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Growth Performance and Immune Response of *Oreochromis Niloticusl* L. with the Effect of Marine Macroalgal Fish Feed: *Halymenia Floresii* (Clemente) C.Ag.

Fredrick Raja E.[1]; John Peter Paul J.[2]*, Mahesh S.[3]
[1*]Research Scholar (Reg. No. 19211282261029), Department of Botany, St. Xavier's College (Autonomous), Palayamkottai - 627 002, Tamil Nadu. Affiliated to Manonmaniam Sundaranar University, Abishekapatti, Tirunelveli-627 012, Tamil Nadu, India.
[2]Assistant Professor of Botany & Director, Centre for Advanced Research in Plant Sciences (CARPS), St. Xavier's College (Autonomous), Palayamkottai – 627 002, Tamil Nadu, India.
[3] CAS in Marine Biology, Faculty of Marine Science, Annamalai University, Parangipettai, Tamil Nadu
Corresponding author - johnarock2008@yahoo.com

Abstract

Fish aquaculture has currently taken a pre-eminent position. The demanding situations confronted via the means of fish farmers, the cost of the fish feed and quality management of fish. Marine macroalgae are embedded with a variety of biochemical compounds that could assist as a shield in opposition to infectious diseases. This study was designed to analyze the impact of the seaweed *Halymenia floresii* in growth promotion and immune response in *Oreochromis niloticus*L as an alternate protein source in replacing a fish meal. The feed proximity includes the analysis of total carbohydrates, total fiber, total proteins, total lipids, moisture and ash. The experimental feed regimens were categorized as T_1 (Control), T_2 (10%), T_3 (20%), T_4 (30%) and T_5 (40%) and enhanced with the consistent percentage of algal powder throughout the study period. The growth parameters such as average weight gain, average length, specific growth rate and feed conversion ratio (FCR) were observed at the 60thday of the rearing period. Red blood cells (RBC), White blood cells (WBC), hemoglobin (Hb), hematocrit (HCT), Mean corpuscle volume (MCV), Mean corpuscle hemoglobin (MCH) and Mean corpuscle hemoglobin concentration (MCHC) were all assessed to evaluate the immunological response of *Oreochromis niloticus*. *Halymenia floresii* also efficient against *Vibrio cholera*. The consequences of this research work revealed that *Halymenia floresii* has positive impact on the growth and immune system of *Oreochromis niloticus.*

Keywords: *Halymenia floresi1*, *Oreochromis niloticus*, *Vibrio cholera*, Proximate, Fish feed,

Introduction

Farming of the aquatic organisms predominates for human consumption, to feed the human population and to increase productivity, commercial farming booming nowadays with advanced technologies and innovations. India is one of the leading producers of fish and shrimp farming. Aquatic organisms are one among to meet the major protein requirements of the world's population. The success of aqua farming includes various factors such as quality of the feed, bio-friendly nature like unpolluted to the environment, no water scarcity, health management, human resources, management skill and agricultural integration. Some of the serious concerns also need to be addressed during aqua farming like control of predatory birds, various pathogens-driven quality of the water like pH, Dissolved oxygen, Hardness, Alkalinity, Salinity, etc., and Stress-related diseases. These types of serious content may lead to financial setbacks for fish farmers (Lichtkoppler, 1993). The feed cost is increased in commercial diets but the feed cost is decreased in the algal-based food regimen for the fish (Saleh, 2020). The algal fish feed is not only for the economical upliftment of coastal culture but also for the alternate business aqua farmers. Algal fish feed is the best food diet for the fish with a good quality of growth performance and immune response of the fish (Noorjahan *et al.*, 2021)

The protein content of the marine macroalgae ranges from 7 to 31% of dry weight, the lipid content ranges from 2 to 13% of dry weight and the carbohydrate content ranges up to 60% of dry weight (Kazir*et al*., 2019). The chemical composition of marine macroalgae varies from species to species, Alanine, Glutamic acid and Aspartic acid were found high in red seaweeds (Machado *et al*., 2020). Compared to plant and animal products, most of the algal species contain a high amount of macro elements like potassium, calcium, magnesium, phosphorous and the trace elements like manganese, copper, zinc, and molybdenum (Ito and Hori, 1989 & Szelag-Sikora *et al.*, 2016).

Tilapia is one of the globally consumed species and categories in second farmed fish. Tilapia is the common name and mostly occurs in freshwater streams, lakes, ponds and rivers but also in brackish water. There are several species included in tilapia *Oreochromisniloticus*is the most common type of tilapia species in tropical and subtropical aquaculture regions(Prabu *et al.*, 2019). Many researchers have been interested on Tilapia fish species in the wake of its ability to thrive in adverse environmental conditions, strong disease resistance, and low respiratory needs, allowing it to withstand low oxygen and high ammonia levels. Tilapia is one of the fish with low fat and high protein content which is highly beneficial for human consumption.

