various organic acids such as citrate, succinate, and malate, through the citric acid cycle [16]. All these metabolic reactions will result in supply of energy [17]. reported that carbohydrates and protein content are both significant factors for promoting the growth rate of clams. Therefore, supplementation of sugar from water to clams may have contributed as an energy source together with the lipid content from the microalgae diet.

5. CONCLUSIONS

The results of the present study suggest a new method of growth enhancement in artificial water tank system for oysters. The formulated diets of *Caulerpa lentillifera* and sucrose supplements can potentially improve wet weight of the oysters. This formulated diet from sugars can supply energy and carbohydrates and protein content from *C. lentillifera* are both significant factors for promoting the growth rate of *Crassostrea virginica.* This will serve as a basis for entrepreneurship as an avenue to generate additional income of the marginalised fisher folks in the coastal areas.

DISCLAIMER

This paper is based on preliminary dataset. Readers are requested to consider this paper as preliminary research article, as authors wanted to publish the initial data as early as possible. Authors are aware that detailed statistical analysis is required to get a scientifically established conclusion. Readers are requested to use the conclusion of this paper judiciously as statistical analysis is absent. Authors also recommend detailed statistical analysis for similar future studies.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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