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Effects of Green Seaweeds (*Ulva sp.*) as Feed Supplements in Red Tilapia (*Oreochromis Sp.*) Diet on Growth Performance, Feed Utilization And Body Composition

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ABSTRACT

This experiment was carried out to study the effect of green seaweeds (*Ulva* sp.) as feed supplements in fish diet on growth performance , feed efficiency and body composition of red tilapia (*Oreochromis sp.*) 1.15 g initial body weight. Six isocaloric diets (236 kcal metabolizable energy /100g diet) containing 26% crude protein, with different levels of green seaweed *Ulva* sp.(0, 5, 10, 15, 20 and 25% of fish diet) were used. Each diet was used to feed triplicate groups of fish two times a day to apparent satiation for 9 weeks**.** Results showed that final body weight, weight gain and specific growth rate (SGR) increased significantly (P < 0.05) with increasing *Ulva* level in fish diet up to 15%. Increasing the level of *Ulva* in the diets from 15 to 25% did not exert any additional advantage to growth of fish. Best significant (P < 0.05) values of feed conversion ratio (FCR) were observed in fish fed diet with 20% *Ulva* (1.49) followed by diets with 15 and 10 % *Ulva* (1.52 and 1.53 respectively). Survival rate and fish body moisture content did not differ significantly among treatments. While lipid content in the fish body differ significantly. Fish fed diet containing 10% *Ulva* get the highest significant (P < 0.05) lipid content having the value of (7.57%). With increasing *Ulva* level in the fish diet, carcass protein concentration increased significantly (P < 0.05).The highest value was maintained at fish fed the diet containing 25% *Ulva* while the lowest was maintained at control treatment. Feed utilization parameters were affected significantly by different *Ulva* level in the diet. The highest significant (P < 0.05) values of protein efficiency ratio (PER), protein productive value (PPV %) and energy retention (ER %) were obtained with the fish maintained at 10, 15 and 20% dietary *Ulva***.** Therefore, green seaweeds (*Ulva* sp.) could be supplemented to red tilapia **(***Oreochromis sp***.)** diet at optimum level of 15% to improve growth performance without any adverse effect on feed efficiency or survival rate.

Keywords: Red tilapia, green seaweeds, *Ulva* sp., growth performance, feed utilization.

INTRODUCTION

Various algae are receiving attention as possible alternative protein sources for cultured fish, particularly in tropical countries, because of their relatively high protein content and production rate (Nakagawa and Montgomery, 2007). Seaweeds aquaculture production in 2005 was estimated at 16.09 million tons (wet weight), (FAO, 2009). Seaweeds are considered as rich sources of bioactive compounds as they are able to produce a great variety of secondary metabolites characterized by a broad spectrum of biological activities not only against human pathogens but also against fish pathogens (Mahasneh *et al.,* 1995; De Val *et al.,* 2001 and Liao *et al.,* 2003).

The nutritional value of such supplements is generally evaluated in terms of growth and survival, with little attention paid to other physiological merits. Although dietary algae as feed supplements may be expected to improve growth and digestive efficiency of feed, the addition of small amounts of algae to the fish diet can produce considerable improvement of physiological condition, fish vitality, disease resistance, desired body composition and carcass quality (Nakagawa, 1985). Accordingly, some species of algae are now used as supplements in commercial diets (Nakagawa, 1985 and Mustafa and Nakagawa, 1995).

Many kinds of macro algae or their extracts are or have been used (presently or historically) as a human food in various locations around the world (Abbott, 1996; Wikfors and Ohno, 2001 and Burtin, 2003). Fujiwara-Arasaki *et al.* (1984) reported that the amino acid composition in seaweeds found to be 10–30 % of the dry weight, and the contents of vitamins A, B1, B2, B6, B12, C and niacin are very high. In addition, these seaweeds have higher content of the important minerals such as (calcium and iron) than vegetables and fruits (Mabeau and Fleurence, 1993). Wong and Cheung, (2000) stated that high protein level and balanced amino acid profile of seaweeds appeared to be an interesting potential source of plant food proteins. Moreover, Basemir, *et al*. (2004) and Nakagawa and Montgomery (2007) reported that macro algal lipids contain a wide variety of fatty acids, including long-chain polyunsaturated important to neural function and health.

