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Research Article

Can Artificial Feed be Replace by Fresh Macro Algae (*Enteromorpha flaxusa*) in Hybrid Red Tilapia (*Oreochromis mossambicus* × *Oreochromis niloticus*) Juvenile Nutrition?

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ABSTRACT

This study was conducted to investigate the effect of use fresh macro algae (seaweed) *Enteromorpha flaxuse* with or without artificial feed on growth performance, survival percentage and feed efficiency of hybrid red tilapia juvenile reared in brackish water under laboratory conditions. Hybrid red tilapia juvenile were fed on three feeds (artificial feed only, fresh macro algae (*Enteromorpha flaxusa*) only and 50% artificial feed with 50% fresh macro algae. Survival percentage was within the range 86–90%, with insignificant differences among treatments. The highest final weight and specific growth rate of fish were recorded with fed on artificial feed alone and fresh algae alone. While, fish fed on artificial feed alone led to higher final length, total weight gain and daily growth rate. The highest feed intake was observed with fish fed on fresh algae alone. While the best feed conversion ratio was recorded with fish fed on artificial feed alone. Hybrid red tilapia juvenile were not acceptance of feeding on fresh algae with feeding on artificial feed, this may be the reason for the lower growth in this treatment. From the results of the present study, it can be said that the artificial feed can be replace by fresh macro algae without affecting growth of hybrid red tilapia juvenile.

Keywords: Hybrid red tilapia; Fresh macro algae (*Enteromorpha flaxusa*); Growth performance; Survival percentage; Feed efficiency

INTRODUCTION

Recently interest has been shown by commercial aquaculture sector to expand tilapia culture in sea and brackish water in Egypt and in Southeast Asia as well as South America [1,2]. Tilapia hybrids that have descended from an *Oreochromis mosambicus* parent are believed to be highly tolerant to saline waters [3]. Hybrid red tilapia (*Oreochromis* sp.) is a hybrid produced by the inter-breeding between *Oreochromis niloticus* and the mutant of *Oreochromis mossambicus*. This fish is euryhaline, omnivorous, reproductive and highly resistant to diseases [4]. Hybrid red tilapia has been becoming more and more popular in many parts of the world, and there is a great potential to culture this species in brackishwater and seawater ponds [5]. Red tilapia were reared in seawater without adverse effect in survival, growth and feed utilization [6].

Aquafeed accounts for about 50-80 per cent of aquaculture production cost and therefore, its use has to be carefully considered and managed. Nutritionally balanced fish feeds generally contain fishmeal, soybean meal, yellow corn and wheat bran. Currently, the search is on for alternative sources of feed ingredients, the main reasons being escalated cost and uncertainty of constant supply of common feed ingredients. The importance of algae as a potential substitute protein source for cultured fish feeding has been documented in recent years [7]. The annual global aquaculture production of marine algae was 14.5 ×10 tonnes (including brown, green and red seaweeds and different aquatic plants) in 2007 [8]. Global production has been dominated by marine macro algae, or seaweeds, grown in both marine and brackish waters. Seaweeds are receiving consideration for their high protein value, essential amino acid content, vitamins and trace metals in fish feeding [7].

All green seaweed belong to the classes Ulvophyceae, Bryopsidophyceae, and Dasycladophyceae, which include approximately 1,500 species currently referred to eight orders [9]. The genus *Enteromorpha* (Phylum: Chlorophyta, Class: Ulvophyceae, Order: Ulvales, Family: Ulvaceae) have been used as a source of bioactive compounds similar to those which cause an inhibitory effect against the bacterium *Xanthomonas oryzae*, which causes leaf blight disease in paddy crops [10]. People in the Japan and Philippines also use *Enteromorpha* spp. as food [11,12].

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Marine macro algae have been used for healthy feed supplement providing necessary amino acids, beneficial polysaccharides, fatty acids, antioxidants, vitamins and minerals [13,14]. Macro algae prefer as food by herbivorous fishes since their stomach have low pH levels and specialize guts required for the digestion of plant materials [15]. Additionally, they improve the immune system, antiviral, antimicrobial, improved gut function and stress resistance serves as an alternative for fish meal, and they would help to take the pressure off wild fish stocks [16]. There is limited evidence that herbivorous and omnivorous fish were more effective at digesting and utilizing seaweed in diet.

