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Effect of using Equal Mixture of Seaweeds and Marine Algae in Striped Mullet (*Mugil Cephalus*) Larval Diets on Growth Performance and Feed Utilization

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ABSTRACT

This study was carried out in the Faculty of Agriculture (Saba- Basha), Alexandria University to study the effect of dietary equal mixture of seaweeds and marine algae (MX) at five levels (0, 21, 28, 35, and 42%) on growth performance and feed utilization for striped mullet (*Mugil cephalus*) fry with initial body weight of 0.157 g. Each treatment was replicated in three aquaria and lasted for ten weeks. Fish were given feed twice daily at a feeding rate of 15% of fish biomass seven days / week. The results showed that weight gain, final body weight (FBW), specific growth rate (SGR), body protein % and PPV% of striped mullet (*Mugil cephalus*) fry increased significantly with increasing dietary seaweeds and marine algae mixture levels up to 21%. FCR, ER% and PER improved with increasing dietary seaweeds and marine algae mixture level up to 21% and no significant differences were observed. There were No significant differences in the body lipid% of striped mullet (*Mugil cephalus*) with increasing dietary seaweeds and marine algae mixture levels. A negative trend was observed between (T2 and T5). It could be conclude that using equal mixture of seaweeds and marine algae for striped mullet fry at level 21% was the best in term of growth performance and feed utilization.

Keywords:

INTRODUCTION

Mullet have been recognized as very desirable species for pond culture in China, Egypt, Hawai, Italy, Japan, Philippine, Taiwan and other parts of the world, where they are mainly grown in polyculture with carps, tilapia, and milkfish (Perlmulter *et al*., 1957; Blanco and Acosta, 1958; Yashouv, 1966; Lin, 1968 and Bardach *et al*., 1972).

Mullets (*Mugil cephalus* and *Liza ramada*, Family Mugilidae) are considered highly esteemed in Egypt.They are also the most important marine fish, used for culture either in brackish or fresh water (Eissawy *et al*., 1974 and Sarig 1981). Because of their great productivity for aquaculture, there is a worldwide interest in mullet culture. They are recognized as highly wanted fish for pond culture in Italy, Japan, Philippines and other parts of the world (Yashouv, 1966; Yashouv and Ben-Shachar 1968, Bardach *et al*.,1972, Oren,1975, Benetti and Fugundo Netto, 1991a,b and El-Dahhar, 2000).

Seaweeds are large algae (macro algae) that grow in a saltwater or marine environment (White and Keleshian, 1994). They are plants, although they lack true stems, roots, and leaves. However, they possess a blade that is leaf like, a stipe that is stem like, and a holdfast that resembles a root. Like land plants, seaweeds contain photosynthetic pigments (similar to chlorophyll) and use sunlight to produce food and oxygen from carbon dioxide and water. Certain seaweeds tend to group together in bands or "stripes" that run roughly parallel to the coast.

The poor survival rates of the wild mullet larvae is a limiting factor in mullet production and many investigations were made to determine environmental and nutrition requirements (Brusle, 1981; Alexis and Papaparaskeva- Papoutsoglou, 1986; Benetti and Fagundes Netto, $1991_{a,b}$ and El-Dahhar, 1999). The poor digestion in their larvae stages according to the primitive digestive system leads to the importance of exogenous additives in the diet to improve survival and growth of mullet larvae (Person Le Ruyet *et al*., 1993 and El-Dahhar, 1999). Treating the diet by heat and pressure improve the diet quality and make the best nutritional use of the raw materials. It can sterilize the diet and give the opportunity to use raw materials with different quality (Botting, 1991 and De-Silva and Anderson, 1995).

After establishing some constituents of mullet acclimatization needs, e.g the use of exogenous zymogen in mullet feed (El-Dahhar, 1999), descending salinity acclimatization (El-Dahhar *et al*., 2000), determination of some vitamin requirements for mullet larvae (El-Dahhar, 2000), survival rate improved from zero to over 90% under the laboratory conditions. Thus, it is possible now to determine the nutritional requirements and establish diets for mullet larvae during the period of acclimatization.

In Egypt, high mortality percentage was recorded for *Mugil cephalus* and *Liza ramada* during transportation and rearing. Generally, the survival of the stocked fry was found to range from 12 to 25% at end of rearing period (El- Zarka and Fahmy 1966 and Eissawy *et al*., 1974) Salama *et al*. (1984) found that mortality of mullet fry was less in aquaria filled with sea water mixed with brackish than with tap water, as the differenece was found to be significant. Gosline and Brook (1965) reported that *Mugil cephalus* prefers brackish water areas, while (Pillay 1975) showed that the mullet can be cultured in both brackish and freshwater farms. (Sivalingam 1975) reported that it is possible to acclimatize *M.cephalus* to fresh water within 36 hrs by gradual dilution and can be reared with common carps in fresh water pond. The importance of fry nutrition on growth and mortality has been investigated by (Salama 1989 and 1990). He found that combined feeding on natural and artificial feed achieved by far the best growth and survival.

