The Effect of Three Oils Sources in the Diets on the Performance of Siganus Rivulatus Fingerlings Cultured in Tanks

Aziza gerdy[#1], Mouaina Badran[#2], Mohamad hasan[#3]
[#1] *Master student, Department of Biology, High Institute of Marine Research, Tishreen University, Syria*
[#2] *Lecturer, Department of Biology, High Institute of Marine Research, Tishreen University, Syria*
[#3] *Assistant Professor, animal production Department , Faculty of Agriculture, Tishreen University, Syria*

Abstract

The aim of the present study was to evaluate the effect of adding three sources of oils in the diets on the performance of Siganus rivulatus fingerlings cultured in tanks.

The fingerlings were caught from the marine coastal waters during May 2016, subjected to adaptation period of seven days, and then distributed in four experiment ponds with 30 individual/pond .The fingerlings were fed on a diet containing 30% plant protein, 8% of three different oils; fish oil, sunflower oil, and linseed oil were added in three tanks, whereas the fourth one considered as control had no oil addition.

results showed that the fingerlings fed on the linseed oil diet, had the best final weight and the best FCR (Feed Conversion Ratio) (1.76) followed by fish oil diet with FCR =2.36. The results also showed no significant difference when sunflower oil diet and control were compared with FCR= 3.29, 2.50 respectively. Fingerlings showed a good response to the new conditions after about a week of rearing process start and had a grey color. In addition, the survival rate was (96%).

Keywords - *Siganaus rivulatus – Oils – Diets Growth – Fingerlings.*

I. INTRODUCTION

Carbohydrates, Proteins, lipids, minerals and vitamins are all required for fish growth and reproduction, and therefore should be supplied in the artificial feed used in aquaculture. Globally, artificial feeding constitutes between 60-70% of the total farming costs. So, the quality and quantity of food for farmed fish would contribute to the sustainable development of aquaculture[1].

Lipids are one of the most studied fish nutritional requirements but earlier focusing specially on some aspects of the fat metabolism, in poly unsaturated fatty acids(PUFA).So, their metabolism is clearer in fish compared to other vertebrates including mammals [2] .

Lipids are also one of the most important essential sources of energy in fish feed, and contribute to increasing the flexibility of the cell membrane of marine fish and their water pressure resistance [3].They provide fish in essential Fatty Acids (EFA) that are important for a best growth [4]. Fish is different from other vertebrate by its containing of the highly unsaturated fatty acids (HUFA), particularly Omega (n-3), that are very important for health, for instance; the nervous system development and the prevention of a range of diseases such as cardiovascular disease and neurological disorders. In consequence, many recommendations have been suggested to include this fat in the human daily diet [5].

Indeed, most of the fatty acids structured in fish are usually saturated, whereas the unsaturated ones (PUFA) should be added to fish diets to ensure optimal growth and productivity [6]. Generally, a fat level of at least 4-6% is used in the commercial feeds for many fish species.

Until recently, fish oil was widely used as a source of fat in the fish diets because of their contents of balanced levels of unsaturated fatty acids PUFA that provide all fat nutritional requirements for fish, particularly marine species [7].

But nowadays, using of fish oils as essential source of fat in fish dietis not viable and couldlimit the aquaculture activities, thus an urgent need to find appropriate alternatives is crucial [8] .

Lately, vegetable oils (corn oil, linseed oil, soybean oil, sunflower oil, etc..) were used as sustainable alternatives, and available as oils rich in unsaturated fatty acids (C18). But these oils lack the highly unsaturated long-chain fatty acids C20 -22 HUFA available in fish oil [9]. So, many researches were done to study the possibility of substituting partly or wholly of fish oil with vegetable oils in the fish diets, and to determine the dietary fat requirements for different marine fish species candidate for aquaculture as these requirements vary according to the species [10].