The most of the cultured marine fish are carnivorous species, and seldom are herbivorous or omnivorous species, and the higher prices and uncertainty of availability of fish meal is limiting the development of mariculture industry, especially the culture of carnivorous fish. Wherefore FAO (food and agriculture organization) quite canonizes the culture of herbivorous or omnivorous species [17]. Therefore, this study aimed to evaluate the effect of feeding on fresh macro algae (seaweed) *Enteromorpha flaxuse* with or without artificial feed on growth performance, survival percentage and feed efficiency of hybrid red tilapia (*Oreochromis mossambicus* × *Oreochromis niloticus*) juvenile reared in brackishwater under laboratory conditions.

MATERIALS AND METHODS

The present study was conducted at Shakshouk Fish Research Station, El-Fayoum Governorate, National Institute of Oceanography and Fisheries (NIOF), Egypt, to investigate the effect of feeding on fresh macro algae (seaweed) *Enteromorpha flaxuse* with or without artificial feed on growth performance, survival rate and feed utilization of hybrid red tilapia (*Oreochromis mossambicus* × *Oreochromis niloticus*) juvenile reared in brackishwater under laboratory conditions. The experimental done through July–August and lasting 50 days after start. Hybrid red tilapia juvenile (3.14 ± 0.18 g initial body weight) were obtained after broodstock hatching in Shakshouk Fish Research Station, NIOF.

Feeding and rearing conditions

This trial consists of three treatments, the first treatment, fish fed on artificial feed only, the second treatment, fish fed on fresh macro algae (*Enteromorpha flaxusa*) only and the third treatment, fish were fed of half feeding rate on artificial feed and other fresh macro algae (*Enteromorpha flaxusa*). Did not take into consideration the percentage of protein feed, but was taking the variety feed. Fishes were randomly distributed and stocked at 25 juveniles/tank in 6 rectangular fiberglass tanks (1.5 m^3 water capacity). The experimental treatments were duplicated. All tanks were provided with continuous aeration. The brackishwater (salinity, 18 ‰) used in this study was prepared as follows (50% tap water with 50% salt water). The salt water used in this study was obtained from Lake Qaroun. About 50% of water tanks were changed twice every week. Feed was offered (on dry matter basis) by hand at three meals/day (9:00, 13:00 and 16:00 h) for 6 days a week at 5% of body weight daily and the amount of feeds were readjusted after each weighing (every two week). Feed consumption was recorded daily and rate of mortality was recorded. Water temperature, dissolved oxygen, pH, total ammonia, un-ionized ammonia, nitrite and nitrate were measured during experimental period. Fishes were held under natural photoperiod condition throughout the experimental period (50 days).

Feed preparation

An artificial diet was formulated by hand, the diet formulated to be almost containing 30% crude protein (Tables 1 and 2). Ingredients were thoroughly mixed, then water added to the mixture. The mash was palletized using a meat mincer with a 1.5 mm diameter. Pellets were dried by air and stored at -18°C ± 1°C until use. Macro algae Enteromorpha (*Enteromorpha flaxusa*) was collected daily from Qaroun Lake, Fayoum Governorate, Egypt and used freshly in fish feeding (Table 2).

Running water system in tanks

The water was forced by two pumps from the source of water to the sandy filter unit, which connected with two large tanks measure (10000 liter/tank) used to storage the water at a point between the water source and experimental tanks, and then the water was release to experimental tanks.

Aeration system in tanks

The system consisted of two blowers to force the air through PVC tubes, which connected with plastic pipes and this pipes transport the air to each tank, the air was controlled by tap of each tank and

Table 1: Composition (%) of the artificial feed.

Ingredients, %	Artificial diet
Fish meal, (CP 63%)	15
Soybean meal	40
Yellow corn	21
Wheat bran fine	15
Soybean oil	5
Commercial yeast	1
Starch	2
Vitamins mixture[1]	0.5
Minerals mixture[2]	0.5

[1]Vitamins each 3 Kg contains: 1200 000 IU Vit. A, 300 000 IU Vit. D_3, 700 mg Vit. E, 500 mg Vit. K_3, 500 mg Vit. B_1, 200 mg Vit. B_2, 600 mg Vit. B_6, 3 mg Vit. B_{12}, 450 mg Vit. C, 3000 mg Niacin, 3000 mg Methionine, 10 000 mg Cholin chloride, 300 mg Folic acid, 6 mg Biotin, 670 mg Panthonic acid, [2]Minerals each 1 Kg contains: 1472 mg Manganese sulphat, 1030 mg Zinc sulphat, 2359 mg Iron sulphat, 747 mg Copper sulphat, 5 mg Cobalt sulphat, 33 mg Potassium iodide, 1.28 mg Sodium selenite, 4300 mg Sodium sulphat 32.37%, 4000 mg Potassium chloride 52%.

the air diffusers was used to distribute of air in all experimental tanks trends.