Thus to increase the production of mullet in Egyptian fish farms we need further research on mullet nutrition. (Salama 1994) found that the fish growth, survival, condition factor, water quality and profitably were achieved by low stocking rate (15.000 fish / h) and supplied with artificial feed.

The present work aimed for studying the effect of different levels of microalgae *Nannochloropsis oculata*. On growth performance, feed utilization and survival rate of *Mugil Cephalus,* Family *Mugilidae*).

MATERIALS AND METHODS

This study was carried out in the Marine Fish Laboratory (MFL), Faculty of Agriculture Saba Basha Alexandria University, Egypt. This experiment was conducted to study the effect of dietary equal mixture of seaweeds and marine algae (MX) inclusion rate at (0, 21, 28, 35and 42%) in striped mullet (*Mugil cephalus*) larval feed on growth performance, feed utilization and survival rate of mullet larvae.

Collection and Preparation of Seaweeds

The seaweeds *Ulva* spp were collected from Alexandria beach, washed well in fresh water to eliminate salts and all algae and outruns on it. They were dried at a temperature (60 – 70^{0}C) to avoid release of nutrients important to marine fish larvae. The dried seaweeds was ground in grinder mixer and stored in plastic sacs until adding to the diets.

Production of Marine Algae

Green microalgae *Nannochloropsis oculata* produced in the MFL is a marine green microalgae produced as feed for rotifer and water conditioner for larvae rearing to improve water quality and sustain rotifer alive. *N. oculata* is selected for its high productivity, the relative ease of its culture, suitability for rotifer culture and its tolerance of a wide range of salinities and temperature. *N.oculata* is high in nutritional value containing Eicosapentanoic acid (EPA) and Decosahexanoic acid (DHA). It has been reported that these highly unsaturated fatty acids (HUFAs) are essential for the growth and development of finfish larvae (Tamaru *et al*., 1991). *Nannochloropsis oculata* is produced at the MFL, Faculty of Agriculture (Saba Basha) using a technique explanted as follows:

Sea Water Supply System

The sea water supply system consists of three components, the seawater supply facilities, the sedimentation and the water storage tanks.

The Seawater Supply Facilities

Sea water is transferred from the sea to the lab by car prepared for this purpose. The tank over the car is filled by means of a pump and the water transferred to the lab by a pipe line to a ground storage tank beside the lab. The reserved water then pumped to the tanks over the Lab and the salinity was adjusted in each of them, by adding fresh water.

Sedimentation, Storage and Aseptic Facilities

At the ground storage tank, all the suspended particles in the transferred water are precipitated. Water then pumped to the reservoir tanks over the Lab. Four tanks over the MFL are used to reserve the water at the desired salinities.

(Nannochloropsis oculata) PRODUCTION

The algae culture starts indoor with laboratory flask culture and up scaled gradually to outdoor mass culture. Production and preparation indoor and outdoor were made according to El-Dahhar et al. (2014).

Experimental procedure

Striped mullet (*Mugil cephalus*) larvae were obtained from Rosita fry collection center and Maadia fishing port. Fish were transported to the MFL in the faculty of

Agriculture Saba Basha and acclimated in salinity the same as that from which the fish were transferred (10 ppt), the fish acclimatization take place in glass aquaria for (15) days on the experimental diet and environmental conditions before the start of experiment. Aquaria of dimensions (100 x 30 x 40 cm) were supplemented with continuous aeration and water changed daily by stocked tap water to flush out wastes. In this experiment, water temperature was maintained constant at (20^0C ± 0.2) by thermostatically heaters, one in each glass aquarium. Before the experiment, aquaria were rinsed with chlorinated water for 24h and then diluted sea water (10ppt) was applied to each aquarium.

Aquaria were cleaned before each feeding. All fish in each aquarium were weighed at the beginning of the experiment and on weekly basis. Thirty fish of striped mullet were killed at the beginning of the experiment and kept frozen for further chemical analysis. At the end of the experiment, (15) fish were taken randomly from each aquarium, killed and dried at 70^0C for about 48 hours for final chemical analysis.

Diets formulation and preparation

Diets were formulated from commercial ingredients of fish meal (FM), wheat flour, fish oil, milk, eggs, (sea weeds and Algae), Ascorbic acid, vit and mineral mixture and carboxy methyl cellulose (CMC) in the experiments. Diets composition and its chemical analysis are shown in Table (1).

Dry ingredients were passed through a sieve (0.6 mm diameter hole) before mixing into the diets. Oil was emulsified with equal amount of water using 0.7 % phosphatedyl choline (lecithin) according to El-Dahhar and El-Shazly (1993). Mixtures were homogenized in a food mixer model SNFGA (Kitchen aid St. Joseph, M 149085 USA). Boiling water then added to the mixtures at the rate of 50 % for pelleting. An autoclave was used to heat the diets for 20 min after adding water at a maximum pressure of 1.2 kg / cm^2 G.Vitamins, minerals mixture, Ascorbic acid and exogenous zymogen were added to diets after the heat treatment.