Fleurence (1999) reported that the crude protein content of *Ulva* sp. ranged between 10 and 26% of dry weight, while it may reach up to 47% of dry weight in red seaweeds which imply the potential for human and animal nutrition (e.g. as functional food and fish feed). This protein is considered high quality protein, since the green algae (e.g. *Ulva lactuca*) and red algae (e.g. *Hypnea japonica* and *Hypnea charoides*) contain all the essential amino acids (EAA) and accounted for 42.1- 48.4% of the total amino acids content (Wong and Cheung, 2000). Similarly, some brown algae from Jeddah coast (KSA) have been reported to have all the (EAA) (Behairy and EL-Sayed, 1983).

The FAO/WHO (1991) requirement pattern showed that all red and green seaweed seemed to be able to contribute adequate levels of total essential amino acids. Some studies reported that subtropical seaweeds contain all the essential amino acids in levels that are comparable to those of the FAO/WHO requirement pattern (Behairy and El-Sayed, 1983 and Qasim, 1991). However, Wong and Cheung (2000) showed that green algae (*Ulva lactuca*) contain all the essential amino acids except tryptophan.

Although algae represent the world's third-largest aquaculture crop behind finfishes and molluscs (FAO, 2002), few of the algae used for human food have been studied for their possible use as feed additives for fish. Others, for examples, sea lettuce *Ulva* are available as fish feed supplements (Nakagawa, 2004). Eur Phycol (2003) stated that algae are difficult organisms to classify and *Ulva* in particular is a difficult genus to classify into species because the morphology of the same species tends to vary widely in nature (varying with age, reproductive state, tidal factors, temperature, salinity and light). Also, Burtin (2003) reviewed that *Ulva* is a genus of algae that includes many species which is probably a considerable underestimate that look like bright green sheets and live primarily in marine environments. They can also be found in brackish water, particularly estuaries.

Hamauzu and Yamanaka (1997) reported that early feeding trials with macro-algal meal predicted improvement of vitality, disease resistance and carcass quality. Moreover, Mustafa *et al*. (1994; 1995a and b) stated that addition of a very small amount of algal meal has produced a significant increase in the growth and feed utilization of red sea bream *Pagrus major*. Yone *et al*. (1986) interpreted the effect on growth as due to an acceleration of nutrient absorption by dietary algae. Nakagawa *et al*. (1993) obtained optimum feed efficiency and protein efficiency were attained in black sea bream *Acanthopagrus schlegeli* when the supplementation level of *Ulva sp*. meal was 2.5 to 5.0 % of the diet.

Many efforts were done in recent years to improve growth performance, body composition, feed utilization and other quantitative traits of red tilapia, *Oreochromis* sp. Hybrid (descended of an original cross of female *O. mossambicus* x male *O. niloticus*) which have become objects of interest for culturist and researchers throughout the world (Watanabe *et al*. 1990; El-Zaeem *et al*. 2009 and El-Tawil and Amer, 2010).

Effect of dietary algae and adequate levels will probably vary with the species of both algae and fish. Therefore, the objective of this work was to study the effect of seaweeds (*Ulva sp.*) supplemented to diet on growth, feed efficiency and body composition and to determined the optimum level in diet for red tilapia (*Oreochromis* sp.) fry.

MATERIALS AND METHODS

This experiment was carried out at the Fish production laboratory, Faculty of Agriculture (Saba Bacha), Alexandria University, Egypt.

The Experimental Fish

Red tilapia, *Oreochromis* sp. fry used in this study were hybrids, descended of an original cross of female *O. mossambicus* x male *O. niloticus* and obtained from the Marine fish hatchery 21 Km, Alexandria. Red tilapia with an initial body weight of 1.15 ± 0.02 g were acclimatized to laboratory conditions for two weeks. They were divided randomly to 6 groups in three replicates of 15 fish for each group per aquarium. Glass aquaria of dimensions 100 x 34 x 50 cm were filled with 100 L of water and supplemented with continuous aeration. Nearly half of the water was exchanged daily by freshly stocked tap water and aquaria were cleaned every day before feeding. Fish were fed twice daily to apparent satiation, six days a week. Fish were weighed at the beginning of the experiment and then biweekly for 9 weeks.

Preparation of seaweeds (Ulva sp.)