Growth performance indices

The growth and feed utilization parameters were calculated according the following equations:

Weight gain (g) = Final weight, g - initial weight, g.

Percentage weight gain (%) = (Weight gain)/(final weight) × 100.

Daily growth rate (g/day) = Weight gain, g/experimental period, day.

Relative growth rate (%) = (Weight gain)/(initial weight) × 100.

Specific growth rate (%/day) = [(ln final weight - ln initial weight)/period in days] × 100, where ln is the natural log.

Condition factor (g/cm^3) = (Fish weight)/(fish length^3) ×100.

Survival percentage (%) = (Number of fish at end/number of fish at start) × 100.

Feed conversion ratio (FCR) = Dry feed intake, g/weight gain, g.

Protein intake (g/fish) = Total feed intake × protein content of feed.

Protein efficiency ratio (PER) = Weight gain, g/protein intake, g.

Energy intake (Kcal/fish) = Total feed intake × energy content of feed.

Energy efficiency ratio (EER) = Weight gain, g/energy intake, Kcal.

Water quality analysis

Water temperature was measured daily by using centigrade thermometer. Dissolved oxygen (DO) and pH were measured every week by using Tintometer® group (pH/ORP, DO, CD/TDS, Nr: 00724200. Germany 01/16). Salinity was measured daily by Refractometer (VITAL Sine SR-6, China). Water ammonia, nitrite and nitrate were determined every two weeks by using Spectrophotometer model (LKB Bichrom UV visible spectrophotometer) according to the method described by APHA [18]. To determine un-ionized ammonia concentration, multiply total ammonia concentration by the percentage which is closest to the observed temperature and pH of the water sample [19].

Chemical analysis of feeds

Feeds used were analyzed for their proximate composition in triplicates following the methods described by AOAC [20]. Gross energy (GE) content was calculated according to NRC, 1993 by using factors of 5.65, 9.45 and 4.22 kcal/g of protein, lipid and carbohydrate, respectively. Digestible energy (DE) content was calculated from standard physiological fuel values as 4, 4 and 9 kcal/g of protein, carbohydrate and lipid, respectively [21].

STATISTICAL ANALYSIS

Data of growth performance and feed utilization at different feeds were statistically analyzed using a one-way analysis of variance (ANOVA test) using SPSS Statistical Package Program (SPSS) version 23 [22]. Mean of treatments were compared by Duncan multiple range test when the differences were significant [23]. Level of significance in all tests was $P \leq 0.05$. The results are expressed as means ± standard error (SE).

RESULTS

Water quality parameters

Criteria on water of tanks such as: temperature, pH, dissolved oxygen, total ammonia, un-ionized ammonia, nitrite and nitrate were presented in Table 3. Water quality parameters were not significantly ($P>0.05$). Similar water quality characteristics were observed in all tanks.

Growth rates and survival percentage

Results of growth rates and survival percentage of fish fed on the three different feeds are shown in Table 4. Important notice: fishes were not acceptance on fresh algae feeding in the third treatment (fish were fed on 50% artificial feed with 50% fresh macro algae).

There was no significant difference in the initial length and body weight of the fish among treatments. Survival percentage was within the range 86–90%, with insignificant differences were observed. The results showed that significant differences ($P \leq 0.05$) were obtained in all growth performance parameters between treatments, except the condition factor. The highest final weight of fish ($P \leq 0.05$) were recorded with fed on artificial feed alone and fresh algae alone followed in a significant decreasing order by fed on artificial feed with fresh algae, however differences in final

Table 2: Proximate chemical analysis (% on dry matter basis) of the experimental feeds.