Locally, in Syria only one study on the Golden grey mullet *Liza aurata* was achieved, where the author compared the effect of the content of diets of animal oil and vegetable oil on the behavior and growth of this species fingerlings [11]. Here, we focus in the current study on another indigenous fish species that economically important and candidate for aquaculture, the Marbled spinefoot *Siganus rivulatus*, and was tested the effect of adding three sources of oils (fish oil, sunflower oil, linseed oil) in the diets on the performance of this species fingerlings cultured in tanks Figure (1).

Fig 1: The general form of the species *Siganus rivulatus*

II. MATERIAL AND METHODS

A. Sampling and fingerling handling

The fingerlings of *Siganus rivulatus* were collected directly from the coastal marine waters (35-35-515N,35-44-491E) Lattakia, Syria (salinity 38 ‰) during May 2016.

Fingerlings were placed for acclimatization in a basin for two days without feeding, and then they were fed on a 30% protein diet for two weeks in order to assure their prior adaptation to the pellets.

After the acclimatization period and just before starting the experiment, the standard length and weight of fingerlings were measured, then they were selected according to their sizes. Thirty fingerlings were distributed in each of four polyethylene tanks (500 liters) Figure (2) .

Fig 2:The tanks of polyethylene.

B. Preparation of the diet and fingerlings feeding

The diets were prepared by mixing all the ingridients with oil and distilled water to have homogeneous and tenacious final product ([12], [13],[14], [15]) then the mixtures were dried at 65 C° for 24 hours, and pellets were prepared according to fingerlings size mouth. Diets were finally stored in special containers until their use.

A diet containing 30% protein was used with soybean meal (42.5% protein) and cotton meal(20.7% protein) as protein source. Four different diets were prepared, the first one contained 8% of fish oil, the second of linseed oil, the third one of sunflower oil, whereas the fourth one was considered as control where no oil was added. Table (1) shows the components of the four diets used in this study.

Table I. The ingredients (g) of diets used.

The Ingredients	Diet1	Diet 2	Diet 3	Diet 4 (control)
Soybean meal	54	54	54	46
Cotton meal	34	34	34	50
White bran	4	4	4	4
Fish oil	8	-	-	-
Linseed oil	-	8	-	-
Sunflower oil	-	-	8	-
Without oil	-	-	-	-
Total (g)	100	100	100	100
Energy kcal/100g*	677.6	677.6	677.6	654.8

* Gross energy was calculated as one gram of fat, protein and sugar gives 4.1, 6.65 and 9.5 calories respective

The fingerlings were fed on the four diets *Ad libitum* for eight weeks from 9/6/2016 to 9/8/2016, twice daily at 10 am and 3 pm.

During the experiment period, basins were cleaned daily; 25% of water were also changed daily and the whole tanks water weekly; dissolved oxygen, water temperature and pH were also measured daily at 10 a.m.

Mean initial total length of fingerlings was 7.75 cm, and the weight of 8.5 g; the mean final weight at the end of experiment was recorded. Feed Conversion Ratio (FCR), Average daily gain, Percentage weight gain and Specific growth rate were calculated as follows:

Feed Conversion Ratio (FCR)= feed intake (g) /weight gain(g).

Average daily gain(g)= Final weight(g) – Initial weight(g) /experiment time (day).

Percentage weight gain=Final weight(g) – Initial weight(g)/Initial weight(g) x 100

Specific growth rate= Final weight(g) –Initial weight(g)/experiment time(day) x 100.

All data were analyzed using the SPSS software, with one-way ANOVA Test. Significant differences were defined as $p < 0.05$.The means were compared using the least significant difference (LSD) at the 5% level.

III. RESULTS AND DISCUSSION

A. Water hydrological changes

The average water temperature in the four experiment tanks was 28 C° during the first month of rearing period, and 29.6C°during the second one; the lowest water temperature was recorded in June (24.5 C°) and the highest one was in august (31.5 C°). Dissolved oxygen varied between 3 – 5 mg/l, and pH between(7 – 7.8).