Seaweeds (***Ulva sp.***) were collected from nature along the coastal line of Alexandria (attached to rocks), rinsed with fresh water then distributed on plastic sheets and left in sun to dry then put in drying oven at (60 -70°C) to complete dryness, then crushed and grinded through a food mixer and kept dry until used in the diets formulation.

Diets formulation and preparation

Six experimental diets were used in this study containing both animal and plant proteins sources. The composition and chemical analysis of the experimental diets are presented in

Table 1. Diets were formulated from commercial ingredients of fish meal, wheat flour, wheat bran, soybean meal, yellow corn, bone meal, vitamins and minerals mixture to achieve 26 % dietary crude protein level with 236 kcal/100 g diet metabolizable energy level (on dry basis) based on feedstuff values reported by NRC (1993). Six different levels of dietary seaweeds (*Ulva sp.*) were used in this study 0% (as control), 5, 10, 15, 20 and 25% of the formulated diet. Dry ingredients were passed through a sieve (0.6 mm diameter hole) before mixing into the diets. Mixtures were homogenized in a food mixer. Boiling water was then blended into the mixture at the ratio of 50% for pelleting. The diets were pelleted using meat grinder with a 1.5 mm diameter.

Analytical methods

At the end of the experiment, samples of five fish were selected randomly and were frozen for body composition analysis. Frozen samples were dried at 70°C for 72 h and passed through a meat grinder into one composite homogenate per aquarium.

Table 1. ***Composition and proximate analysis of diets containing different levels of seaweeds Ulva sp. used in this experiment.***

	Ulva sp. level in diet					
Ingredients	**0%**	**5%**	**10%**	**15%**	**20%**	**25%**
Wheat flour	**27**	**26**	**25**	**22**	**18**	**14**
Wheat bran	**19.7**	**12.5**	**7**	**10**	**9**	**6**
Soybean meal	**27**	**30**	**28**	**28**	**26**	**26.5**
***Ulva* sp.**	**0**	**5**	**10**	**15**	**20**	**25**
Yellow corn	**12**	**12.2**	**13.2**	**7.2**	**7.2**	**7.7**
Fish meal	**12**	**12**	**14.5**	**15.5**	**17.5**	**18.5**
Bone meal	**2**	**2**	**2**	**2**	**2**	**2**
Vit &Min Mix*	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**
Total	**100**	**100**	**100**	**100**	**100**	**100**
Proximate analyses %						
Moisture	**10.58**	**10.14**	**10.70**	**10.89**	**10.77**	**10.45**
Crude protein	**25.51**	**25.66**	**26.10**	**25.71**	**25.83**	**25.76**
Crude fat	**7.26**	**7.23**	**7.17**	**7.24**	**6.94**	**7.10**
Crude fiber	**3.97**	**5.21**	**6.37**	**7.63**	**8.91**	**10.12**
NFE	**43.57**	**42.31**	**39.80**	**38.21**	**36.89**	**35.85**
Ash	**9.11**	**9.45**	**9.86**	**10.32**	**10.66**	**10.72**

Content/kg of Vitamin & minerals mixture (P- Fizer, Cairo, Egypt). Vitamin A, 4.8 MIU; Vitamin D, 0.8 MIU; Vitamin E, 4.0 g; Vitamin K, 0.8 g; Vitamin B_1, 0.4 g; Vitamin B_2, 1.6 g; Vitamin B_6, 0.6 g; Vitamin B_7, 20.0 mg; Vitamin B_{12}, 4.0 g; Folic acid, 0.4 g; Nicotinic acid, 8.0 g; Pantothenic acid, 4.0 g; Colin chloride, 200 g; Zinc, 22 g; Cooper, 4.0 g; Iodine, 0.4 g; Iron, 12.0 g; Manganese, 22.0 g; Selenium, 0.04 g.

Chemical analysis of homogenized fish and experimental diets were carried out according to the methods of AOAC (1990) for protein (macro-keldahl method), fat (ether extract method) and moisture (oven drying). The analysis of variance (ANOVA) and Duncan's multiple range tests were made according to Snedecor and Cochran (1981).