In aquaculture, a variety of microorganisms, including Gram-negative and Gram-positive bacteria, have been utilized as probiotics(Nayak, 2010). In the freshwater tilapia species, there are so many probiotics previously recorded. The *Lactobacillus* species and *Bacillus* Species are used as an immune boosters to promote growth performance to enhance the immune system/ immune power and as disease resistance for Nile tilapia (Hai, 2015). Mostly the fish species can be affected by infectious diseases and natural degradation. Especially the tilapia fish can also be affected by some kind of harmful diseases like *Pseudomonas septicaemia*, *Vibriosis* species, *Staphylococcus,* etc.

This decline in the fish population has to be overcome. If the potential of the fish feed is its resistance power that functions as a remedy for the particular disease and also proliferates the fish growth rate. Owing to this purpose, most aqua farmers are in search of the alternate source. The primary goal of this research was to develop a cost-effective and efficient feed from marine macroalgae, as the algae have also the potential to fight against bacterial disease. This study was designed to analyze the effect of *Halymenia floresii* as an alternative to fish meal on the impact of growth enhancement and immune response in *Oreochromis niloticus* L.

Materials and Methods

Algal sample:

The fresh red algal sample Halymenia floresii (Clemente) C.Ag. was collected from Mandapam coastal line, Ramanathapuram district of Tamil Nadu, India, with the Latitude 9° 16’ 48.00” N and Longitude 79° 07’ 12.00” E.

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The collected sample was authenticated and deposited in Xavier's College Herbarium, Centre for Biodiversity and Biotechnology, St. Xavier's College (Autonomous), Palayamkottai-627002 and the Voucher number was given as XCH20505. The collected samples were completely rinsed with marine water in the field to exclude epiphytes and silt particles. The samples were carried to the laboratory in polythene bags and properly washed in freshwater before being rinsed with distilled water to remove the salt from the thalli's surface. They were well preserved in 5% formalin solution. The specimens were cleaned and dried on blotting paper in the shade at room temperature. The shade-dried samples were crushed to a fine powder using a tissue blender (Moubayed *et al*., 2017).

Proximate analysis:

The dried, powdered samples were subjected to the major biochemical constituent like total protein, total lipid, total carbohydrates, fibers, moisture and ash can be identified by following the various protocols.

The extraction of lipid was done by the chloroform-methanol mixture (Folch*et al*., 1957), the total carbohydrate was estimated following the Phenol-sulphuric acid (Dubois *et al*., 1956) the total protein, fiber, moisture and ash were estimated using the method of AOAC 20th edition 2016.

Experimental fish and husbandry

*Oreochromisniloticus*L. (tilapia fish) was selected because of its ability to tolerate an adverse situation under its availability. Red tilapia with an initial body weight of 1.15 ± 0.02 g and an initial length of4± 0.5cm were acclimatized to laboratory conditions for about two weeks. They were divided into six groups at random, each with 15 fish in three duplicates per aquarium. Glass aquaria measuring 100 x 34 x 50 cm were filled with 100 L of water and aeration were provided with continuous aeration. Every day, about half of the water was replaced with freshly replenished tap water, and the aquaria were cleaned before feeding. Until the completion of the trial, the fish were fed at 10% of their body weight. Six days a week, the fish were fed twice daily until they appeared satiated. The fish was weighed at the start of the experiment and then once a month.

Diet formulation and preparation:

This study employed five experimental diets that included both animal and plant protein sources. Based on feedstuff values reported by NRC, diets were formulated using commercial ingredients such as fish meal, wheat flour, rice flour, ground oil, vitamins and minerals In this study, five different levels of dietary *Halymenia floresii* were used: 0% (control), 10, 20, 30, and 40% of the designed diet (Table 1). To achieve agglutination, the mixture was progressively mixed with hot water (80 °C) in a 70:30 (v/w) proportion. The dough was pressed through a meat chopper to produce pellets with a diameter of 2 mm, which were then sun-dried for 3 days before being kept at room temperature. Then the nutritional qualities of formulated feed were tested.

