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The Influence of Diet Quality on Growth Performance of *Oreochromis aureus* Fingerlings Reared in Brackish Water

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□ ABSTRACT □

This study has been conducted to investigate the effect of different diet qualities on growth performance and feed conversion of *Oreochromis aureus* fingerlings reared in brackish water (salinity, 20‰) of 100 liters glass aquaria. The fingerlings were fed two diet types which differ by their dietary protein and lipid contents: a scientific diet (SD) and a commercial diet (CD), twice a day to satiation for 30 days.

The results revealed that the best growth rates (ADG, % weight gain, SGR) were significantly higher ($P<0.05$) at fingerlings fed the scientific diet. Feed conversion (FC) showed the same trend. There were significant differences ($P<0.05$) between SD (0.63) and CD (1.41).

Key words: *Oreochromis aureus*, Fingerlings, Brackish water, Diet quality.

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تأثير نوعية العلف على نمو اصبعيات المشط الأزرق (*Oreochromis aureus*) المرباة في المياه شبه المالحة

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□ ملخّص □

تم إجراء البحث لدراسة مدى تأثير نوعية العلائق المختلفة في معاملات النمو و معامل تحويل الغذاء عند اصبعيات المشط الأزرق المرباة في المياه شبه المالحة ‰ 20 ضمن أحواض زجاجية سعة 100 ليتر والتي تم تغذيتها مرتين في اليوم حتى الشبع لمدة شهر واحد .قمنا بتغذية الاصبعيات على عليقتين تختلفان من حيث محتواهما من البروتين و الدهون، الأولى عليقة علمية تم تحضيرها في المختبر بحسب الطرق العلمية المعروفة أما الثانية فهي تجارية و تستعمل في بعض المزارع السمكية.

حققت الاصبعيات التي غذيت على العليقة العلمية SD أفضل معدلا ت للنمو (معدل الكسب اليومي ADGوالنسبة المئوية للوزن المكتسب والنسبة المئوية لمعدل النمو اليومي SGR) فاقت مثيلاتها عن تلك المرباة على العليقة التجارية CD ($P<0.05$). وعلى السياق نفسه، أثبتت هذه الدراسة وجود اختلافات جوهرية ($P<0.05$) في معامل تحويل الغذاء (FC) مابين نوعي الاصبعيات المرباة على العليقة العلمية (0.63) والتجارية (1.41).

الكلمات المفتاحية: المشط الأزرق–إصبعيات–المياه شبه المالحة–نوعية الغذاء

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Introduction:

Tilapias are a major protein source in many developing countries. Although endemic to Africa, their distribution has been widened by introductions into many tropical and subtropical countries including Southeast Asia, Japan, Asiatic Russia, India, East Europe, United Sates and Latin America (Pullin and McConnell, 1982).Tilapias are among the most widely cultured fishes in the world, second only to carp (Baradach *et al*., 1972).

Tilapia culture has been practiced since the beginning of the recorded history. Ancient Egyptians raised tilapias in ponds for human consumption more than 2500 years ago (Baradach *et al*., 1972).

Tilapias are quoted for aquaculture duo to their fast growth, tolerance to a wide range of environmental conditions (such as temperature, salinity…etc), resistance to stress and diseases (Lovell, 1980; Jauncey and Ross, 1982), ability to reproduce in captivity and having short generation time (Pullin and McConnell, 1982), and finally feeding on low trophic levels and acceptance of artificial feeds immediately after yolk-sac absorption (El-Sayed and Teshima, 1992).

In spite of the above mentioned characteristics, little information is available on the rearing and husbandry of many tilapia species and their nutritional requirements when reared at different water salinities.

Despite the fact that tilapias are fresh water fish, they can tolerate a wide range of water salinity (Watanabe and Kuo, 1985; Kalio, 1988; Watanabe *et al*., 1992; El-Sayed *et al*., 2003, 2005; Mansour and lahlah, in print). However, the effect of water salinity on nutrient requirements of these fish is not fully understood. It is assumed that tilapia evolved from a marine ancestor and that their penetration to fresh water is secondary (Myers, 1938; Steinitz, 1954). This may account for the marked euryhalinity of certain tilapia species (Chervinski, 1961), where they can tolerate a wide range of water salinity, with varying performances.

Salinity tolerance of tilapia is affected by a number of factors such as temperature, method of acclimation and fish age (Suresh and Lin, 1992).

Salinity tolerance of tilapia ranges from the generally fresh water *O.macrochir* (Balarin and Hatton, 1979) to the highly saline tolerant *O.mossambicus* which has been reported to survive, with acclimation, up to a concentration of 120 ‰ (Whitfieled and Blaber, 1979). In addition, *O.mossambicus* fry production was approximately three times higher in brackish water (8.9-15.2‰) than in fresh water (Uchida and King, 1962).