RESULTS

The results of the present study have shown that final body weight (FBW), weight gain (WG), feed conversion ratio (FCR) and specific growth rate (SGR%/day) of red tilapia (*Oreochromis* sp) were affected significantly (P < 0.05) by different levels of seaweeds (*Ulva sp.*) in the diet (Table 2). The highest significant (P < 0.05) values of FBW, WG and SGR%/day were obtained with the fish maintained at 15% *Ulva* level, they were found to be 10.90g, 9.75g and 3.56%/day, respectively. Followed by fish maintained at 10% *Ulva* level without any significant differences (P <0.05) between both treatments, then the fish maintained at 20 and 5% *Ulva* level and the control diet. However, the least values (P < 0.05) of FBW, WG and SGR%/day were recorded with fish maintained at 25% *Ulva* level with the value of 8.56g, 7.42g and 3.22%/day, respectively.

Feed conversion ratio (FCR) improved with increasing the inclusion rate of *Ulva* in the diet. The significant improvements (P < 0.05) in FCR were achieved when *Ulva* level in the diet increased from 10 to 15 and to 20%. They were found to be 1.53, 1.52 and 1.49 respectively. These values were significantly (P < 0.05) better than those of the gropes maintained at the control, 5 and 25% *Ulva* levels in the diet. Similarly, SGR (100 ln final body weight-ln initial BW/number of days) increased with increasing *Ulva* level in diet (Table 2) up to 15% *Ulva* level. The best SGR (P < 0.05) was observed with the fish maintained at 15% *Ulva* level (3.56). It did not differ significantly from SGR of the fish maintained at 10% *Ulva* level, it was (3.53) which were high significant than 3.42, 3.33 and 3.32 for the fish maintained at 20, 5% *Ulva* level and control diet, respectively. Finally, the worst (P < 0.05) SGR value was observed with fish maintained at 25% *Ulva* level in the diet it was (3.22). Survival rate at the end of the experiment showed that there were insignificant differences (P > 0.05) among treatments. It ranged between 93 and 100 %.

With respect to body composition of red tilapia, results in Table 3 showed that no significant differences were observed in fish

Table (2). Means ± standard error (SE) of initial body weight (IBW), final body weight (FBW), weight gain (WG), feed conversion ratio (FCR), specific growth rate (SGR%/day) of red tilapia (*Oreochromis sp.*) fed at different dietary levels of seaweeds (*Ulva sp.*).

Treatments	*IBW (g)*	*FBW (g)*	*WG (g)*	*FCR*	*SGR % / day*
Control	1.13 ± 0.02	9.10 ± 0.20 b	7.98 ± 0.42 b	1.61 ± 0.04a	3.32 ± 0.10 b
5%	1.14 ± 0.01	9.26 ± 0.17 b	8.12 ± 0.26 b	1.62 ± 0.06 a	3.33 ± 0.05 b
10%	1.16 ± 0.02	10.70 ± 0.15 a	9.54 ± 0.31a	1.53 ± 0.04 b	3.53 ± 0.06 a
15%	1.15 ± 0.01	10.90 ± 0.20 a	9.75 ± 0.41a	1.52 ± 0.05 b	3.56 ± 0.08 a
20%	1.15 ± 0.02	9.72 ± 0.12 b	8.57 ± 0.31b	1.49 ± 0.03 b	3.42 ± 0.07 b
25%	1.14 ± 0.03	8.56 ± 0.15 c	7.42 ± 0.16 c	1.63 ± 0.02 a	3.22 ± 0.04 c

Means in each column followed by different letters are significantly different (P < 0.05).
Initial and final body weight (IBW and FBW) = body weight at start and end of experiment.
Weight gain (WG) = final weight (g) - initial weight (g).
Feed conversion ratio (FCR) = dry feed intake/gain.
Specific growth rate (SGR%/day) = (100 ln final BW - ln initial BW / number of days)

Table (3). ***Means ± standard error (SE) of body composition and feed utilization of red tilapia (Oreochromis sp.) fed at different dietary levels of seaweeds (Ulva sp.).***