Aquaria management, heat treating of the diet and exogenous zymogen addition were made according to El-Dahhar (1999). The diets were pelleted using meat grinder of kitchen aid with a 1.5 mm diameter and kept frozen in a deep freezer until they were used.

The Experimental Design

The effect of using an equal mixture of seaweeds and marine algae (MX) additions at the levels of (0,21,28,35 and 42% of the diets) on growth performance , feed utilization and survival rate of striped mullet (*Mugil cephalus*) fry was investigated in glass aquaria using brackish water (10ppt) for 10 weeks. The five treatments were evaluated in a block design with three replicates for each treatment.

Striped mullet fry of initial body weight (IBW) ± SE (0.157 ± 0.0) were stocked in each glass aquarium at the rate of 40 fish per aquarium. Fish were fed twice daily at 9.00 a.m and 15.00 p.m using the rate of 15% of body weight which was adjusted weekly in response to weight gain. Water temperature was maintained constant at (20 ^{0}C ± 0.2) by thermostatically heaters.

Table (1): Composition and chemical analysis of the five feeding mixtures used in the experiment.

Ingredients / (MX) level	Control (0%)	(21%)	(28%)	(35%)	(42%)
Wheat flour	50.7	27	19.1	11.2	3.3
Fish meal	15.0	15.0	15.0	15.0	15.0
Fish oil	1.0	3.7	4.6	5.5	6.4
Milk	12.0	12.0	12.0	12.0	12.0
Egg	17.0	17.0	17.0	17.0	17.0
MX[1]	0.0	21.0	28.0	35.0	42.0
CMC[2]	3.0	3.0	3.0	3.0	3.0
Vit.&Min.Mix[3]	0.9	0.9	0.9	0.9	0.9
Ascorbic acid	0.4	0.4	0.4	0.4	0.4
Proximate analysis (%)					
Moisture	12	13.02	12.56	12.16	12.73
Crude protein	27.6	27.4	27.4	27.3	27.3
Crude lipid	8.76	8.34	8.45	8.51	8.62
Crude fiber	0.0	0.0	0.0	0.0	0.0
Carbohydrate (NFE)[4]	44.94	34.5	31.46	27.07	23.16
Ash	6.7	16.74	20.13	24.96	28.19
Gross Energy (Kcal/g)	4.26	3.79	3.67	3.49	3.34

1- (MX) is equal mixture of seaweeds and marine algae.
2- (CMC) is carboxy methyl cellulose.
3- Vitamin and mineral/ Kg premix: vitamin A, 4.8 million IU, D3, 0.8 million IU; E, 4g; K, 0.8g, B1 0.4g riboflavin, 1.6g; B6, 0.6g, B12, 4mg; Pantothenic acid, 4g, Nicotinic acid, 8g, Folic acid, 0.4g; Biotin, 20mg; choline chloride, 200g; CU, 4g; 1, 0.4g; Iron, 12g; Mn, 22g; Zn 22g, Selenium, 0.4g.
4- (NFE) is nitrogen free extract.

RESULTS

This experiment was carried out to evaluate the effect of dietary equal mixture of seaweeds and marine algae (MX) inclusion levels (0, 21, 28, 35 and 42% in the diet) on survival, growth and feed utilization of striped mullet (*Mugil cephalus*) fry with initial BW= (0.157g) for ten weeks

Survival and growth

Survival, final body weight (FBW), average daily gain (ADG) and specific growth rate (SGR) of striped mullet fry was shown in Table (2). Result indicated that the highest final body weight (FBW) was noticed with the fry fed 21% MX diet (T2) having the value of 0.498± 0.024g followed by that fed 35% MX diet (T4) 0.419±0.0197g, 28% MX diet (T3) 0.418±0.018g, diet free of MX 0.416±0.012g and 42% MX diet (T5) 0.399±0.0099g respectively. A significant difference ($P < 0.05$) was observed between FBW of striped mullet fed (T2) and all treatments. The FBW in (T2) was higher significantly that those of the other treatments.

Likewise, the highest ADG was recorded at the fry fed 21% MX diet (T2) having the value of (0.0049± 0.0004g/day) followed by that of fry fed 35% MX diet (0.0037±0.0003g/day), 28% MX diet (0.0037±0.0003g/day), the control diet (0.0037±0.0002g/day) and 42% MX diet (0.0035±0.0001g/day) respectively. A significant difference ($P < 0.05$) in ADG of striped mullet was recorded between (T2) and all treatments. The ADG in (T2) was higher significantly than those in the other treatments.