Table 1: Percentage of feed ingredients used in experimental diets

Ingredients	**Control Feed (T_1)**	**T_2 (10%)**	**T_3 (20%)**	**T_4 (30%)**	**T_5 (40%)**
Fish Meal	20g	20g	20g	20g	20g
Wheat Flour	40g	35g	30g	25g	20g
Rice Flour	35g	30g	25g	20g	15g

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Ground Oil	5ml	5ml	5ml	5ml	5ml
Algal Sample	-	10g	20g	30g	40g

Growth parameters:

Fish were sampled at one-month intervals to determine their body weight. The fish were starved for 24 hours before being weighed. An electronic balance was used to determine the weight. (Vadher*et al*., 2016)

Average weight gain (g) = Final body weight – initial body weight

Average Length increase(cm) = Final body length – Initial body length

Specific Growth Rate (SGR % per day) = $\frac{\text{Log w2} - \text{log w1}}{\text{Time}} \times 100$

Where, w_1 = the initial body weight, w_2 = the final body weight

Food Conversation Ratio = $\frac{\text{Amount of feed intake (g)}}{\text{Wet eight gain (g)}}$

Blood collection and preservation:

After the experiment was completed, blood was taken from the experimental fish. The needle was immersed in a 2 percent heparin solution as an anticoagulant before blood collection. Blood was drawn from the caudal peduncle of the fish using a syringe. The blood was then put into an EDTA (Ethylene Diamine Tetra Acetic Acid) tube and kept at 4°C to determine the hematological parameters. Red Blood cells (RBC), White blood cells (WBC), Hematocrit (Hct), Hemoglobin (Hb), Mean corpuscle volume (MCV), Mean Corpuscle Hemoglobin(MCH) and Mean Corpuscle Hemoglobin Concentration (MCHC) were determined as hematological parameters.

Antibacterial Activity

Disc Diffusion method:

The disc diffusion method was used to antibacterial potential of the algae. Using a sterile swab, freshly grown liquid cultures of the test pathogens were seeded over the nutrient agar plates. Sterile filter paper discs of eight mm diameter were soaked with 40 µl of 50mg/ml of the extracts and air-dried to evaporate the solvent and the discs were applied over the plates at equidistance. The plates were incubated for 18 to 24 hours at 37°C. After the incubation time, the plates were examined for a clearing zone around the discs, indicating that the extracts had antibacterial action. Measurements were taken of the clearing zones that developed around each disc. Each experiment was repeated three times.

Results:

Proximate analysis

Marine algae have high humidity because they live in aquatic habitats and have a wide range of humidity. However, in this research, the collected algal sample became dried and powdered so the moisture content is in the normal range. The moisture content of *Halymenia floresii* was 8.86 percent in a qualitative study. Significant ash content was observed, which is most likely related to the presence of salt in the fronds. The ash content of the sample is 28.06 percent. Quantitative analysis of protein content in the *Halymenia floresii* is9.48%. Protein content differed between

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genera and even between species within the same genus. This shift might be either spatial or temporal. However, the surrounding water quality is mostly to blame. The protein concentration of macroalgae might vary according to the station, depth, and habitat. The lipid content of the sample is 4.17%. The carbohydrate content of the *Halymenia floresii* was 39.16 percent. The maximum content of carbohydrates in the red seaweed is related to the presence of phycocolloids content in their cell walls. The Quantitative analysis of crude fiber in the *Halymenia floresii* is 4.95 percent. The biochemical composition of marine algae varies depending on the season and the habitat (Table 2).

Table 2: Proximate analysis of *Halymenia floresii* (Clemente) C.Ag.

S.No	Parameters	Results (%)
1	Moisture Content	8.86
2	Ash Content	28.06
3	Total Protein	9.48
4	Total Lipid	4.17
5	Total Carbohydrate	39.16
6	Crude Fiber	4.95

The research was carried out to establish a suitable alternative of feed that had ingredients that were both naturally available and cost-effective in terms of wide availability to improve the culture. Although marine algae are an excellent source of protein, lipids, and other nutrients, and their cultivation is simple, they have yet to be recognized as major fish food. The gradual increase in the percentage level of protein, lipid, and carbohydrate shows the variation in the algal content (Table 3).

Table 3: Results of proximate composition analysis of feed

S.No	Parameters	Control (T_1)	T_2 (10%)	T_3 (20%)	T_4 (30%)	T_5 (40%)
1	Moisture Content	11.68	12.51	13.92	14.72	15.34
2	Ash Content	14.26	16.31	19.67	22.82	23.95
3	Total Protein	39.15	40.12	41.29	43.07	44.57
4	Total Lipid	8.04	8.73	9.12	9.83	10.24
5	Total Carbohydrate	24.36	29.59	32.27	36.91	39.92
6	Crude Fiber	4.17	4.92	6.73	7.18	8.12

Parameters of water quality:

The pH, ammonia, average temperature and soluble oxygen levels during the experimental period were7.16, 0.3 mg/l, 26^0C, and 5.21 mg/l, respectively. During the trial, however, there was no significant difference in the water quality characteristics of the experimental locations.