Treatments	Moisture%	Lipid %	Protein%	PER	PPV%	ER%
Control	74.05 ± 0.45	6.78 ± 0.05 b	16.21 ± 0.12 c	2.40 ± 0.04 b	40.73±1.1 b	27.06±0.25 b
5%	73.94 ± 0.24	6.39 ± 0.04 b	16.34 ± 0.08 c	2.28± 0.03 c	39.11±0.85 b	25.23±0.12 b
10%	71.96 ± 0.61	7.57± 0.03 a	17.12 ± 0.21 b	2.55 ± 0.02 a	45.59±1.32 a	31.23±0.40 a
15%	72.86± 0.42	6.87 ± 0.02 b	17.09 ± 0.14 b	2.51 ± 0.04 a	44.88±0.96 a	30.76 ±0.17a
20%	72.88± 0.73	6.21 ± 0.04 c	17.39 ± 0.12 a	2.58 ± 0.05 a	47.24±1.12 a	29.44±0.11 a
25%	72.16 ± 0.49	5.93 ± 0.06 c	17.58 ± 0.08 a	2.39 ± 0.04 b	44.48±0.74 a	26.97±0.15 b

Means in each column followed by different letters are significantly different (P < 0.05).
Protein efficiency ratio (PER) = gain/protein intake.
Protein productive value (PPV) = protein increment (100) / protein intake.
Energy retention percent (ER %) = energy increment (100) / energy intake.

moisture contents (P > 0.05) at all treatments. It ranged between 71.96 and 74.05% in fish maintained at 10% *Ulva* level and control diets, respectively. Lipid content in the fish body showed significant differences among treatments (P < 0.05). Fish maintained at 10% *Ulva* level in the diet were significantly the highest (P < 0.05) in body lipid content than other treatments, with the value of 7.57%, followed by fish maintained at 15, control and 5% *Ulva* level in diet which were 6.87,6.78 and 6.39% respectively. While the lowest significantly (P < 0.05) lipid contents were found at the fish maintained at 20 and 25% *Ulva* level in diet with the values of 6.21 and 5.93%, respectively .On the other hand, protein content increased gradually with increasing *Ulva* level in the diet. Generally, the highest protein contents (P < 0.05) were found at fish maintained at both of 20 and 25% *Ulva* level in the diet with the values of 17.39 and 17.58%, respectively, followed by fish maintained at 15 and 10 % *Ulva* level in the diet which were 17.09 and 17.12% respectively. Finally the lowest significantly (P < 0.05) body protein contents were obtained with the fish maintained at 5% *Ulva* level and control diet, with the values of 16.34 and 16.21% respectively.

Protein efficiency ratio (PER) data in Table 3 indicate that best PER (P < 0.05) was obtained with the fish maintained at 20% *Ulva* level (2.58) followed by the fish maintained at 10 and 15% *Ulva* level (2.55 and 2.51 respectively). The differences among the last groups were not significant (P > 0.05). While the worst (P < 0.05) PER value (2.28) was observed with the fish maintained at 5% *Ulva*. Fish maintained at the control diet and the diet with 25% *Ulva* were the intermediate between them having the values of 2.40 and 2.39 respectively. Results of protein productive value (PPV) affected significantly (P < 0.05) by different levels of *Ulva sp.* in the diet. Fish maintained at 10, 15, 20 and 25% *Ulva* level get the values of 45.59, 44.88, 47.24 and 44.48 respectively were significantly (P < 0.05) higher than the other two treatments (control and 5% *Ulva* level).With regard to energy retention (ER %) as shown in Table 3, results indicate that fish maintained at 10, 15, and 20% *Ulva* level were significantly (P < 0.05) higher than other treatments and the highest value of ER% was observed with fish maintained at 10% *Ulva* level, it was 31.23% while the worst value was obtained with fish maintained at 5% *Ulva* level with the value of 25.23%.