Table (2). ***Means ± SE of final body weight (g/fish), average daily gai (ADG, g/fish/day), specific growth rate (SGR%/day) and survival rate (%) of striped mullet fry (0.157g Initial BW) fed the five dietary equal mixture of seaweeds and marine algae (MX) inclusion levels (0, 21, 28, 35 and 42%) of the diet in the experiment.***

Treatments MX levels	Final BW	ADG	SGR	Survival %
T1 (0%) Control	0.416 ± 0.012[b]	0.0037 ± 0.0002 [b]	1.393 ± 0.043 [b]	74.17 ± 21.25
T2 (21%)	0.498 ± 0.024[a]	0.0049 ± 0.0004[a]	1.648 ± 0.070 [a]	66.67 ± 2.36
T3 (28%)	0.418 ± 0.018 [b]	0.0037 ± 0.0003 [b]	1.397 ± 0.061 [b]	65 ± 3.54
T4 (35%)	0.419 ± 0.0197 [b]	0.0037 ± 0.0003 [b]	1.399 ± 0.068 [b]	58.33 ± 7.17
T5 (42%)	0.399 ± 0.0099 [b]	0.0035 ± 0.0001[b]	1.331 ± 0.035 [b]	61.667 ± 4.25

Means within column followed by different letter are significantly different (P < 0.05)

With respect to SGR, the highest value was recorded with the larvae fed (T2) with the value of 1.648± 0.070 followed by (T4) 1.399±0.068, (T3) 1.397±0.061, (T1) 1.393±0.043 and (T5) 1.331±0.035 respectively. Significant difference (P < 0.05) was observed between SGR of striped mullet fed (T2) and all treatments.

The survival rate coincides with equal mixture of seaweeds and marine algae (MX) inclusion level in the diet up till diet free of MX (T1) 74.17± 21.25% followed by (T2) 66.67±2.36%, (T3) 65±3.54%, (T5) 61.67±4.25% and (T4) 58.33±7.17%, respectively without any significant difference (P > 0.05) between them.

Weight gain (g/fish), offered feed (g/fish) and feed conversion ratio (FCR) of striped mullet in this expermient are shown in Table (3). The highest weight gain of striped mullet larvae was recorded with the larvae fed (T2) 0.341± 0.024g/fish followed by (T4) 0.262±0.0197g/fish, (T3) 0.261±0.018g/fish, (T1) 0.259±0.012g/fish and (T5) 0.242±0.0099g/fish respectively. A significant difference (P < 0.05) was observed between weight gain of striped mullet fed (T2) and all treatments.

The results concerning offered feed indicated that the highest offered feed was recorded with the larvae fed (T1) with a value of 0.900± 0.1967 g/fish followed by (T2) 0.851±0.0129g/fish, (T3) 0.766±0.0372g/fish, (T4) 0.739±0.0635g/fish and (T5) 0.735±0.0451g/fish, without any significant difference (P > 0.05) between them.

Table (3). Means ± SE of weight gain (g/fish), offered feed (g/fish) and feed conversion ratio (FCR) of striped mullet fry fed the five dietary equal mixture of seaweeds and marine algae (MX) inclusion levels (0,21,28,35 and 42%) of the diet in the experiment.

Treatments / MX levels	Weight gain	Offered feed	CR
T1 (0%) Control	0.259±0.012 [b]	0.900 ± 0.197	3.461±0.684
T2 (21%)	0.341±0.024 [a]	0.851±0.0129	2.504±0.144
T3 (28%)	0.261±0.0177 [b]	0.766±0.0372	2.946±0.178
T4 (35%)	0.262±0.0197 [b]	0.739±0.0635	2.839±0.309
T5 (42%)	0.242±0.0099 [b]	0.735±0.451	3.040±0.0686

Means within column followed by different letter are significantly different (P < 0.05)

Results indicate that the highest feed conversion ratio (FCR) was recorded with the fry fed 21% MX diet (T2) having the value of 2.504±0.144 followed by that fed 35% MX diet (T4) 2.839±0.309, 28% MX diet (T3) 2.946±0.178, 42% MX diet (T5) 3.040±0.0686 and diet free of MX (T1) 3.461± 0.684 respectively. FCR showed the lowest value in (T1), while the highest value was in (T2), without any significant difference (P > 0.05) between the other treatments.

Body composition

Moisture %, protein % and lipid content % of striped mullet larval body after ten weeks feeding on the five diets in the Third experiment are shown in Table (4). From the data of moisture %, showed the highest fish body moisture % was recorded with the fish fed 42% MX (T5) having the value of 74.41± 0.580% followed by (T4) 73.71±1.758%, (T3) 73.183±0.723%, (T1) 71.69±1.062% and (T2) 70.76±1.189%, respectively without any significant difference (P > 0.05) between them.

The results concerning the fish body protein % indicated that the highest protein % was recorded with the fish fed 21% MX diet (T2) having the value of 15.765± 0.737% followed by that fed diet free of MX 12.899±0.618%, 28% MX diet (T3) 10.858±0.760%, 35% MX diet (T4) 10.771±0.998% and 42% MX diet (T5) 9.808±0.459% respectively. A significant difference (P < 0.05) was observed between protein % of striped mullet fed 21% MX diet (T2) and that fed (T3), (T4) and (T5) respectively.