Growth performance:

The initial body weight of the Oreochromisniloticus is 1.35 ±0.5g and the initial length of the Oreochromisniloticus is 4±0.5 cm. The weight of the Oreochromisniloticus and the length of the Oreochromisniloticus are measured at regular intervals and are shown in Tables 4 & 5.

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Table 4: Measuring the final weight of the *Oreochromisniloticus* within 15 days

Food Regimen	15 days (g)	30 days (g)	45days (g)	60 days (g)
T_1	3.93±0.2	6.67±0.3	9.82±0.4	11.38±0.3
T_2	4.05±0.3	7.68±0.6	10.08±0.6	13.61±0.6
T_3	4.11±0.8	8.32±0.5	11.97±0.3	15.27±0.4
T_4	4.27±0.4	8.93±0.2	12.17±0.4	16.14±0.7
T_5	5.23±0.2	9.96±0.3	14.39±0.3	17.59±0.5

Table 5: Measuring the final length of the *Oreochromisniloticus* within 15 days

Food Regimen	15 days (g)	30 days (g)	45days (g)	60 days (g)
T_1	4.21±0.5	5.14±0.5	6.28±0.5	7.03±0.5
T_2	4.87±0.5	5.39±0.5	6.72±0.5	8.26±0.5
T_3	5.32±0.5	6.21±0.5	7.86±0.5	8.74±0.5
T_4	6.04±0.5	7.51±0.5	8.48±0.5	9.52±0.5
T_5	7.26±0.5	8.53±0.5	9.68±0.5	10.71±0.5

The average weight gain of *Oreochromisniloticus* varied between 10.03±0.4g and 16.24±0.4g. T_5 (16.24±0.4g) had the highest result, whereas T_1 (10.03±0.4g) had the lowest average weight gain (10.03±0.4g). The average length increase of *Oreochromisniloticus* varied ranges from 3.03±0.6 cm and 6.71±0.4 cm and the T_5 food regimen had the maximum average length increase (6.71±0.4 cm), whereas T_1 had the lowest average weight gain (3.03±0.6 cm). The percentage of specific growth rate per day of *Oreochromisniloticus*was maximum inT_5 (1.86±0.5%) and minimum in T_1 (1.55±0.4%). The Value of the food conversion ratio of the *Oreochromisniloticus* of T_1, T_2, T_3, T_4 andT_5 was 1.45±0.3, 1.31±0.2, 1.24±0.4, 1.13±0.4 and 1.02±0.3. The food conversion ratio of *Oreochromisniloticus*fed with macroalgae supplement feed was substantially different from the control. The food conversion ratio value for *Oreochromisniloticus* in this investigation was higher than the control and within a reasonable range (Table 6).

Table 6: Growth value parameters of experimental *Oreochromisniloticus*

Food Regimen	Average weight gain	Average length increase	Specific growth rate	Food conversion Ratio
T_1	10.03±0.4	3.03±0.6	1.55±0.4	1.45±0.3
T_2	12.26±0.6	4.26±0.3	1.67±0.6	1.31±0.2
T_3	13.92±0.3	4.74±0.4	1.75±0.3	1.24±0.4
T_4	14.79±0.4	5.92±0.5	1.80±0.4	1.13±0.4
T_5	16.24±0.4	6.71±0.4	1.86±0.5	1.02±0.3

Hematology analysis:

Complete Blood Count (CBC), is the assessment of the composition of the blood based on Red blood cells, white blood cells, hemoglobin, Haematocrit values, Mean corpuscle volume, mean

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corpuscle hemoglobin, and mean corpuscle hemoglobin concentration. For fisheries biologists, these metrics give crucial information for assessing fish health.