Chemical analysis (%)	Artificial diet	Fresh algae	Diet + Algae
Moisture	11.62	77.83	44.73
Dry matter, DM	88.38	22.17	55.28
Crude protein, CP	30.89	25.64	28.27
Ether extract, EE	7.79	2.16	4.97
Crude fiber, CF	4.19	4.59	4.39
Ash	5.83	28.75	17.29
Nitrogen free extract, NFE[1]	51.30	38.86	45.08
Gross energy, GE kcal/g[2]	4.823	3.486	4.155
Digestible energy, DE kcal/g[3]	4.156	2.958	3.557

[1]Calculated by differences.
[2]Calculated according to NRC, 1993.
[3]Calculated according to Garling and Wilson, 1976.

weight among artificial feed alone and fresh algae alone groups were insignificant (P ≤ 0.05). The same trend was observed with percentage weight gain, specific growth rate and relative growth rate. However, fish fed on artificial feed alone led to higher final length, total weight gain and daily growth rate compared to those fed on fresh algae alone and artificial feed with fresh algae. The results indicated that the fish fed on artificial feed alone and fresh algae alone grow better in weight compared to those fed on artificial feed with fresh algae under the experimental conditions.

Feed efficiency parameters

Results of feed utilization efficiency parameters of fish fed on the three different feeds are shown in Table 5. The results showed that significant differences (P ≤ 0.05). were obtained in all feed utilization parameters between treatments. The highest feed intake was observed with fish fed on fresh algae alone. But, the best FCR (lowest) was recorded with fish fed on artificial feed alone. The highest protein intake and energy intake of fish (P ≤ 0.05). were recorded with fed on artificial feed alone and fresh algae alone followed in a significant decreasing order by fed on artificial feed with fresh algae. The highest protein efficiency ratio of fish were recorded with fed on artificial feed alone.

DISCUSSION

In view of the economic side, the fishmeal and fish oil remain the main protein and lipid sources of feed for marine fish, and the development and application of formulated feed are restricted by the high cost of these ingredients. Therefore, efforts should focus on producing commercial feed for fish at low cost and high efficiency [24]. Such as the use of seaweeds in the development of low-cost, highly nutritive diets for animal nutrition, especially animal nutrition since sea vegetables are able to accelerate the growth of oysters, tilapia, salmon, trout, etc., all of great commercial interest [25,26]. Additionally marine macro algae could be a potential low-

Table 3: Average water quality criteria recorded during the experimental period (mean ± SE).

Parameters	Artificial diet	Fresh algae	Diet + Algae	CV, %*
Temperature, °C	29.50 ± 0.50	29.45 ± 0.15	29.50 ± 0.30	1.29
pH	8.14 ± 0.03	8.17 ± 0.03	8.17 ± 0.04	0.47
Dissolved oxygen, mg/l	7.40 ± 0.20	7.25 ± 0.15	7.20 ± 0.30	3.62
Total ammonia, mg/l	0.314 ± 0.04	0.337 ± 0.02	0.311 ± 0.03	10.85
Un-ionized ammonia, mg/l	0.034 ± 0.005	0.037 ± 0.002	0.034 ± 0.004	12.64
Nitrite, mg/l	0.732 ± 0.13	0.772 ± 0.09	0.641 ± 0.03	16.98
Nitrate, mg/l	1.62 ± 0.17	1.68 ± 0.12	1.71 ± 0.41	17.58

*Coefficient of variation (CV, %) = (Standard deviation)/(mean) × 100

Table 4: Average of the growth rates and survival percentage for 50 days (mean ± SE).

Parameters	Artificial diet	Fresh algae	Diet + Algae
Initial length, cm/fish	5.85 ± 0.15	5.80 ± 0.20	5.70 ± 0.30
Final length, cm/fish	9.55 ± 0.05^{a}	8.95 ± 0.05^{b}	7.65 ± 0.05^{c}
Initial weight, g/fish	3.19 ± 0.36	3.14 ± 0.40	3.11 ± 0.44
Final weight, g/fish	14.02 ± 1.14^{a}	10.83 ± 0.39^{a}	7.17 ± 0.41^{b}
Total weight gain, g/fish	10.83 ± 0.78^{a}	7.69 ± 0.02^{b}	4.07 ± 0.03^{c}
Percentage weight gain, %	77.33 ± 0.70^{a}	71.09 ± 2.67^{a}	56.89 ± 3.61^{b}
Daily growth rate, g/day	0.22 ± 0.02^{a}	0.15 ± 0.001^{b}	0.08 ± 0.001^{c}
Specific growth rate, %/day	2.97 ± 0.06^{a}	2.49 ± 0.19^{a}	1.69 ± 0.17^{b}
Relative growth rate, %	341.55 ± 13.58^{a}	248.85 ± 32.18^{a}	133.65 ± 19.53^{b}
Condition factor, g/cm^3	1.61 ± 0.11	1.51 ± 0.03	1.60 ± 0.06
Survival percentage, %	86.00 ± 2.00	90.00 ± 2.00	88.00 ± 4.00

- (a, b, c) Average in the same row having different superscripts are differ significantly (P ≤ 0.05).

