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Effect of Using Sea Weeds in Grey Mullet (*Liza Ramada*) 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 five dietary seaweeds levels (0, 7, 14, 21, and 28%) on growth performance and feed utilization for grey mullet (*Liza ramada* Risso 1829) with initial body weight of 0.094 g. Each treatment was replicated in three aquaria and lasted for nine weeks. Fish were given feed twice daily at a feeding rate of 12% of fish biomass seven days / week. The results showed that weight gain, final body weight (FBW), specific growth rate (SGR), protein% and PPV% of grey mullet increased significantly with increasing dietary seaweeds levels up to 28%. Feed conversion ratio (FCR) and (PER) improved with increasing dietary seaweeds level up to 14% and it did not show clear trend. No significant differences were observed in lipid content of the grey mullet body with increasing dietary seaweeds levels. A negative trend showed in T2 and T5. ER% improved with increasing dietary seaweeds level up to 28% and no significant differences were recorded. The conclusion from this study indicate that the best seaweeds levels for grey mullet 0.094 g IBW is 28% in term of total weight gain and 14% feed conversion ratio.

Keywords: Sea Weeds; Grey Mullet (*Liza Ramada*); Larval Diets.

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 a 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 investigation 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 . The authors attributed that to the existence of the natural food in the brackish water. 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 seaweed *Ulva*.sp., collected from Alexandria beach on growth performance, feed utilization and survival rate of *Liza ramada*, 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 seaweeds inclusion rate at (0, 7, 14, 21and 28%) in grey mullet (*Liza ramada*) 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 – 70^0C) 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.

Experimental procedure

Grey mullet (*Liza ramada*) 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 tranfered (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 grey 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), 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

This experiment was conducted to evaluate the effect of seaweeds (SW) additions at the levels of (0,7,14,21 and 28% of the control diet) on Growth Performance , feed utilization and survival rate of grey mullet larvae in glass aquaria using brackish water (10ppt) for 9 weeks . The five treatments were evaluated in a complete randomized block design with three replicates for each treatment.

Grey mullet larvae of initial body weight (IBW) ± SE (0.094 ± 0.0) were stocked in each glass aquarium at the rate of 35 fish per aquarium. Fish were fed twice daily at 9.00 a.m and 15.00 p.m using the rate of 12% of body weight which was adjusted weekly in response to weight gain. Water temperature was maintained constant at 20 ^{0}C ± 0.2 by means of electric aquarium heaters.

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

(SW) level	Control (0%)	(7%)	(14%)	(21%)	(28%)
Ingredients					
Wheat flour	50.7	47.1	43.6	40.0	36.5
Fish meal	15.0	14.0	12.9	11.9	10.8
Fish oil	1.0	0.9	0.9	0.8	0.7
Milk	12.0	11.2	10.3	9.5	8.6
Egg	17.0	15.8	14.6	13.4	12.2
SW[1]	0.0	7.0	14.0	21.0	28.0
CMC[2]	3.0	2.8	2.6	2.4	2.2
Vit.&Min.Mix[3]	0.9	0.8	0.8	0.7	0.7
Ascorbic acid	0.4	0.4	0.3	0.3	0.3
Proximate analysis (%)					
Moisture	12	11.87	12.54	11.58	11.91
Crude protein	27.6	27.2	26.7	26.3	25.9
Crude lipid	8.76	8.22	8.59	8.11	8.71
Crude fiber	0.0	0.0	0.0	0.0	0.0
Carbohydrate (NFE)[4]	44.94	44.59	42.77	43.33	42.23
Ash	6.7	8.12	9.4	10.68	11.25
Gross Energy (Kcal/g)	4.27	4.18	4.11	4.06	4.05

1- (SW) is seaweeds.
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 conducted to evaluate the effect of dietary seaweeds (SW) inclusion levels (0, 7, 14, 21 and 28% in the control diet) on survival, growth and feed utilization of grey mullet (*Liza ramada* Risso) larvae with initial BW = (0.094g) for nine weeks.

Survival and growth

Survival, final body weight (FBW), average daily gain (ADG) and specific growth rate (SGR) of grey mullet is shown in Table (2). Results indicate that the highest FBW was recorded with the larvae fed 28% SW diet (T5) having the value of 0.576± 0.033g followed by that fed 21% SW diet (T4) 0.47±0.032g, 14% SW diet (T3) 0.436±0.044g, 7% SW diet (T2) 0.398±0.086g and diet free of SW (T1) 0.318±0.056g. This implies a positive relationship between FBW and seaweed levels. A significant difference ($P < 0.05$) was observed between FBW of grey mullet fed (T5) and that fed the control diet (T1).