The maximum count of Red blood cells in T_5 (3.48×10^6) and the minimum in T_1 (2.26×10^6). The maximum count of white blood cells in T_5 (13.02×10^3) and the minimum in T_1 (12.31×10^3). The gradual increase of the RBC and WBC count showed the hemoglobin increased, transported more oxygen in the blood and prevented anemia. It also protected the fish from invasive bacteria and viruses. So it is a good immunological sign for *Oreochromisniloticus.* The highest hemoglobin was measured in T_5(13.6g dL_{-1}) and the lowest in T_1 (7.9 g dL_{-1}**)**. The highest hematocrit was measured in T_5 (38.4 %) and the lowest in T_1 (27.4 %). The ability to create a relationship between the oxygen concentration available in the habitat and the health state of these fish is made possible by increasing hemoglobin rate and the percentage of hematocrit, which is a good indicator of their oxygen transportation capability. The maximum range of the mean corpuscle volume, Mean corpuscle hemoglobin and mean corpuscle hemoglobin concentration is in T_5 (172.5 fl, 50.4 pg and 31.5 g I^{-1}) and minimum in T_1 (166.7fl, 46.3pg and28.4g I^{-1}). However, in this study, the blood parameter was within good range and boosted the immunity of the *Oreochromisniloticus*(Table 7). Erythrocytes with a normal hemoglobin value (normal MCHC) are referred to as normochromic. When the MCHC is unusually low, it is referred to as hypochromic, and when it is extremely high, it is referred to as hyperchromic. The MCHC range in this investigation suggested that it was in the normochromic range.

Table 7: Hematological parameters of experimental *Oreochromisniloticus*

Treatment	**RBC (cells mm^{-3})**	**WBC (cells mm^{-3})**	**Hb(g dL_{-1})**	**HCT (%)**	**MCV (fl)**	**MCH (pg)**	**MCHC (g I^{-1})**
T_1	2.26×10^6	12.31×10^3	7.9	27.4	166.7	46.3	28.4
T_2	2.51×10^6	12.48×10^3	9.4	30.6	167.9	47.6	29.5
T_3	2.93×10^6	12.74×10^3	11.6	33.2	169.6	49.3	30.2
T_4	3.27×10^6	12.91×10^3	12.7	36.9	171.2	49.9	30.9
T_5	3.48×10^6	13.02×10^3	13.6	38.4	172.5	50.4	31.5

Antibacterial activity:

The ethanolic extract of *Halymenia floresii* was tested for antibacterial activity in *in-vitro* systems. The effects of *Vibrio cholerae* on ethanolic extract of *Halymenia floresii* showed significant results. Ethanol extracts show the maximum zone of inhibition in the T_4 (27mm), followed by T_5 which is 26 mm, T_3 which is 14 mm andT_2 which is 8 mm. No inhibition zone occurs in T_1 (Plate 1 and Table 8).

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Plate 1: Antibacterial activity of ethanolic extract of *Halymeniafloresii*against *Vibrio cholerae*

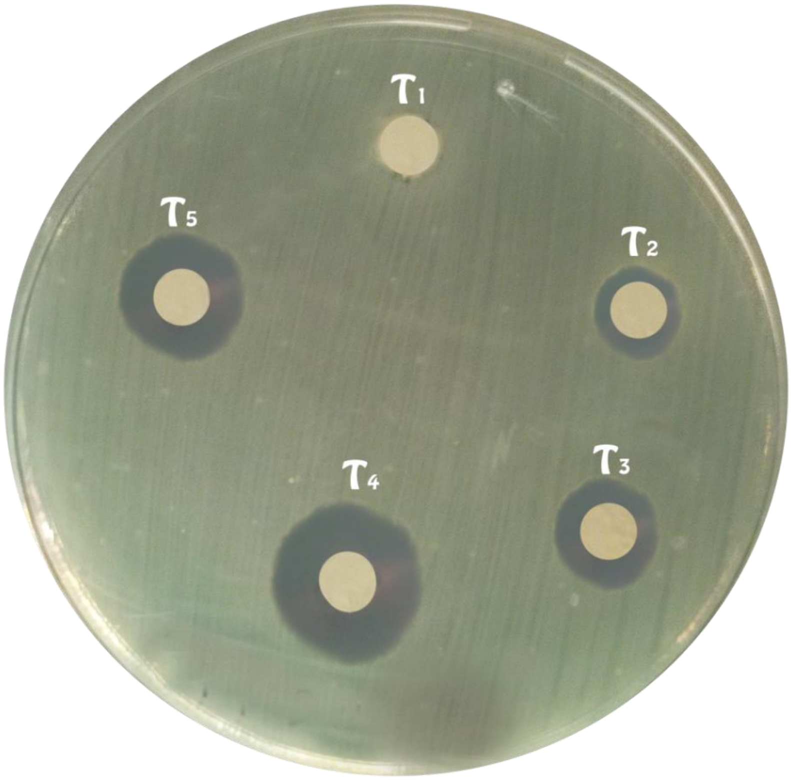

Table 8: Antibacterial activity of ethanolic extract of *Halymeniafloresii*against *Vibrio cholerae*