The highest fish body lipid % was noticed at the highest inclusion level of MX 0% (T1) having the value of 9.843± 1.722% followed by (T2) 9.477±0.199%, (T3) 8.815±0.648%, (T5) 7.844±0.137% and (T4) 6.911±0.808%, respectively without any significant difference (P > 0.05) was observed between other treatments.

Protein and energy utilization

Protein efficiency ratio (PER), energy retention (ER %) and protein productive value (PPV %) of striped mullet larvae fed the five diets in the Third experiment are shown in Table (5). The highest (PER) was recorded with the fish fed 21% MX diet (T2) having the value of 1.732± 0.098 followed by that fed 35% MX diet (T4) 1.538±0.178, 42% MX diet (T5) 1.515±0.034, 28% MX diet (T3) 1.503±0.090 and diet free of MX (T1) 1.195±0.269, respectively without any significant difference (P > 0.05).

Table (4). ***Means ± SE of moisture (%), protein (%) and lipid content (%) in the carcass of striped mullet fry fed the five dietary equal mixture of seaweeds and marine algae (MX) inclusion levels (0,21,28,35 and 42%) of the diet in the experiment (fresh weight basics).***

Treatments mixture levels	Moisture %	Protein %	Lipid %
T1 (0%) Control	**71.69±1.062**	**12.899±0.618^{ab}**	**9.843±1.722**
T2 (21%)	**70.76±1.189**	**15.765±0.737^{a}**	**9.477±0.199**
T3 (28%)	**73.18±0.723**	**10.858±0.760^{b}**	**8.815±0.648**
T4 (35%)	**73.71±1.758**	**10.771±0.998^{b}**	**6.911±0.808**
T5 (42%)	**74.41±0.580**	**9.808±0.459^{b}**	**7.844±0.137**

Means within column followed by different letter are significantly different (P < 0.05)

Table (5). ***Means ± SE of protein efficiency ratio (PER), energy retention (ER%) and protein productive value (PPV%) of striped mullet fry fed the five dietary equal mixture of seaweeds and marine algae (MX) inclusion levels (0,21,28,35 and 42%) of the diet in the experiment.***

Treatments mixture levels	PER	PPV %	ER %
T1 (0%) Control	1.195 ±0.269	21.288±6.084 ^{b}	17.073 ±5.234
T2 (21%)	1.732 ±0.098	35.839±3.119 ^{a}	25.846 ±1.892
T3 (28%)	1.503 ±0.090	21.582±2.861 ^{b}	19.417 ±2.550
T4 (35%)	1.538 ±0.178	21.526±0.927 ^{b}	17.483 ±1.156
T5 (42%)	1.515 ±0.034	19.479±1.505 ^{b}	18.352 ±0.893

Means within column followed by different letter are significantly different (P < 0.05)

The highest (ER %) was recorded with the fish fed 21% MX diet (T2) 25.846± 1.892% followed by that fed 28% MX diet (T3) 19.417±2.550%, 42% MX diet (T5) 18.352±0.893%, 35% MX diet (T4) 17.483±1.156% and diet free of MX (T1) 17.073±5.234%, respectively without any significant difference (P > 0.05) between them.

The results concerning (PPV %) indicate that the highest (PPV %) was recorded with the fish fed 21% MX diet (T2) having the value of 35.839± 3.119% followed by T3 (28% MX) 21.582±2.861%, T4 (35% MX) 21.526±0.927%, T1 (0% MX) 21.288±6.084% and T5 (42% MX) 19.479±1.505%. Significant difference (P < 0.05) was observed between protein productive value (PPV %) of striped mullet fed (T2) and all Treatments.

DISCUSSION

This study was carried out to investigate the effect of dietary levels of mixture at a ratio of (1:1) on weight gain, feed utilization and body composition of striped mullet (*Mugil cephalus*).

Ulva sp. known by the common name sea lettuce can be eaten in salads or used in soups. *Ulva* is a particularly popular food in Scotland. Nutritionally, it is very healthy.*U. lactuca* composed of 20% protein, 50% sugar and starch, less than 1% fat. It is useful as roughage in the human digestive system. *Ulva* are very high in iron, as well as in protein, iodine, aluminum, manganese and nickel. They also contain vitamin A, vitamin B12, vitamin C, sodium, potassium, magnesium, calcium, soluble nitrogen, phosphorous, chloride, silicon, rubidium, strontium, barium, radium, cobalt, boron and trace elements (Kirby Anna, 2001).

Phytoplankton (*Nannochloropsis oculata*) forms the basis of the food chain (predominantly by photosynthesis) on earth. Like their land-based relatives, phytoplankton requires sunlight, water and nutrients for growth. It is use sunlight as an energy source to fuse water molecules and carbon dioxide into carbohydrates-plant food. Marine phytoplankton is not a seaweed or marine plant; it is a single celled organism. The phytoplankton enrich with highly unsaturated fatty acids (HUFAs) such as {eicosapentaenoic acid (EPA), docosahexaenoic acid (DHA), palmitoleic acid, oleic acid, linoleic acid, linolenic acid and arachidonic acid}(Lavens and Sorgeloos, 1996).

