The Effect of Aquafat- Omega in Some Reproductive Aspects of Nile Tilapia *Oreochromes niloticus*

Muhammad A. AL-Samarrai\(^1\), Luay M. Abbas\(^1\) and Abdulkareem J. Abu Elheni\(^1\)

\(^1\)Ministry of Science and Technology, Agricultural Research Directorate, Iraq.

Email: Mhameda165@gmail.com

**Abstract**

The aims of the present study were to assess the effects of the replacement graded of Aquafat-O levels (0, 1, 2 and 3%) instead of corn oil and the effect of this substitution on some male and female Nile tilapia for 4 weeks. The results obtained showed that 3% gave the best values in male and female Nile tilapia, absolute and relative fecundity of it can be concluded that the replacement of corn oil at the level of 3% of the Aquafat-O® was the best in the previous measurements and can be used as an Aquafat-O as a catalyst for growth because of its importance in fish farming and hatchery in addition to its role in increasing immunity and health.

Key words: Tilapia, Nutrition, Freshwater Fishes, Aquafat-Omega.

1. Introduction

Tilapia fish are belonging to the family *Cichlidae* that settle in the river, running water and lakes in many countries. This family is consisting of about 100 types that subdivided into three major species include: *Tilapia, Oreochromis*, and *Sarotheradon* [1]. The Nile tilapia is an African warm water fish and this fish are widespread worldwide in Africa, Southeast Asia, United States of America, Latin America and other countries [2].

Nile tilapia is considered one of the most important freshwater fish species that is cultured world widely [3]. This species have many benefits characteristics such as fast growth, tolerate different environmental conditions, high resistance to diseases and the possibility of benefiting from natural food and synthetic food that exist in its environment and convert it to animal protein with high nutritional value, this species can also tolerate the low dissolved oxygen concentrations in its environment [4]. Parents Nile tilapia are also considered the cradle of laying eggs for the period from April to September. Therefore, Nile tilapia comes in the second rank after carp fish as the freshwater fish that scattered around the world [5]. Females have a unique way to incubate fertilized eggs in their mouth until they hatch [6].

The availability of adequate food and nutrient can have important effects due to the production of the required energy for the fish growth and reproduction and that lead to early maturation of the fish and production of more gametes due to the improvement in the metabolic processes [7]. It is known that the lipids and especially the content of essential fatty acids play an important role in improving the quality of eggs and larvae [8]. The requirements of essential fatty acids usually vary from one species to another.

In general, freshwater fish require a high level of \(n-6\) fatty acids in the food that provided to them because of its importance in egg production and increasing the number of eggs and larvae resulting from each hatchery and increasing the number of hatched eggs per female [9]. This gives an indication that tilapia fish can benefit from vegetable oils rich in \(n-6\) fatty acids compared to those that contains the \(n-3\) fatty acids. Therefore, the main objective of this study were to evaluate the effects of added graduated levels of Aquafat-O instead of the diet which provided to parents Nile tilapia fish and the effect of this replacement on some reproductive traits of the male and female Nile tilapia parents for 4 weeks.
2. **Materials and Methods**

The experiment was conducted in laboratory of the Seed Technology Center in Samarra City by cooperation with Animal and Fish Center / Agricultural Research Directorate.

2.1 **Preparation of the farm and fish**

The fish farm was prepared to receive the fish that was purchased from the Fish Research Unit of the College of Agriculture / AL- Mansoura University. The fish were stored in plastic tanks for two weeks before starting the experiment as an acclimatization period, fish was fed during this period on the control diet. The fish were placed in 1 cubic meter plastic ponds opentop and are supplied with fresh groundwater.

Mature males and females were separated from each other in the plastic ponds during the acclimatization period. These ponds were equipped with an air pump device to continuously supply air and ensure no oxygen depletion in the tanks.

After the parents showing the signs of sexual maturity, males and females were mixed in single pond and according to the sex ratio (3 females: 1 male per pond). The temperature was measured daily. The dissolved oxygen and pH was measured also. Figure 2. showing the differences between male and female fish and their incubation of the fertilized eggs:

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**Figure 1.** Plastic tank for tilapia culture

Mature males and females were separated from each other in the plastic ponds during the acclimatization period. These ponds were equipped with an air pump device to continuously supply air and ensure no oxygen depletion in the tanks.

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2.2. Experimental Groups

This study consisted of 4 experimental groups (3 replicates per each group) as shown in the table (1) below:

| Groups  | Description                                      |
|---------|--------------------------------------------------|
| Group 1 | Contain 5% corn oil (Control Diet)               |
| Group 2 | Contain 4% corn oil + 1% Aquafat-O               |
| Group 3 | Contain 3% corn oil + 2% Aquafat-O               |
| Group 4 | Contain 2% corn oil + 3% Aquafat-O               |

The fish were fed during the experiment which lasted for 4 weeks on the basis 2% of the biomas. The daily feed was given at 9 am, 12 am and 3 pm.