Treatment	**Inhibition Zone (mm)**
T_1	-
T_2	8
T_3	14
T_4	26
T_5	27

Discussion

Aquaculture is the fast-growing sector that cultivates the aquatic organism in a controlled environment to provide food and employment for the fish farmers of the society. The major factors that influence the rate of aquaculture are the nutritional composition of intake of the fish and the quality of the water (Thorpe & Cho, 1995 and White, 2013). The dietary protein requirement of Nile tilapia ranges from 25 to 45% for growth, reproduction and survival (Abdel-Hakim *et al*., 2001). Lipid has a crucial role in brood stock conditioning particularly concerning the growth and maturation of eggs and serves as a precursor for the production of functional metabolites (Ling*et al*., 2006). The content of the lipid in the tilapia is excess it is deposited as fat, so the lipid content of the fish diet is low (Earle, 1995). Carbohydrate is the cheapest energy source and can act as a spare for protein and lipids. The carbohydrate content of the Nile tilapia varies between 30 to 70 % of the diet (Shiau, 1997). The quality of the water includes pH, Dissolved oxygen, temperature, and humidity. The pH range of the water is 6 to 9 for tilapia to survive (Rakocy*et al.*, 2006). The level of dissolved oxygen for the growth of tilapia is 6 to 9 mg L^{-1} (Dagne *et al.*, 2013). The highest growth rate of tilapia fish is at 28 - 32°C and the lowest growth rate is at 24°C and 34°C (Balkew 2012). The concentration of ammonia should be maintained below 0.5mg/L to achieve a normal growth performance of fish (El-Shafai*et al*., 2009).

In this current research, the protein content of the fish feed in all 5 regimens is in the range of 25 to 45%. The lipid content is below 10 % and the carbohydrate content is up to 40%. Among these 5 regimens, T_5 shows the excess content of protein, lipid and carbohydrates. The experimental water quality is also in the good condition. The pH value is 7.16, the ammonia concentration is 0.3 mg/l, the average temperature is 26^0C and the soluble oxygen level is 5.21 mg/l. From this result, it was evident the nutritional composition and the quality of the water can promote the growth, reproduction and survival of tilapia fish.

For the supplement algal diet for the red tilapia in the present study, three different regimens of spirulina diet were used in the feed formulation for improved growth performance of tilapia (Sarr*et al*., 2019), *Ulva lactuca* perform as a supplement diet for tilapia fish shows a good result at the 5% of diet but in 10% the growth performance is decreased it may be the presence of indigestible fiber can influence the protein digestion (Natify *et al.*, 2015), *Gracilaria arcuata* could be incorporated into tilapia diets instead of fish meal by less than 20% (Yonis *et al.*, 2017) The growth performance of the tilapia fish is increased when its supplement with the different regimens of algal diets. The *Hypnea* species is the red algae can perform as a supplement for the fish fed. The perspectives of average weight gain, specific growth rate and Food Conversion ratio indicated the 10% of algal content regimen shows the best growth performance during 3 months of rearing period (Mohammad *et al.*, 2018).

In the present study, *Halymenia floresii* can perform as a supplement to *Oreochromis niloticus* feed. The growth value parameters of average weight gain, length increase, Specific growth rate and food conversion ration shows the best growth performance in T_5 regimen (40% of algal content) during the 60 days of rearing period.

The immune response of the tilapia fish can conclude by the hematological parameters. The healthy state of the experimental fish can be examined by the composition of blood-based on Red Blood cells, White blood cells, hemoglobin, hematocrit values, Mean corpuscle volume, mean corpuscle hemoglobin, and mean corpuscle hemoglobin concentration. *Hypneamusciformis* perform as the algal diet for tilapia fish allow to the assessment of growth performance and hematological parameters. 30% supplement diet can show the good growth performance and the hematological parameters conclude the healthy state of fish (Nur*et al.*, 2020).

In the present study, the best regimen (T_5 regimen - 40% of algal content)) of the *Halymenia floresii* can allow to the hematological parameters. The composition of the blood includes RBC, WBC, Hb, HCT, MCV, MCH and MCHC test shows the maximum results in the same T_5 regimen (40% of algal content).

Aquafarming is mainly affected by the probiotics including the variety of micro organism like gram negative and gram positive bacteria. *Vibrio* species is the one of the serious concern for the decline rate of the *Oreochromisniloticus*(Fouz*et al.*, 2002). The marine macroalgae can perform against the *Vibrio* species. *Gracillaria dura, Gracilaria gracilis, Gracilaria longissima, Chaetomorpha linum, Cladophora rupestris, Ulva prolifera* can perform against the six *Vibrio* species. *Gracilaria longissima* shows the maximum inhibition zone against the two Vibrio species (Cavollo*et al.*, 2013).