Valente *et al*., (2006) fed sea bass (*Dicentrarchus labrax*) juveniles (IBW = 4.79 g) on diets contain *G. bursa-pastoris* (GB) and *U. rigida* (UR) for 10 weeks. The maximum fish growth was achieved at 10% seaweed incorporation in the diet. Beyond that level the growth declined. This difference was due to the difference in feeding habits of the examined fish; sea bass in this work and mullet in the present work. The Asian sea bass is a carnivorous, euryhaline species originating in seawater (Harpaz *et al*., 2005), while mullet is herbivorous. This indicated by the study of Fish species other than mullet, they are either carnivorous or omnivorous while mullet could be vegetarian, planktophagous, detritivorous, omnivorous and even carnivorous (Brusle, 1981 and Benetti and Fagundes Netto, $1991_{a,b}$). Albertini-Berthaut, (1974) reported that mullet change their food performances from carnivorous to herbivorous as they grow up. Also we can refer this difference to the less ability of sea bass to digest cellulose, but grey mullet (*Liza ramada*) can digest it easily owing to the tallest intestine, pyloric thieca and gizzard in its digestive system which help in seaweeds digestion (El-Dahhar, 1999).

The another study showed that WG, FBW, SGR and survival% of grey mullet were increased significantly with increasing seaweeds levels up to 28% in the first experiment (El-Dahhar *et al*., 2010). and 21% of SW and AL mixture in the third experiment (El-Dahhar *et al*., 2010). Some studies have demonstrated that using of algae meal, *Ulva rigida*, as an inexpensive and locally available feed ingredient in the diet of common carp, *Cyprinus carpio* a 0, 5, 10, 15 and 20% may improve the growth performance, final mean weight, percent weight gain, specific growth rate, feed conversion ratio, protein efficiency ratio, body composition and survival with increasing the inclusion rate up to 15% (Diler *et al*., 2007). They also stated that fish group fed the diet with 5% *Ulva* meal (U5) achieved the best growth performance (P > 0.05). The poorest growth performance was recorded with fish fed the diet with 20% *Ulva* meal supplementation (U20), suggesting that the dietary *Ulva* meal inclusion of 5 to 15% replacing wheat meal in carp diets could be acceptable for common carp. But it was different for Nile tilapia.

Guroy *et al*., (2007) fed the juvenile Nile tilapia with diets supplemented with various level of *Ulva* meal (5%, 10%, or 15%) or *Cystoseira* meal (5%, 10%, or 15%). The highest values for weight gain were for fish fed the 5% *Cystoseira* diet, control diet, and 5% *Ulva* diet, but the values were not significantly different (P > 0.05) compared to the other treatments, except for the fish fed on the 15% *Ulva* diet (P < 0.05), which exhibited the lowest weight gain. Fish fed the diet containing 15% *Ulva* meal showed the poorest feed conversion ratio (FCR). Protein and energy utilization tended to decrease in the groups fed the algae meals at the highest supplementation level of 15%. The results suggested that *Ulva rigida* or *Cystoseira barbata* meals could be used in small percentages in tilapia diets. Ergun *et al*., (2008) fed Nile tilapia on diets containing *Ulva* up to 5% which was the best level. The differences between these results and the present results may be due to cocking the diets in an autoclave for 20 min after adding water at a maximum pressure of 1.2 kg / cm^2 which break the seaweeds cell walls. Also the differences in species, season and the places of collection of seaweeds, could make changes in temperature, light intensity and salinity, which affect seaweeds characteristics

(Floreto *et al*., 1993). Mensi *et al*., (2001) studied five seaweeds species, (*Ruppia maritima*, *Posidonia oceanica*, *Cymodocea nodosa*, *Ulva rigida* and *Chaetomorpha linum*). The chemical analysis showed that dry matter (DM), ash, crude protein (CP) and crude fiber (CF) contents vary in the five seaweeds according to the species, season and the places of collection. When considering the nutritional needs of Nile tilapia, *Ulva rigida* seems to be the best option to be included in diets for this fish. So it uses four diets containing different levels of *Ulva rigida*: 0%, 9%, 18% and 27% and found that the best level of *Ulva* up to 27% which is in consistent with our findings.

Penaflorida and Golez, (2000) used two seaweed meals as binders in shrimp diets. In the first study, *Kappaphycus alvarezii* or *Gracilaria heteroclada* in dry ground form were added at 3, 5, 7 or 10%. A second study used the seaweed meals at 5, 10 or 15%. In study 1, shrimp fed diets with 3% K. *alvarezii* and 10% *G. heteroclada* had the highest total biomass and those fed the diet containing 5% *K. alvarezii* the highest specific growth rate (SGR), total biomass and FCR. Shrimp survival was highest with those fed 3% *K. alvarezii* and decreased as *K. alvarezii* was increased. Survival was not affected by the level of *G. heteroclada* in the diet. In study 2, total biomass and SGR of shrimp fed 10% *G. heteroclada* did not significantly differ from the control, or from 10% *K. alvarezii* and 5% *G. heteroclada*. Diets with 5% and 10% *K. alvarezii* or *G. heteroclada* had the best FCR. Survival was highest among shrimp fed 5% *G. heteroclada* but was not significantly different from those of the control, 10% *G. heteroclada* and 10% *K. alvarezii* groups. The reason for different results obtained from these studies, may be due to differences in seaweeds species and due to feeding habits shrimp carnivorous, the sand shrimp *Crangon septemspinosa* is a common estuarine decapods distributed along the northwestern Atlantic from Newfoundland to eastern Florida. Although *Crangon septemspinosa* is carnivorous, it also may ingest organic matter in various forms (Wilcox and Jeffries, 1974).