The highest ADG was noticed at the larvae fed 28% SW diet (T5) having the value of (0.0075± 0.0005g/day) followed by that of the larvae fed 21% SW diet (0.0059±0.0005g/day), 14% SW diet (0.0054±0.0007g/day), 7% SW diet (0.0048±0.0014g/day) and the control diet (0.0035±0.0009g/day). Again, a positive trend was clearly found between ADG of grey mullet and seaweed inclusion level in the control diet. A significant difference ($P < 0.05$) in ADG of grey mullet was recorded between (T5) and the control (T1).

Similarly SGR showed a positive correlation with increasing the inclusion of seaweeds in the control diet. SGR of the larvae fed T5 was higher significantly than that of the larvae fed the control diet.

Table(2): ***Means ± SE of final body weight (g/fish), average daily gain (ADG, g/fish/day), specific growth rate (SGR, %/day) and survival rate (%) of grey mullet larvae (0.094g initial BW) fed the five dietary seaweeds (SW) inclusion levels (0, 7, 14, 21 and 28%) of the control diet in the experiment.***

Treatments SW levels	Final BW	ADG	SGR	Survival %
T1 (0%) Control	0.318 ± 0.056^{b}	0.0035 ± 0.0009^{b}	1.877 ± 0.295^{b}	66.67 ± 5.87
T2 (7%)	0.398 ± 0.086^{ab}	0.0048 ± 0.0014^{ab}	2.220 ± 0.335^{ab}	73.33 ± 15.88
T3 (14%)	0.436 ± 0.044^{ab}	0.0054 ± 0.0007^{ab}	2.391 ± 0.163^{ab}	58.09 ± 11.97
T4 (21%)	0.470 ± 0.032^{ab}	0.0059 ± 0.0005^{ab}	2.511 ± 0.109^{ab}	61.91 ± 1.35
T5 (28%)	0.576 ± 0.033^{a}	0.0075 ± 0.0005^{a}	2.832 ± 0.088^{a}	77.14 ± 12.12

Means within column followed by different super script are significantly different (P < 0.05).

The survival rate coincides with seaweed inclusion level in the control diet until 28% (T5) 77.14± 12.12% followed by (T2) 73.33±15.88%, (T1) 66.67±5.87%, (T4) 61.91±1.35% and (T3) 58.09±11.97%. The survival rate showed no particular trend, without any significant difference (P > 0.05) between treatments.

Weight gain (g/fish), offered feed (g/fish) and feed conversion ratio (FCR) of grey mullet in this experiment are shown in Table (3). The highest weight gain of grey mullet larvae was recorded with the larvae fed (T5) 0.483± 0.033g/fish followed by (T4) 0.376±0.032g/fish, (T3) 0.343±0.044g/fish, (T2) 0.304±0.086g/fish and (T1) 0.224±0.056g/fish. Significant difference (P < 0.05) was observed between weight gain of grey mullet fed (T5) and the control diet (T1).

The results concerning offered feed indicate that the highest offered feed was recorded with the larvae fed (T5) with the value of 0.965± 0.275g/fish followed by (T2) 0.671±0.0945g/fish, (T4) 0.665±0.0347g/fish, (T1) 0.594±0.117g/fish and (T3) 0.544±0.0087g/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 grey mullet larvae fed the five dietary seaweeds (SW) inclusion levels (0,7,14,21 and 28%) of the control diet in this experiment.***

Treatments Seaweeds levels	Weight gain	Offered feed	FCR
T1 (0%) Control	**0.224±0.056^{b}**	**0.594 ± 0.117**	**2.652±0.198**
T2 (7%)	**0.304±0.086^{ab}**	**0.671 ± 0.0945**	**2.207±0.615**
T3 (14%)	**0.343±0.044^{ab}**	**0.544 ± 0.0087**	**1.590±0.239**
T4 (21%)	**0.376±0.032^{ab}**	**0.665 ± 0.0347**	**1.768±0.107**
T5 (28%)	**0.483±0.033^{a}**	**0.965 ± 0.275**	**2.002±0.422**

Means within column followed by different super script are significantly different (P < 0.05).