Table 5: Average of the feed utilization efficiency parameters (mean ± SE).

Parameters	Artificial diet	Fresh algae	Diet + Algae
Feed intake, g/fish/period	13.91 ± 0.62^{b}	16.87 ± 0.55^{a}	8.93 ± 0.59^{c}
FCR, g feed/g gain	1.29 ± 0.04^{b}	2.19 ± 0.08^{a}	2.20 ± 0.16^{a}
Protein intake, g/fish	4.30 ± 0.19^{a}	4.33 ± 0.15^{a}	2.53 ± 0.17^{b}
Protein efficiency ratio	2.52 ± 0.07^{a}	1.78 ± 0.06^{b}	1.62 ± 0.12^{b}
Energy intake, Kcal/fish	67.06 ± 2.97^{a}	58.81 ± 1.92^{a}	37.11 ± 2.46^{b}
Energy efficiency ratio	0.17 ± 0.005^{a}	0.14 ± 0.005^{ab}	0.11 ± 0.01^{b}

- (a, b, c) Average in the same row having different superscripts are differ significantly (P ≤ 0.05).
Notice: Feed intake was on dry matter basis (13.91 g equal to 15.74 g on wet weight), (16.87 g equal to 76.09 g on wet weight) 8.93 g equal to 5.06 g artificial diet +20.16 g algae on wet weight).

cost source of protein for fish [27]. Furthermore, the economic comparison of feed cost indicated that increasing level of fresh and dried gut weed in alternative feeding treatments, commercial feed used for fish growth was reduced leading to significantly reduction of feed cost [28].

In the present study, hybrid red tilapia juvenile fed on three feeds, artificial feed only, fresh macro algae (*Enteromorpha flaxusa*) only and 50% artificial feed with 50% fresh macro algae. The highest final weight and specific growth rate of fish were recorded with fed on artificial feed alone and fresh algae alone. But, fish fed on artificial feed alone led to higher final length, total weight gain and daily growth rate. In this regard, artificial feed can be replace by fresh macro algae without compromising growth of red tilapia juvenile. Use of the fresh macro algae alone in red tilapia juvenile feeding had positive effect on growth performance and reduce of the feed cost. The positive effects of macro algae on growth performance may be due to the algae are a strongly appreciated source of protein, essential amino acids and vitamins [29,30]. As well as the positive effect of the used additive algae decrease the cholesterol and fat level and improved lipid metabolism in fish too [31]. Seaweeds cannot be considered as a main source of energy but they have nutritional value regarding vitamin, protein and mineral contents [32]. According to Chapman and Chapman, 100 g seaweed provides more than the daily requirement of Vitamin A, B_1 and B_{12} and two thirds of Vitamin C [33]. Also seaweeds are natural sources of hydrosoluble and liposoluble vitamins, such as thiamine and riboflavin, *b*-carotene and tocopherols, as well as of long-chain polyunsaturated essential fatty acids from the omega-3 (ω-3) (family such as eicosapentaenoic acid [34]. Moreover, Some dietary macroalge meals are improved the growth, lipid metabolism, physiological activity, stress response, disease resistance and carcass quality of various fish species [8]. Wherefore gut weed can be used as a direct feed or as ingredient in diets for herbivorous fish according to Teimouri et al. [35]. Early studies of stomach contents and food preference revealed that among the many different algal species and vascular plants eaten, the presence of *Enteromorpha* was high and was the preferred species. Preference for *Enteromorpha* by siganids is not directly related to the calorific value of the algae but is related to the texture of its thallic which is crispy and thin [36,37].

The higher growth performance of fish fed on artificial feed, because protein percentage of the artificial feed was high level (30% CP) in addition to artificial feed contained on fish meal which is high protein content and balanced essential amino acids profile. Fishmeal is also an excellent source of essential fatty acids, digestible energy, minerals and vitamins and it is well known as being highly palatable and digestible to fish [38,39].