In the another study, the second experiment (El-Dahhar *et al*., 2010) showed that the FBW, WG, SGR, FCR and survival% increased with increasing algae level up to 21%. Studies of Sheeno and Sahu, (2006) indicated that the use of mixed diet (azolla protein concentrate (APC) mixed with dry Spirogyra powder (SP) at 4:1 ratio) to fed *Labeo rohita* fry as a substitute of fish meal at T1 (0%), T2 (25%), T3 (50%), T4 (75%) and T5 (100%) affected each of growth, WG, SGR, FCR. With increasing APC- SP inclousion rate in the diet from 0 to 50%, WG, SGR, and FCR did not affected significantly (P < 0.05) but they decreased significantly (P < 0.05) as the APC-SP content increased in the diet beyond 50%. This finding was in agrement with the results of the present work in the 3rd experiment with increasing SW and AL mixture beyond 21%.

Ekpo and Bender, (1989) reported that Nile tilapia (*Tilapia nilotica*) and common carp (*Hypophthalmichthys molitrix*) can digest the microbial mat at the percent of 75% and 81%, respectively. The dried form was significantly less digestible by both species. Fresh microbial mat compared favorably with commercial catfish feed in digestibility by Nile tilapia. These studies illustrate that Nile tilapia, Silver carp and cat fish differ in their digestibility from mullet. In which they digest fresh diet better than dried one, and that may be due to differences in feeding habits.

Different results were obtained when different species of microalgae were incorporable in fish diet. Stanley and Jones, (2003) recorded poor growth and FCR for grass carp when fed on spirogyra sp. Tilapia aurea and big mouth buffalo fed on Spirulina and spirogyra and showed high growth rate of 29g dry weight/ kg for 28 days, 14g/ kg body weight respectively; FCR was 2.0, 10, respectively.

The incorporation of microalgal powder in diets for marine fishes appears more effective, since lower percentages are needed to cover the mineral requirements. Most mineral needs of turbot can be covered with low percentages of marine microalgal powder in the diet: 3.8% of *Tetraselmis suecica*, 5.7% of *Isochrysis galbana*, 3.57% of *Dunaliella tertiolecta* and 3.9% of *Chlorella stigmatophora*. Mn and Co must, however, be added. Thus, incorporation of small amounts of marine microalgae in diets can replace a mineral mixture (Fabregas and Herrero, 1986). This study investigated the importance of algae addition to marine fishes diet compensate minerals.

The study of Badwy *et al*., (2005) was designed to investigate the effect of partial replacement of fish meal with dried microalgae (*Chlorella spp* and *Scenedesmus spp*) in Nile tilapia (*Oreochromis niloticus*) diets on fish growth performance, feed efficiency and body composition. Nine isonitrogenous (32% cp), isocaloric (440 kcal/100 g) diets were formulated to contain *Chlorella* and *Scenedesmus* as fish meal replacers at zero (control), 10, 25, 50 and 75% substitution, (*Chlorella spp* 0, 3.43, 8.56, 17.11, 25.66% and *Scenedesmus spp* 0, 3.13, 7.82, 15,64, 23.46% of the total diet). Results indicated that, growth performance, feed conversion ratio and protein productive value were significantly ($P<0.05$) higher in fish feed diets containing 50% of both *Chlorella spp* and *Scenedesmus spp*, whereas fish feed diets containing 75% algae had significance lower performance ($P < 0.05$). This finding was in agrement with the results of the present work.

Mustafa *et al*., (1994) indicated that feeding of red sea bream, *Pagrus major* on both *Ascophyllum* and *Spirulina* elevated growth rates and improved feed conversion efficiency, protein efficiency ratio, and muscle protein deposition without negative effects. In our study there is negative effects after 21% the differences in both studies is may be due to differ in species of algae.

CONCLUSION

The conclusion from these results indicated that the best (seaweeds & Algae mixture) levels for striped mullet (*Mugil cephalus*) 0.157 g IBW is 21% in term of total weight gain and FCR.