B. Fingerlings Behavior:

Some behaviors concerning *S. rivulatus* were noted; so the fingerlings were gathered in tanks corners and behind filters during the acclimatization period. This comportment was also repeated when the fingerlings were distributed in the experiment tanks and after each sampling [16].

Fingerlings showed a good response to the new conditions after about a week of rearing process start and had a grey color. But the hiding comportment was continued during the experiment, probably due to the characteristics of this fish family related to its habitat of rocky or sandy bottoms covered with algae and seaweed [17].

The fingerlings used to take food during thirty minutes of their deposit in tanks, as one individual firstly moved to the food followed by all of the pack, this comportment is well known in many fish species [18]. Besides, the fingerlings started feeding when the location was calm that indicate the effect of noisy on fish feeding or in their habitat either in farms [19].The mortality rate was very low during the rearing period, it was not more than 4% caused by the fingerlings handling during the sampling and tanks cleaning.

C. Growth Rate and Feed Conversion

Figure (3) and table (2) shows the results of fingerlings growth and eed Conversion, it was noted that fingerlings fed on the diet containing linseed oil had given the greatest final weight 14.48g and the best feed conversion 1.76, followed by fish oil diet 14.73g and 2.36 respectively. Whereas the sunflower and control diets had given proximate values of final fingerlings weight reaching 12.25g and 12.40g, and FCR values of 3.29 and 2.50 respectively.

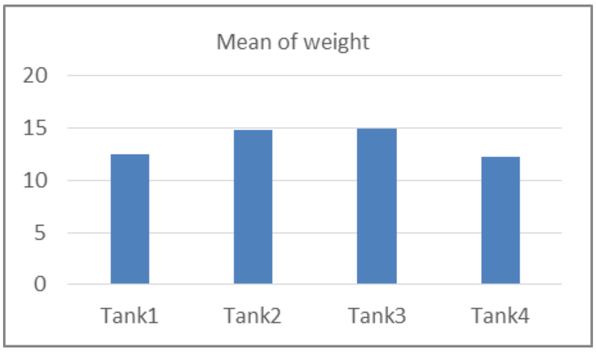

Fig 3: The mean of final weight of Siganus rivulatus

Statistical analysis of data using ANOVA Test and LSD, $p < 0.05$ showed significant differences concerning the final weight between linseed oil diet and; sunflower oil diet and control, whereas no significant values were found with fish oil diet. In addition, significant differences were recorded when comparing fish oil as lipids source with sunflower and control diets, whereas no significant values were recorded when sunflower and control were compared.

It was focused in this study for the first time in Syria on an indigenous fish species candidate for aquaculture, the Marbled spine foot *Siganusrivulatus*, and tested the effect of adding three sources of oils; fish oil, sunflower oil and linseed oil in the diets, on the performance of this species fingerlings reared in tanks.

The results concerning fingerlings comportment as their gathering in tanks corners and behind filters during the acclimatization period, during their distribution the tanks and after each sampling; the hiding and feeding comportment were all in agreement with those of [20].

The mortality rate of *S.rivulatus* fingerlings cultured in tanks was null during the acclimatization and very low during all rearing period. These results were previously noted on the same species where the survival was 100% [21], that indicate a good adaptation of *S. rivulatus* to aquaculture conditions.

The results also showed that all diets used had good FCR values with a preference of linseed oil diet that reached 1.76. This value is better than those obtained in [22] study on *S. rivulatus* fingerlings reared in glass tanks (50 litres) with an initial weight of 4 g and 35% protein diet, where the FCR was 3.20 – 3.80. This could be explained by the difference of fingerlings sizes, diets components and rearing conditions.

The linseed oil diet used in this study was better than fish oil despite the fact that this later is the most lipids source used in fish nutrition as it contains all of essential fatty acids specially DHA and EPA necessary for fish growth [23], and the majority of diets used in aquaculture includes this oil.