DISCUSSION

Results of the present work indicate that growth performance of red tilapia were affected significantly (P < 0.05) by different levels of seaweeds (*Ulva sp.*) in the diet (Table 2). Final body weight, weight gain, feed conversion ratio and specific growth rate of red tilapia (*Oreochromis* sp) improved significantly (P < 0.05) with increasing *Ulva* level in the diet up to 15%. Increasing *Ulva* level beyond 15% had no significant effects on growth. These results are in agreement with those reported in previous studies. Nakagawa *et al.* (1993) found that the optimum feed efficiency and protein efficiency in black sea bream when the supplementation level of *Ulva* sp. meal was 2.5–5.0% of the diet. Also, Nakagawa and Kasahara (1986) and Mustafa *et al.* (1995a and b), stated the same results with level of 5% *Ulva* sp. of the diet. Xu *et al*. (1993) found that growth of Japanese flounder *P. olivaceus* was maximized with *Ulva sp*. level at 2% of the diet. In other study, Nakagawa and Montgomery (2007) reported that supplementation of *Ulva* meal to a prepared diet at 5% elevated phagocytosis in black sea bream. Also, with Nile tilapia, Ergun *et al.* (2008) reported that fish fed 5% *Ulva* meal showed an increased growth performance compared with fish fed non *Ulva* supplemented diets (CP 40%).Valente *et al.* (2006) when fed juveniles sea bass *Dicentrarchus Iabrax* on diets contain *Ulva sp.* for 10 weeks, maximum fish growth was achieved at 10% seaweeds incorporation in the diet. While, Elmorshedy (2010) showed that final body weight, weight gain and specific growth rate of gray mullet *Liza ramada* 0.094g initial body weight were increased significantly with increasing seaweeds level (*Ulva sp.*) up to 28% in the fish diet. Diler *et al.* (2007) suggested that the dietary *Ulva* meal inclusion of 5 to 15% replacing wheat meal in carp diets improved the growth performance and could be acceptable for common carp. Moreover, Guroy *et al.* (2007) found that highest values for weight gain of Nile tilapia fed on diets supplemented with various levels of *Ulva* meal were obtained at fish fed the 5 to 10% *Ulva* diets. Differences among results of adequate levels of seaweeds may be variable depending on the feeding habits, age and the species of both algae and fish.

The present study revealed that supplementation of *Ulva sp*. to a prepared fish diet improved growth performance significantly (P < 0.05). Mustafa and Nakagawa (1995) stated that the addition of small amounts of dietary algae as feed supplements improved the growth and digestive efficiency of feed and can produce considerable improvement of physiological condition, fish vitality, disease resistance, desired body composition and carcass quality. Yone *et al*. (1986) interpreted the effect on growth as due to an acceleration of nutrient absorption of dietary algae. Nakagawa and Montgomery (2007) reported that macro-algal lipids contain a wide variety of fatty acids, including long-chain polyunsaturated important to neural function. With respect to feed conversion ratio (FCR) results of the present study indicate that, supplementation of *Ulva sp*. to the prepared fish diet had a positive effect on FCR except fish fed the diet containing 25% *Ulva* level with the poorest FCR value (1.63). These results can be partly explained by the leaching of some dietary constituents of the artificial feeds into water due to high level of *Ulva* which released the homogeneity of the formulated diet. These occurred losses raised the amount of offered feed without utilization which leads to poor results. This agrees with the results of juvenile Nile tilapia and common carp obtained by Guroy *et al.,* 2007 and Diler *et al*., 2007 at the level of 20% *Ulva* meal in the diet, respectively.

With respect to body composition of red tilapia in present study, results show that no significant differences were observed in fish moisture contents ($P > 0.05$) at all treatments. These results agree with what Elmorshedy (2010) had found. On the other hand, lipid content in fish body shows that there were significant differences among treatments ($P < 0.05$). Fish maintained at 10% *Ulva* level in the diet get significantly the highest lipid value ($P < 0.05$). These results are nearly similar with what Diler *et al*. (2007) found for common carp at the level of 15% *Ulva* meal in the diet. Protein content in the present study increased gradually with increasing *Ulva* level in the diet. This agrees with the results obtained by Elmorshedy (2010) with gray mullet, protein content increased significantly with increasing seaweeds level *Ulva sp* up to 28% in the fish diet.

In the present study, data of protein efficiency ratio (PER) and energy retention (ER %) presented in Table 3 indicate that fish maintained at 10, 15, and 20% dietary *Ulva* level were significantly ($P < 0.05$) higher than other treatments. Elmorshedy (2010) reported that there were positive trends between protein efficiency ratio (PER) and energy retention (ER %) on one side and seaweeds inclusion levels in the diet up to the level of 14% on the other side. Protein productive value (PPV) affected significantly ($P < 0.05$) by different levels of *Ulva sp.* It increased significantly with increasing *Ulva* level in the diet. Fleurence (1999) reported that the crude protein content of *Ulva sp*. ranged between 10 and 26% of dry weight and this protein considered as high quality protein, contains all the essential amino acids, and accounted for 42.1- 48.4% of the total amino acids content (Wong and Cheung, 2000). Diler *et al.* (2007) stated that PPV improved significantly with increasing dietary *Ulva* inclusion rate up to 15%. Also, similar results were found by Elmorshedy (2010) with gray mullet.