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تأثير استخدام خليط متساوى من الطحالب والأعشاب البحرية فى اعلاف يرقات البورى على اداء النمو والأستفادة من الغذاء

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أجريت هذه الدراسة في كلية الزراعة (سابا باشا) جامعة الإسكندرية ، حيث أجريت التجربة بهدف دراسة تأثير مستويات خليط متساوى من الطحالب و الاعشاب البحرية علي كفاءة النمو والاستفادة من الغذاء ليرقات أسماك العائلة البورية في مراحل النمو الأولي. تم الحصول علي زريعة البورى من بوغاز المعدية وقد استخدم تصميم القطاعات العشوائية الكاملة في ثلاث مكررات عشوائية.

تم تجميع الأعشاب البحرية من البلوكات الأسمنتية من شاطيء الإسكندرية بمنطقة سيدي جابر ثم وضعت في ماء عذب وذلك لغسلها وازالة الاملاح والشوائب الموجودة بها وجففت في فرن التجفيف علي درجة حرارة من ٦٠ الي ٧٠ درجة مئوية حتي لا تفقد ما بها من عناصر غذائية هامة تحتاجها يرقات الأسماك في مراحل النمو الأولي، ثم تم طحنها وتعبئتها في أكياس مغلقة لتكون جاهزة لاستخدامها في علائق يرقات الأسماك. كما تم إنتاج الطحالب البحرية في معمل الأسماك البحرية بكلية الزراعة سابا باشا وتم تجفيفها بطريقتين :

أولا: بفصل التهوية عن الطحالب البحرية فتترسب فيؤخذ الراسب في أقل كمية من الماء في طبق بتري، ويتم غسلها بالماء العذب لإزالة ما بها من أملاح وتجفيفها وطحنها وتعبئتها في أكياس لحين الاستخدام.

ثانيا: بعملية الطرد المركزي حيث استخدم جهاز الطرد المركزي علي عشرة الاف لفة لكل دقيقة، فتم فصل السائل عن الطحالب وإزالته وتم غسلها بالماء العذب لازالة ما بها من أملاح، وتجفيفها وطحنها وتعبئتها في أكياس لحين الاستخدام.

الهدف من إجراء هذه التجربة :

الهدف من إجراء هذه التجربة هو دراسة تأثير مستويات مختلفة من خليط من الاعشاب و الطحالب البحرية علي كفاءة النمو والاستفادة من الغذاء لاسماك البوري في مراحل النمو

الأولي في تجربة مكونة من خمس معاملات (٠ ، ٢١، ٢٨، ٣٥، ٤٢%). كررت كل معاملة ثلاث مرات بعد فترة أقلمة استمرت ١٠ أيام ، حيث استخدم ١٥ حوض زجاجي بمقاس (١٠٠X ٣٠ X ٤٠ سم) مزودة بمصدر تهوية ، بمعدل تخزين للأسماك بكل حوض ٤٠ سمكة. وقد استمرت التجربة ١٠ أسابيع بوزن ابتدائي (٠.١٥٧ جم) ، ومعدل التغذية ١٥% من وزن الأسماك طوال أيام الأسبوع وتقدم العلائق مرتين يوميا.

وقد أظهرت النتائج ما يلي :

١- أفضل معدلات نمو تم الحصول عليها عند مستوي (خليط من الاعشاب والطحالب البحرية ٢١%) .

٢- وقد وجد أن الأسماك التي تم تغذيتها علي ٢١% من الخليط المكون من الطحالب والاعشاب البحرية بنسبة ١:١ كانت أفضل في معدلات نموها عن الأسماك التي تم تغذيتها علي باقي المستويات من الخليط (٢٨، ٣٥، ٤٢%) وان نسبة ٢١% من الخليط تؤدي الي زيادة معنوية في معدلات نمو الأسماك.

٣- وجد أن أفضل معدل استفادة من الغذاء تم الوصول اليه بتغذية الأسماك علي مستوي ٢١% من الخليط المكون من الاعشاب والطحالب البحرية .

٤- وقد وجد أنه لم يكن لمستويات الخليط تأثير معنوي علي محتوي أسماك البوري من الرطوبة.

٥- وقد وجد أيضا أنه لم يكن لمستويات الخليط تأثير معنوي علي محتوي أسماك البوري من الدهون .

٦- وقد وجد انه يوجد لمستويات الخليط تأثير معنوي علي محتوي أسماك البوري من البروتين عند مستوي ٢١% من الخليط عند أحتمال ٠.٠٥ ولكن بزيادته الي ٤٢% لا تؤدي الي زيادة معنوية.

ومما سبق نستنتج :

١- زيادة مستوي الخليط المكون من الطحالب والاعشاب البحرية حتي ٢١% أدي الي زيادة معنوية في الوزن وتحسنت معها الكفاءة التحويلية للغذاء عند أحتمال (٠.٠٥) .

٢- زيادة مستوي الخليط حتي٢١% زادت معها معدلات النمو والاستفادة من الغذاء وكان لها تأثير معنوي . ومن هذه البيانات اتضح ان أفضل مستوي من الخليط المكون من الطحالب والاعشاب البحرية هو ٢١% وهو المستوي الأمثل الذي حقق أعلي معدل نمو لأسماك البوري عند وزن (٠.١٥٧ جم) .