From the results of the present study, hybrid red tilapia juvenile were not acceptance of feeding on fresh algae with feeding on artificial feed in the third treatment (fish were fed on 50% artificial feed with 50% fresh macro algae), this may be the reason for the lower growth in this treatment.

In the current study, the results indicated that the water quality criteria were similarly in all treatments and they were within the safe ranges and acceptable for the growth of tilapia as reported by El-Sayed and El-Sherif et al. [39,40]. It can be said that, the water quality criteria were not affected by growth of red tilapia juvenile.

In general, these results are in agreement with Costa et al. reported that fresh and dried gut weed can be used as a feed to substitute commercial feed for fish such as spotted scat, (*Scatophagus argus*), red tilapia (*Oreochromis* sp.) and giant gourami (*Osphronemus goramy*) juveniles [41]. Similarity results with El-Tawil who reported that, specific growth rate of red tilapia (*Oreochromis* sp) improved significantly with increasing *Ulva* level in the diet up to 15% [42]. Increasing *Ulva* level beyond 15% had no significant effects on growth. Elmorshedy showed that final body weight, weight gain and specific growth rate of gray mullet *Liza ramada* were increased significantly with increasing seaweeds level (*Ulva sp.*) up to 28% in the fish diet. Xu et al. recommend a level of less than 33% Dried *Gracilaria lemaneiformis* in the diet for *S. canaliculatus* and the optimum level require to be investigated in future studies. Incorporation 5% of green seaweed *Ulva lactuca* in *Oreochromis niloticus* feeds promoted growth, diet utilization, immune response [24,43,44]. Inclusion of 5% red seaweed *Pterocladia capillacea* enhanced some growth performance parameters of European seabass (*Dicentrarchus labrax*) fry, with an increase in body weight, and weight gain. Patel et al. studied the three experimental diets consisting of seaweed *Ulva lactuca* at 10%, 20% and 30% with control diet without seaweed on growth and survival of *Labeo rohita* fry [7,45]. Fish fed with 10% Ulva meal showed an increased survival and growth performance and also a significant increase was found in SGR, PER and FCR.

On the other hand, Siddik et al. found that, the lowest final body weight and SGR were observed in treatments feeding fresh and dried gut weed as single feeds [28]. The inclusion of 20-30% different seaweeds (*Cystoseira barbata*, *Ulva lactuca*, *U. rigida* and *Gracilaria cornea*) in different species of fish meals decreased all growth performance and feed utilization parameters [46]. Abdel-Aziz and Ragab who reported that, the green seaweed (*Ulva* and *Enteromorpha*) exhibited a positive effect on growth performance of rabbit fish fry and reduce of the feed cost as half of the feeding rate with artificial feed, but replacement of artificial feed with fresh seaweeds had negative effect on growth performance of rabbit fish fry [47].

In the present study, survival percentage was within the range 86–90%, with insignificant differences among treatments. These results similar with the results of Siddik et al. found that, the equal survival of tilapia juvenile in all dietary treatments was in agreement with the study of Rahman and Meyer who observed similar survival of fish fed diet with seaweed and without seaweed [28,48].

From the results of the present study, the highest feed intake was observed with fish fed on fresh algae alone. But the best FCR (lowest) was recorded with fish fed on artificial feed alone. These results disagree with the results of Yousif et al. who found that, the fish was fed a control diet with addition of a known weight of fresh *Enteromorpha* placed in plastic baskets at the bottom of the rearing tanks was the best in FCR than the other treatments [38]. Siddik et al. who found that, tilapia fed alternative 1 day commercial feed and 1 consecutive day fresh or dried gut weed showed similar feed utilization to tilapia feed the commercial feed [28]. This results clearly indicated that gut weed can be used 1 day after using 1 day commercial feed without affecting feed utilization of tilapia. El-Tawil reported that, supplementation of *Ulva sp.* into the prepared fish diet had a positive effect on FCR except fish fed the diet containing 25% *Ulva* level with the poorest FCR value [42-48].

CONCLUSION

From the results of the present study, it can be said that the artificial feed can be replace by fresh macro algae (*Enteromorpha flaxusa*) without affecting growth of hybrid red tilapia juvenile. Use of the fresh macro algae alone in red tilapia juvenile feeding had positive effect on growth performance and reduce of the feed cost. Hybrid red tilapia juvenile were not acceptance of feeding on fresh algae with feeding on artificial feed.

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