Also FCR showed no clear relation with seaweed inclusion level in the control diet. The best FCR was recorded with the fish fed (T3) having the value of 1.590±0.239 followed by (T4) 1.768±0.107, (T5) 2.002±0.422, (T2) 2.207±0.615 and (T1) 2.652± 0.198. Regardless the control diet and 7% SW a positive relation was noticed between FCR and seaweed inclusion levels in the control diet (14, 21 and 28% SW), (T3, T4 and T5 respectively), without any significant difference (P > 0.05).

Body composition

Moisture %, protein % and lipid % of grey mullet larval body after nine weeks feeding on the five diets in the present study are shown in Table (4). From the data of Moisture %, it is evident that the highest fish body Moisture % was recorded with the fish fed 7% SW (T2) having the value of 71.66± 1.38% followed by (T3) 71.62±0.27%, (T1) 70.26±1.84%, (T4) 70.15±1.54% and (T5) 69.34±0.33%. Apart from the control, a negative trend was noticed between seaweed levels and Moisture %, without any significant difference (P > 0.05) was observed between treatments.

The highest fish body protein % was noticed at the highest inclusion level of SW 28% (T5) with the value of 16.213± 0.296% followed by (T4) 13.548±2.257%, (T1) 10.662±1.455%, (T2) 10.251±0.533% and (T3) 8.687±0.257%. There is a clear inverse relationship between the fish body Protein% from one side and body Moisture% and fat% from the other side. The highest significantly body protein (16.213± 0.296%) was recorded with the fish fed 28% SW level of the control diet (T5) it was higher significantly than the control diet, 7% SW, and 14% SW inclusion level of the control diet T1, T2 and T3, respectively, and higher but not significant (P > 0.05) then T4 (21% SW diet).

The results concerning the fish body lipid % indicate that the highest lipid % was recorded with the fish fed the control diet (T1) 13.253± 1.080% followed by (T3) 12.178±0.933%, (T2) 11.833±1.389%, (T5) 11.764±0.667% and (T4) 11.206±1.258%, without any significant difference (P > 0.05) between them.

Protein and energy utilization

Protein efficiency ratio (PER), energy retention (ER %) and protein productive value (PPV %) of grey mullet larvae fed the five diets in the first experiment are shown in Table (5). There is a positive trend between Protein efficiency ratio (PER) and seaweed inclusion levels in the control diet up to the level of (14%) 2.630± 0.383, then the relation turned into

Table(4). ***Means ± SE of moisture (%), protein (%) and lipid content (%) in the carcass of grey mullet larvae fed the five dietary seaweeds (SW) inclusion levels (0,7,14,21 and 28%) of the control diet in the present experiment (fresh weight basics).***

Treatments Seaweeds levels	Moisture %	Protein %	Lipid %
T1 (0%) Control	70.26 ± 1.84	10.662 ± 1.455 [b]	13.253 ± 1.080
T2 (7%)	71.66 ± 1.38	10.251 ± 0.533 [b]	11.833 ± 1.389
T3 (14%)	71.62 ± 0.27	8.687 ± 0.257[b]	12.178 ± 0.933
T4 (21%)	70.15 ± 1.54	13.548 ± 2.257[ab]	11.206 ± 1.258
T5 (28%)	69.34 ± 0.33	16.213 ± 0.296[a]	11.764 ± 0.667

Means within column followed by different super script are significantly different (P < 0.05).

Table(5). Means ± SE of protein efficiency ratio (PER), energy retention (ER%) and protein productive value (PPV%) of grey mullet larvae fed the five dietary seaweeds (SW) inclusion levels (0,7,14,21 and 28%) of the control diet in the present experiment.

Treatments Seaweeds levels	PER	PPV %	ER %
T1 (0%) Control	1.474 ±0.109	19.027±2.669 [b]	21.051 ±2.104
T2 (7%)	1.999 ±0.636	23.010±5.076 [ab]	22.861 ±6.249
T3 (14%)	2.630 ±0.383	24.995±2.907 [ab]	30.579 ±4.777
T4 (21%)	2.281 ±0.133	35.606±7.562 [ab]	30.491 ±3.729
T5 (28%)	2.143 ±0.403	39.332±8.102 [a]	31.731 ±7.207

Means within column followed by different super script are significantly different (P < 0.05).

a negative trend, with the fish fed (21%) 2.281±0.133, (28%) 2.143±0.403, (7%) 1.999±0.636 and (0%) 1.474±0.109, without any significant difference (P > 0.05) between them.