In the present study, *Halymenia floresii* can perform against the pathogen *Vibrio choerae*. The maximum inhibition zone is found in the T_5 food regimen which contains 40 % of algal content. It concludes that a food regimen which contains the maximum content of algae has the maximum growth performance of *Oreochromis niloticus*, with a good rate of blood composition representing the healthy state of fish and had good immunity against *Vibrio choerae*.

Conclusion

Marine algae are a potential healthy dietary supplement for human diets, and they may be useful to the food industry as a source of high-nutrient components. Their economic worth may be increased by increasing quality and extending the range of algal-based products.An environmental variation includes physical and chemical causes and the natural fluctuations can change the biochemical composition of the species. Marine algae could be used as a major feed ingredient in aquaculture. The marine algae are a good source of protein, carbohydrates, lipids and fiber that helps as the feed for fish. This research concludes that marine algae replaced feed has an improved growth performance. Furthermore, as compared to the control, all of the hematological parameters detected in the algal-replaced supplement exhibited the best results, suggesting that the immune system is performing better. There has been a relationship found between a higher percentage of algal powder in the diet and improved growth and immunological response. Aquacultures are often declining due to the impact of *Vibrio* species. From the antibacterial activity, *Halymenia floresii* had good immunity against *Vibrio cholerae*. So it can be concluded that *Oreochromis niloticus*can take the algal supplement feed possible to survive at all stages.

Conflict of Interest

The author declares no conflict of interest

References

[1]. Abdel-Hakim NF, Hussein MS, Bakeer MN, Soltan M. Effect of protein level and stocking density on growth performance of Nile Tilapia (*Orchenomis niloticus*) cultured in tanks. Egyptian J. Nutrition and Feeds 2001; 4(Special Issue): 763-780.

[2]. AOAC Official methods of Analysis, 20th ed. Association of Analytical Chemists. Rockville, Maryland, USA 2016.

[3]. Balkew K. Evaluation of Growth Performance, Feed Utilization Efficiency and Survival Rate of Juvenile Nile tilapia, *Oreochromisniloticus* (*Linnaeus*, 1758) Reared at Different Water Temperature, Int J Aquac 2012; 2: 59-64.

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[4]. Cavallo RA, Acquaviva MI, Stabili L, Cecere E, Petroceli A, Narracci M. Antibacterial activity of marine macro algae against fish pathogenic *Vibrio* species 2013; 8(7): 646-653.

[5]. Dagne A, Degefu F, Lakew A. Comparative growth performance of mono-sex and mixed-sex Nile tilapia (*O. niloticus L.*) in Pond Culture System at Sebeta, Ethiopia. Int J Aquac 2013; 3: 30-34.

[6]. Dubois M, Gilles KA, Hamilton JK, Rebers PA, Smith F. Colorimetric method for determination of sugar and related substances. Annal Chem 1956; 28 (3): 350-356.

[7]. Earle KE. The nutritional requirements of ornamental fish. *Veterinary quarterly* 1995; 17 (Suppl. 1): 53-55.

[8]. El-Shafai SA, El-Gohary FA, Nasr FA, Van Der Steen NP, Gijzen HJ. Chronic ammonia toxicity to duck weed - fed tilapia (*Oreochromis niloticus*). J Aquac 2009; 232: 117-127.

[9]. Folch J, Lees M, Stanley GHS. A simple method for the isolation and purification of total lipids from animal tissues. J. Biol Chem 1957; 226(1): 497-509.

[10]. Fouz B, Alcaide E, Barrera R, Amaro C. Susceptibility of Nile tilapia (*Oreochromis niloticus*) to vibriosis due to *Vibrio vulnificus* biotype 2 (serovar E). Aquaculture 2002; 212: (1-4).

[11]. Hai NV. Research findings from the use of probiotics in tilapia aquaculture: A Review. Fish & Shellfish Immunology 2015; 45 (2): 592-597.

[12]. Ito K, Hori K. Seaweed: Chemical composition and potential food uses. Food Rev Int 1989; 5(1): 101–144.

[13]. Kazir M, Abuhassira Y, Robin A, Nahor O, Luo J, Israel A, et al. Extraction of proteins from two marine macroalgae, *Ulva* sp. and *Gracilaria* sp., for food application and evaluating digestibility, amino acid composition and antioxidant properties of the protein concentrates. Food Hydrocol 2019; 87: 197–203.

[14]. Lichtkoppler FR. Factors to Consider in Establishing a Successful Aquaculture Business in the North Central Region. NCRAC Technical Bulletins 1993; 13.