However, *S. rivulatus* is considered as herbivorous fish species that prefers protected areas and feeds mainly by grazing on algae. This fact could explain the preference of linseed oil diet by the fingerlings reared in our study [24]. Indeed, linseed oil is the most plant oil similar to fish oil with a few of differences in the fatty acids types that do not affect the growth rate, so it is very common in fish diets as an alternative of fish oil [25]. Besides, the initial weight of fingerlings used in this study was 7.75 g and their size 8.5 cm, so they were not in early stages that need fish oil for their optimal growth [26].

Many studies have been achieved on other fish species to test the effect of plant oils in their diets, for instance [27] used linseed oil and sunflower oil in the diets of *Sparusaurata* fingerlings with an initial weight of 4 g, reared in tanks (50 litres) and fed on 46% protein and 18% lipids diets. Although, *S. aurata* is a carnivorous fish species, the sunflower diet provided the best growth, that could be explained by the presence of various animal protein resources in their diet.

This could support the idea of replacement the fish oil by a plant oil when the diet contains animal protein resources specially fish meal.

In conclusion, our results indicate that the linseed oil diet had the best effect on the performance of *S. rivulatus* fingerlings reared in tanks. Consequently, it could be practical to use this oil instead of fish oil in its diets. As well, more experiments are needed to better establish a comprehensive picture of oils requirements of *S. rivulatus* during rearing periods and for different age stages.

Table II. Growth (g) and Feed Conversion Rate of *Siganus rivulatus*

Protein source and percentage	30% plant protein			
source and percentage Lipids	**Diet 1 8% fish oil**	**Diet 2 8% sunflower oil**	**Diet 3 8% linseed oil**	**Control 0% oil**
Initial weight	9.67	9.33	7.31	7.63
Final weight	14.73	12.25	14.88	12.40
Weight gain	4.97	2.92	7.17	4.77
Food given	12.61	13.1	13.11	9.16
Average daily gain	0.08	0.04	0.12	0.07
Percentage weight gain	50.9	31.2	101.5	62.3
Specific growth rate\	0.179	0.119	0.305	0.211
FCR	2.36	3.29	1.76	2.50
Fingerlings number	28	30	28	30

REFERENCES

[1] M.R.Hasan, "Nutrition and feeding for sustainable aquaculture development in the third millennium Aquaculture in the third millennium." Aquaculture in the third millennium, Technical proceedings of the conference on aquaculture in the third millennium, Bangkok, Thailand, Vol. 20, p. 25, 2000.

[2] J.Bell, D. R. Tocher, "Farmed Fish: The impact of diet on fatty acid compositions." Oils and Fats Handbook, pp. 171-184 , 2009.

[3] J.R.Sargent, L. A. McEvoy, and J. G. Bell, "Requirements, presentation and sources of polyunsaturated fatty acids in marine fish larval feeds." Aquaculture, PP.117-127, 1997.

[4] J.Ghanawi, L. Roy, "Effects of dietary lipid levels on growth performance of marbled spinefoot rabbitfish Siganus rivulatus." Aquaculture, PP 395-400, 2011.

[5] J.Orsavova, L. Misurcova, "Fatty acids composition of vegetable oils and its contribution to dietary energy intake and dependence of cardiovascular mortality on dietary intake of fatty acids." International journal of molecular sciences 16(6), PP. 12871-1289, 2015.

[6] M.Hedayatifard, M. Yousefian, "The fatty acid composition of golden mullet fillet Liza aurata as affected by dry-salting" J. Fish. Aquat. Sci 5, PP 208-215, 2010.

[7] A.Jackson, J. Shepherd, "Connections between farmed and wild fish: fishmeal and fish oil as feed ingredients in sustainable aquaculture." Advancing the Aquaculture Agenda, Workshop Proceedings, pp. 331-343, 2010.

[8] J.Bell, G. R. Waagbø, "Safe and nutritious aquaculture produce: benefits and risks of alternative sustainable aquafeeds." Aquaculture in the Ecosystem, PP. 185-225, 2008.

[9] G.M.Turchini, W. K. Ng, "Fish oil replacement and alternative lipid sources in aquaculture feeds". CRC Press. 2010.