With the obtained results, it could be concluded that seaweeds (*Ulva sp.)* can supplemented to red tilapia (*Oreochromis sp.*) diet at optimum level of 15% to improve growth performance without any adverse effect on feed efficiency or survival rate.

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تأثيرإضافة الأعشاب البحرية الخضراء (أولفـــا) في غذاء أسماك البلطى الأحمر على النمو وكفاءة الأستفادة من الغذاء وتركيب الجسم

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أجريت هذه التجربة بمعمل إنتاج الأسماك بكلية الزراعة (سابا باشا) جامعة الإسكندرية لدراسة تأثير إضافة مستويات مختلفة من الأعشاب البحرية (*Ulva sp.*) في علائق الأسماك على أداء الأسماك وكفاءة الإستفادة من الغذاء وتركيب الجسم لأسماك البلطى الأحمر ذات الوزن الإبتدائى 1.15 جم .غذيت الأسماك على ست علائق متساوية في الطاقة (236 كيلو كالورى طاقة ميتابوليزمية لكل 100 جم غذاء) ومتساوية في نسبة البروتين(26 ٪) مع استخدام الأعشاب البحرية من النوع *Ulva* والتي تم تجميعها من شواطئ مدينة الإسكندرية في ست مستويات كالتالى (0 ، 5 ، 10 ، 15 ، 20 و 25 ٪ من غذاء الأسماك)، وزعت كل معاملة على ثلاث مكررات، وتمت التغذية مرتين يوميا حتى الإشباع لمدة تسعة أسابيع. وأظهرت النتائج ما يلى : زاد كل من الوزن النهائي والوزن المكتسب ومعدل النمو النوعى للأسماك زيادة معنوية مع زيادة مستوي الأعشاب البحرية في الغذاء حتي مستوي 15% ، بعدئذ لم تحقق الزيادة في مستوي الأعشاب البحرية في العلائق أي زيادة معنوية في الوزن النهائي او معدل النمو النوعي للأسماك. كما أظهرت النتائج أن معدل تحويل الغذاء في الأسماك التى تغذت على مستوى أعشاب بحرية 20% هي الأفضل معنويا تلتها الأسماك التى تغذت على مستوى أعشاب بحرية 15 و10% على التوالى بدون فروق معنوية بين الثلاث معاملات. أما بالنسبة لمعدل الإعاشة ومحتوى جسم الأسماك من الرطوبة في نهاية التجربة فلم تكن هناك أى فروق معنوية بين المعاملات. من ناحية أخرى أظهرت التحاليل المعملية ان محتوي جسم الأسماك من الدهون اختلف معنويا بين المعاملات حيث ارتفعت نسبة الدهن معنويا في الأسماك التى تغذت على مستوى اعشاب بحرية 10 % عن باقى المعاملات. كما أن زيادة مستوي الأعشاب البحرية في الغذاء يزيد محتوى بروتين جسم الأسماك معنويا, حيث سجلت أعلى نسبة بروتين في الأسماك التى تغذت على العليقة التي تحتوي على 25 % اعشاب بحرية بينما أقل نسبة كانت مع الأسماك التى تغذت على العليقة الكنترول. كما أفادت النتائج المتحصل عليها أيضا أن القياسات الخاصة بكفاءة إستخدام الغذاء قد تأثرت معنويا بالمعاملات فبالنسبة لمعدل الإستفادة من البروتين وإنتاجية البروتين والطاقة المحتجزة بالجسم كانت جميعها لصالح الأسماك التى تغذت على علائق تحتوي على نسب 10و 15 و20% أعشاب بحرية بالمقارنة بباقى المعاملات . مما سبق وتحت ظروف التجربة فيمكن التوصية بأن أفضل مستوى من الأعشاب البحرية من النوع *Ulva* يمكن إضافته لعلائق أسماك البلطى الأحمر لتحسين النمو وأداء الأسماك هو مستوى 15% وذلك بدون اى تأثير سلبى على كفاءة الإستفادة من الغذاء أو معدل الإعاشة للأسماك.