[15]. Ling H, Zuo K, Zhao J, Qin J, Qiu, C, Sun X, Tang K. Isolation and characterization of a homologous to lipase gene from *Brassica nappus*. Russian Journal of Plant Physiology 2006; 53: 366-372.

[16]. Machado M, Machado S, Pimentel BF, Freitas V, Alves CR, Oliveira MBPP. Amino Acid Profile and Protein Quality Assessment of Macro algae Produced in an Integrated Multi-Trophic Aquaculture System. Foods 2020; 9(10): 1382.

[17]. Mohammad M, Sultana N, Naser MN, Hoq. Growth performance of Nile tilapia (*Oreochromis niloticus*) fed with seaweed (*Hypnea* sp.). Bangladesh J Fish 2018; 30(1): 21-27.

[18]. Moubayed NMS, Houri HJA, Khulaifi MMA, Farraj DAA. Antimicrobial, antioxidant properties and chemical composition of seaweeds collected from Saudi Arabia (Red sea and Arabian gulf). Saudi journal of biological sciences 2017; 24(1): 162 – 169.

[19]. Natify W, Droussi M, Berday N, Araba A, Benabid M. Effect of the seawed *Ulva lactuca* as a feed addictive on growth performance, feed utilization and body compostion of Nile tilapia (*Oreochromisniloticus* L.). International Journal of Agronomy and Agricultural Research , 2015; 7(3): 85-92.

[20]. Nayak SK. Review: probiotics and immunity: a fish perspective. Fish Shellfish Immunol 2010; 29(1): 2-14.

[21]. Noorjahan A, Mahesh S, Manupoori S, Aiyaperumal B, Anantharaman P, Muthukumaran M. Efficiacy of incorporating spent seaweeds in aqua feeds as a nutritional source. Journal of Survey in Fisheries Sciences, 2021; 8(1): 31-45.

[22]. Nur A, Hossain MF, Hasan MN, Zanna, S, Chakroborty K, Rafiquzzaman SM. Effect of selected seaweed powder as a fish feed growth and immune system of tilapia (*Oreochromis niloticus*). International Journal of Fisheries and Aquatic Studies 2020; 8(4): 24-30.

[23]. Prabu E, Rajagopalsamy CBT, Ahilan B, Jeevagan IJMA, Renuhadevi M. Tilapia – An Excellent Candidate Species for World Aquaculture. A Review Annual Research & Review in Biology 2019; Article no. ARRB.35935.

[24]. Rakocy J, Masser M, Losordo T. Recirculating Aquaculture Tank Production Systems: Aquaponics-Integrating Fish and Plant Culture. Southern Regional Aquaculture Center 2006; 454: 1-16.

[25]. Saleh HEE. Review on using of macro algae (seaweeds) in fish nutrition. Journal of Zoological Research 2020; 2(2): 6-11.

[26]. Sarr SM, Fal, J, Barry RO. Growth and survival of red tilapia (*Oreochromis aureus* x *Oreochromis mossambicus*) fry fed on corn and soy meal, peanut meal and fish meal enriched with spirulina (*Arthrospira platensis*). International Journal of Agricultural policy and Research 2019; 7(1): 1-9.

[27]. Shiau SY. Utilization of carbohydrate in warm water fish-with particular reference to tilapia, *Oreochromis niloticus* x *O. aureus*. Aquaculture 1997; 151: 79-96.

[28]. Szelag-Sikora A, Niemiec M, Sikora J. Assessment of the content of magnesium, potassium, phosphorous and calcium in water and algae from the Black Sea in selected bays near Sevastopol. Journal of Elementology 2016; 21(3): 915-926.

[29]. Thorpe JE, Cho CY. Minimizing waste through bioenergetically and behaviourally basefeeding strategies. Water Science and Technology 1995; 31(10): 29 – 40.

[30]. Vadher KK, Vyas AA, Parmar PV. Effects of seaweed *Gracillaria* sp. as feed additive in diets on growth and survival of *Labeo rohita*. Journal of Experimental Zoology India 2016; 19(2): 771-778.

[31]. White P. Environmental consequences of poor feed quality and feed management. FAO Fisheries and Aquaculture Technical Paper 2013; 583: 553– 564.

[32]. Yonis EMI, Al-Quffail AS, Al-Asgah NA, Al-Hafedh YS. Effect of dietry fish meal replacement by red algae *Gracilaria arcuata*, on growth performance and body composition of Nile tilapia *Oreochromis niloticus*. Saudi Journal of Biological Science 2017; 25(2); 198-203.