Increasing the inclusion rate of SW in the control diet, increase ER% from 21.051±2.104% with the control diet to 31.731±7.207% with 28% SW in the control diet (T5), without any significant difference (P > 0.05) between them. Values of the other treatments were (22.861±6.249%, 30.579±4.777% and 30.491±3.729%) for T2, T3 and T4 respectively. The results concerning protein productive value (PPV %) indicate that the highest protein productive value (PPV %) was recorded with the fish fed 28% SW diet (T5) with value of 39.332± 8.102% followed by T4 (21% SW) 35.606±7.562%, (T3) 24.995±2.907%, (T2) 23.010±5.076% and (T1) 19.027±2.669%. This implies a positive relationship between PPV% and seaweed levels. It was found that the highest value 39.332 ± 8.102 % was differ significantly (P < 0.05) only with the lowest one 19.027±2.669% (T1) without any significant difference between the other treatments**.**

DISCUSSION

This study was carried out to investigate the effect of dietary levels of seaweeds on weight gain, feed utilization and body composition of grey mullet (*Liza ramada*).

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 (Anna Kirby, 2001).

In the present study, the maximum growth of grey mullet with an initial BW of 0.094 g was obtained with 28% seaweed levels. FBW and WG increased with increasing dietary seaweed levels up to 28%. There were significant differences (P < 0.05) in FBW and WG with the increase of dietary seaweed levels.

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 present study showed that WG, FBW, SGR and survival% of grey mullet were increased significantly with increasing seaweeds levels up to 28%. 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 coocking 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* 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).

CONCLUSION

The conclusion from these results indicated that the best seaweeds levels for grey mullet (*Liza ramada*) 0.094 g IBW is 28% in term of total weight gain, protein & energy retention while 14% in term feed conversion ratio (FCR).

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تأثير استخدام الأعشاب البحرية في تغذية يرقات أسماك الطوبارة على كفاءة النمو والاستفادة من الغذاء

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أجريت هذه الدراسة في كلية الزراعة (سابا باشا) جامعة الإسكندرية ، بهدف دراسة تأثير مستويات الاعشاب البحرية علي كفاءة النمو والاستفادة من الغذاء ليرقات أسماك العائلة البورية في مراحل النمو الأولي. تم الحصول علي زريعة الطوبارة 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 60 الي 70 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. استخدمت الأعشاب البحرية بخمس مستويات (0 ، 7، 14، 21، 28%). كررت كل معاملة ثلاث مرات بعد فترة أقلمة لليرقات على الظروف المعملية استمرت ثلاثة اسابيع ، وقد استخدم 15 حوضا زجاجيا بمقاس (100× 30 × 40 سم) مزودة بمصدر تهوية ، بمعدل تخزين 35 سمكة بكل حوض زجاجي.

وقد استمرت التجربة 9 أسابيع بوزن ابتدائي (0.094 جم) ، ومعدل التغذية 12% من وزن الأسماك طوال أيام الأسبوع وتقدم العلائق مرتين يوميا.

<u>وقد أظهرت النتائج ما يلي :</u>

1- أفضل معدلات نمو تم الحصول عليها عند مستوي أعشاب بحرية 28% .
2- أن الأسماك التي تم تغذيتها علي 28% اعشاب بحرية كانت أفضل في معدلات نموها معنويا بمستوي معنوية 0.05 عن الأسماك التي تم تغذيتها باستخدام باقي المستويات من الأعشاب البحرية (7، 14، 21%).
3- أفضل كفاءة تحويلية تم الوصول اليها بتغذية الأسماك علي مستوي 14% من الأعشاب البحرية.
4- لم يكن لمستويات الأعشاب البحرية تأثير معنوي علي محتوي أسماك الطوبارة من الرطوبة.
5- لم يكن لمستويات الأعشاب البحرية تأثير معنوي علي محتوي أسماك الطوبارة من الدهون .
6- محتوي جسم الأسماك من البروتين قد تأثر بزيادة مستوي الأعشاب البحرية، ويوجد فرق معنوي بزيادة مستوي الاعشاب البحرية حتي 28% عند مستوي 0.05 .

ومما سبق نستنتج : أن أفضل مستوي من الأعشاب البحرية للتغذية هو 28% وهو المستوي الأمثل الذي حقق أعلي معدل نمو وتحسن في الكفاءة التحويلية للغذاء لأسماك الطوبارة عند وزن (0.094 جم) .