Aim of Research:

The scarcity of fresh water, especially in the Middle East including Syria, and the competition for it with other activities such as irrigation, drinking and other urban activities, make its use for tilapia culture unguaranteed. Therefore, the challenge facing fish farmers and aquaculture researchers is to use brackish water, which is available in most of the tropics and subtropics, for tilapia culture. The euryhaline characteristics of tilapia would support this approach. So, the present study was conducted to investigate the effect of two different diets on the growth rates and feed conversion efficiency of *O.aureus* fingerlings reared at brackish water, where water salinity used was 20‰.

Materials and Methods:

This experiment was conducted at the High Institute of Marine Researches. *O.aureus* fingerlings, with an initial weight of 11.32 g, were brought from El-Sin River Farms, Lattakia. The fingerlings were put in plastic containers filled with fresh water. After arrival, the fingerlings were distributed into glass aquaria (100 liter), which were previously filled with dechlorinated tap water (free of Chlorine), it is worth to mention that the fingerlings were stayed unfed within the first two days following the transportation stress. Then, we divided the fingerlings at groups of 30 fingerlings for each aquarium. The saline water (38 ‰) was added to the aquaria gradually within two to four days until 20‰ salinity was reached, during this period the fingerlings were fed on the tested diets.

We tested two diets, the first was the commercial diet –control diet -(CD) (28 % protein), brought from the General Fish Establishment, Jablah, Lattakia, while the second diet (35 % protein) was the scientific diet (SD) prepared in the laboratory with the composition shown in tables (1&2). The fingerlings were fed the diets two times a day (at 9 am and at 4 pm) to satiation for 30 days (from 16-7 to 15-8 2007). The aquaria were cleaned every day in order to remove the feces, and expelled water was replaced by another water of similar salinity. The aquaria were provided with special air pump to provide more Oxygen. The values of salinity, temperature and dissolved Oxygen were monitored daily using an apparatus (Dissolved Oxygen Kit-WTW milti 34oi), and the salinity was always set at (20‰). The temperature ranged from 26-28.4 C °, while water was almost saturated with dissolved Oxygen (5.39 - 6.11 mg o_2/liter).

To study the effect of the tested diets on fingerlings performances, a series of measurements were accomplished including the initial weight (g/fish, to the nearest 0.1 g), the final weight (g/fish, to the nearest 0.1g), and the amount of food given (g/fish). To study the effect of the diets on the growth rates and feed utilization efficiency of the tested fingerlings, we made up the following measurements:

a- Average daily gain (ADG) = W_2-W_1/t

b- Percent weight gain (%) = W_2-W_1/W_1×100

c- Specific growth rate (SGR) = $\log_e W_2$-$\log_e W_1$/t×100

d- Feed conversion (FC) = dry feed intake (g) /fish live weight gain (g)

Where: W1 = initial weight (g), W2 = final weight (g), t = duration of the experiment (days).

At the end of the experiment, the fingerlings in each aquarium were netted and weighed to estimate the final weight (g). The statistical analysis was performed by using a two-way analysis of variance (ANOVA) to test the effect of the diets on the fingerlings growth performance.

Table (1): Composition of the scientific diet.

Ingredients	Amounts used (g)
Fish meal (63% protein)	25
Soy bean (44.8% protein)	46
Plant oil	2
Fish oil	3
Wheat bran	24
Total	100

Table (2): Composition of the commercial diet.

Ingredients	Amounts used (g)
Fish meal (63% protein)	10
Soy bean (44.8% protein)	50
Cotton seed meal (35% protein)	20
Yellow corn (9.6% protein)	10
Wheat bran	5
Wheat flour	5
Total	100

Results and Discussion:

-Results:

The results of the tested diets (commercial and scientific diets) on *O.aurues* fingerlings reared at 20‰ salinity are summarized in table (3).

The results showed a significant effect ($P<0.05$) of the tested diets on the growth rates and feed conversion of *O.aureus* fingerlings reared at 20‰. The best growth rates (ADG, % weight gain, SGR) were significantly higher ($P<0.05$) at fingerlings fed the scientific diet. Although starting from nearly the starting from nearly the same initial weight (11.32g), the final weight showed a different trend. The final weight of the fingerlings fed the SD was higher (16.81g) than those fed on the CD (13.86g) and consequently gained more weight (5.47g) at the end of the experiment. Regarding the amount of food given, the fingerlings fed the CD ate more food (3.62g) than those fed on the SD (3.48g) ($P<0.05$).