[10] D.R.Tocher, "Fatty acid requirements in ontogeny of marine and freshwater fish". Aquaculture Research 41(5), PP. 717-732, 2010.

[11] M.Badran, "Liza aurata fry Culture in different protein content lipid content and water salinitiesmaine". Phd thesis, Department of Marine Biology, High Institute of Marine Research, Tishreen University, p. 95, 2013.

[12] A.M.El-Sayed, "Protein requirements for optimum growth of Liza ramada fry (Mugilidae) at different water salinities". Aquatic Living Resources 4(2), pp. 117-12, 1991.

[13] A.F.M. El Sayed, "Mullet culture in qatar: effects of replacing fish meal With soybean meal on growth rates and feed utilization efficiency of liza macrolepis (pisces: mugilidae)". 1994.

[14] A.F.M. El-Sayed, C. R. Mansour, "Effects of dietary protein level on spawning performance of Nile tilapia (Oreochromis niloticus) broodstock reared at different water salinities". Aquaculture 220(1-4), pp.619-63,. 2003

[15] A.F.M. El-Sayed, C.R. Mansour, "Effects of dietary lipid source on spawning performance of Nile tilapia (Oreochromis niloticus) broodstock reared at different water salinities". Aquaculture 248(1-4), pp. 187-196, 2005.

[16] M.Badran, "culture of two syrian marine economical fingerling", thesis, Department of Marine Biology, Tishreen University, Syria, 2008

[17] T.Wray, W.F. Authority," Commercial fishes of Saudi Arabia". 1979.

[18] C.I.Martins, L. Galhardo, "Behavioural in dicators of welfare in farmed fish". Fish Physiology and Biochemistry, 38(1), pp. 17-41, 2012.

[19] H.Slabbekoorn, N. Bouton, I. van Opzeeland, A. Coers and A. N. Popper "A noisy spring: the impact of globally rising underwater sound levels on fish." Trends in ecology & evolution, pp. 419-427, 2010.

[20] M.Badran, "culture of two syrian marine economical fingerling marine biology." M. Thesis, Department of Marine Biology, High Institute of Marine Research, Tishreen University, pp. 89, 2008.

[21] I.P.Saoud, M. Chadi, and G. Joly "Effects of temperature on survival and growth of juvenile spinefoot rabbitfish (Siganus rivulatus)". Aquaculture Research 39(5), pp.491-497, 2008.

[22] P.Saoud, J. Ghanawi, N. Lebbos, and A. Davis "The Effect of Linseed Oil and Kelp Meal in Diets on Fatty Acid Profile of Rabbit fish Siganus Rivulatus." Mediterranean Aquaculture Journal, PP. 36-44, 2010.
[23] R.C.Mansour, "Nutritional requirements of Nile tilapia broodstock reared at different water salinities", Ph.D. thesis, Alexandria University, Alexandria, Egypt. 2001.
[24] C.J.George, "Notes on the breeding and movements of the rabbitfishes, Siganus rivulatus (Forsskål) and S. luridus Rüppell, in the coastal waters of the Lebanon." Annali del Museo Civico di Storia Naturale de Genova, PP. 32-44. 1972.
[25] C.Regost, J. Arze, J. Robin, G. Rosenlund, and S. J. Kaushik "Total replacement of fish oil by soybean or linseed oil with a return to fish oil in turbot (Psetta maxima)" Aquaculture, pp. 465-482, 2003.
[26] M.V.Bell, D. R. Tocher "Biosynthesis of polyunsaturated fatty acids in aquatic ecosystems: general pathways and new directions." Lipids in aquatic ecosystems, Springer, New York, NY, pp.211-236, 2009.
[27] E.A.Wassef, S. H. Shalaby, and N. E. Saleh. "Comparative evaluation of sunflower oil and linseed oil as dietary ingredient for gilthead seabream (Sparus aurata) fingerlings." OCL, 22(2). A201, 2015.