Table (3): Growth rates and feed conversion efficiency of *O.aurues* fingerlings reared in 20‰ water salinity.

Parameters	Scientific diet	Commercial diet
Initial weight (g/fish)	11.34	11.31
Final weight (g/fish)	16.81	13.86
Food given (g/fish)	3.48	3.62
Weight gain (g/fish)	5.47	2.55
Daily weight gain (g/fish)	0.18	0.085
%Weight gain	48.23	22.54
Specific growth rate %	0.56	0.3
Feed conversion	0.63	1.41

The same trend was observed on the fingerlings regarding feed conversion. The worst FC was noticed on the fingerlings fed the CD (1.41), comparing to SD (0.63), again despite the amount of food eaten by the two groups of the fingerlings.

Finally, the mortality was almost negligible for the fingerlings fed on both the SD and CD, where within the time of the experiment we recorded the death of only one fingerling at the acclimation period and was replaced by another one of the same weight and salinity.

The swimming activity did not differ among the two fingerlings during the course of the experiment.

Discussion:-

Blue tilapia (*O.aureus*) has supported a large commercial fishery and has been used as an aquaculture species in Africa and the Middle East for many years (Spatura and Zorn, 1978). It is most commonly found in fresh water, but can also inhabit brackish and saline waters (Shafland and Pestrak, 1982; Trewevas, 1983).

It is worth to mention that we chose the tested water salinity in this research (20‰) according to many studies which candidate this degree (Wohlfarth and Hulata, 1981; Mansour and Lahlah, in print). This experiment demonstrated that the SD is more appropriate than CD to rear *O.aureus* fingerlings in brackish water (20‰). The better growth rate and feed conversion were obtained from fingerlings fed on the SD.

The better performance of *O.aureus* fingerlings fed SD than those fed CD is due to the fact that the SD provided fingerlings with the most feeding elements required in this exotic conditions that they submitted (meaning rearing them in brackish water). On the one hand, the SD contains more protein (35%) than the CD (28%), and on the other hand, the SD provided the fingerlings with a very important component (fish oil) needed by fish in general, especially when reared in brackish water. So, these missing elements from the CD make it an inappropriate diet for *O.aurues* fingerlings at 20‰.

Several studies were conducted to investigate the protein requirements of tilapias, and many are in agreement with the present study. For example, *O.niloticus* required a 35% protein for the best growth (El-Sayed, 2006), a diet containing 35% protein produced the optimum growth and most efficient feed utilization of red tilapia fingerlings (Mansour, 1997). *O.niloticus* fingerlings required also 35% protein for optimum growth (Teshima *et al*., 1985). Optimal growth of *O.niloticus* young (6.1-16.5g) occurred at 30% dietary protein level (De Silva and Radampola, 1990). Jauncey (1982) found that 40% protein was required for *O.mossambicus* fingerlings. In the mean time, protein requirements of tilapia hybrid (*O.niloticus x O.aureus*) were 32% (Shiau and Huag, 1990). These differences in protein requirements according to these various studies may be due to culture conditions, fish size, species, protein and energy sources. It is worth to mention that all the above mentioned studies were performed at fresh water environment. There is a scarcity of information about the dietary protein requirements of tilapias (including the test species) at more saline water.

As far as we know, no studies have approached the effect of oils on growth performance of *O.aureus* reared at brackish water, and information about this matter is rare. It is well known that dietary lipids are the source of essential fatty acids (EFA's) that are necessary for normal growth and survival of fish (NRC, 1981, 1983). These acids cannot be synthesized by the fish, therefore, they should be provided in the food. In general, marine fish require n-3 highly unsaturated fatty acids (HUFA), while fresh water fish, including tilapias, require n-6 fatty acids (Kanazawa *et al*., 1980; Rodriguez *et al*., 1997). The interactive effect of dietary lipids and water salinity on growth and survival of tilapia species is not clear. Tilapias are tropical, herbivorous fish which are able to live in both fresh water and brackish water and can tolerate full strength sea water. Such unique aspect of tilapia in the ecological and physiological viewpoints assumes that their EFA requirements are probably different from other fish (Kanazawa *et al.*, 1980), in which they need dietary n-6 fatty acids than n-3 and HUFA.

The question that should be asked is whether these n-6 requirements change with any change in water salinity. El-Sayed *et al*. (2003, 2005) have emphasized that when rearing Nile tilapia broodstock and larvae at 7 and 14‰ water salinities, a source of n-3 FA (fish oil) must be added to the diet. It may be in the current study that the bad effect of the CD

on fingerlings growth is due to the lack of the source of both n-6 and n-3 fatty acids in the CD, while the SD is rich in these components (the presence of both plant oil and fish oil).

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