The Aquafat-O was purchased from Noril Egypt. The table 2. showing the chemical composition of the Aquafat-O according to the Noril Egypt company analysis:

| Ingredient   | Composition Percentage % |
|--------------|--------------------------|
| Crude Fat    | 84                       |
| Ash          | 4.5                      |
| Calcium      | 8                        |
| Moisture     | 3.5                      |
| Antioxidant  | 0.01                     |
Table 3. Fatty Acids Content of the Aquafat-O According to the Noril Egypt company analysis:

| Fatty Acids Types | Composition Percentage % |
|------------------|---------------------------|
| Saturated Fatty Acids |                           |
| Myristic          | 1.4                       |
| Palmitic          | 30.1                      |
| Stearic           | 4.3                       |
| Total             | 35.8                      |
| Unsaturated Fatty Acids |                     |
| Palmitolic        | 0.8                       |
| Oleic             | 37.75                     |
| Linoleic          | 19                        |
| Linolenic         | 6.65                      |
| Total             | 64.2                      |

2.3. Diet Components

The main diet components were supplied from the local markets in the Arab Republic of Egypt, where a diet containing 30% crude protein was used (the materials were mixed together in each diet with partial substitution of corn oil with Aquafat-O at the levels (1, 2, 3 %).

Table 4. The combinations of the used diets.

| Ingredient | Control (0) | 1   | 2   | 3   |
|------------|-------------|-----|-----|-----|
| Fish Meal  | 10          | 10  | 10  | 10  |
| (70% Crude Protein) | 12          | 12  | 12  | 12  |
| Corn gluten (60% Crude Protein) | 28          | 28  | 28  | 28  |
| Soybean (44% Crude Protein)       | 20          | 20  | 20  | 20  |
| Yellow corn  | 20          | 20  | 20  | 20  |
| Broken Rice | 5           | 4   | 3   | 2   |
| Corn Oil   | 0           | 1   | 2   | 3   |
| Aquafat-O  | 4           | 4   | 4   | 4   |
| Molasses   | 1           | 1   | 1   | 1   |
| Multivitamins | 89.99     | 90.34 | 90.97 | 90.05 |
| Crude Protein | 33.20     | 32.80 | 33.05 | 33.30 |
| Ether Extract | 7         | 7.71 | 7.84 | 7.50 |
| Ash        | 5.32        | 5.58 | 5.79 | 5.76 |
2.5. Fish samples and the used measurements:

At the end of the experiment, the abdominal cavity of the mature male and female Nile tilapia used in the experiment was opened to extract the gonads (testes and ovaries) as well as the liver to perform the following fish body calculations:

- Gonado Somatic Index (GSI) = \( \frac{\text{Testes or ovaries weight}}{\text{Body Weight}} \times 100 \)
- Hepato Somatic Index (HSI) = \( \frac{\text{Liver Weight}}{\text{Body Weight}} \times 100 \)
- Condition Factor (k%): Is a biological relation between the length and the weight as described in the following equation:

\[
\text{Condition Factor} = \frac{\text{Fish Weight}}{\text{Fish Length}^3} \times 100
\]

The eggs were counted and correlated with the weight of the ovary or the weight of the fish for the following measurements [11]:

- Absolute Fecundity (AF) = Total eggs weight (gm) \times \text{number of the eggs in one gram}
- Relative Fecundity (RF) = \( \frac{\text{Absolute Fecundity}}{\text{Fish Weight (gm)}} \)

2.6. The statistical analysis:

Statistical analysis was performed with statistical program (SPSS, 2001). The General linear model (GLM) test was used to analyses all the obtained data in one direction.

3. Results and Discussion:

Condition Factor (k%) and Body Indices:

Table 6. The effect of replacing corn oil with different levels of Aquafat-O in the Nile tilapia diets on the Condition Factor (K%), Gonado Somatic Index, and the Hepato Somatic Index of mature Nile tilapia males and females:

| Level of Aquafat-O | Females | Males |
|-------------------|---------|-------|
|                   | K       | HSI   | GSI   | K     | HSI   | GSI   |
| 0                 | 1.70b   | 2.59b | 2.52b | 1.63  | 2.11b | 0.48b |
| 1                 | 1.74b   | 2.41b | 3.25b | 1.76  | 2.12b | 0.79b |
| 2                 | 1.80b   | 2.33c | 3.14a | 1.73  | 2.19b | 0.73b |
| 3                 | 1.85a   | 2.76a | 3.35a | 1.77  | 2.52a | 1.06a |
| ±SE               | 0.036   | 0.13  | 0.184 | 0.086 | 0.087 | 0.059 |
| P-Value           | 0.034   | 0.14  | 0.009 | 0.672 | 0.014 | 0.0001 |

From the obtained results showed in table (6) the females showed that there was a significant increase in both of the condition factor (K%) and the GSI, but there where non-significant differences in the HSI between the experimental groups. On the other hand, the males showed that there was a significant increase in both of the GSI and HSI, but there where non-significant differences in the condition factor (K%) between the experimental groups.
In this regard, a study done by [12] showed that the body indices (GSI and HSI) were not significantly affected by the source of the dietary fat. However, it was observed that the hybrid tilapia when was fed on diets containing palm oil showed a significant increase in GSI for both males and females. The condition factor (K%) is considered as a biological aspect to measure fish quality. The results of this study showed that the condition factor (K%) in females was increased by increasing the Aquafat O concentrations in the diet. However, there was non-significant differences in the condition factor (K%) in males between the experimental groups. The variations between males and females may be due to the difference in the lengths and weights between the males and females, in addition, the condition factor can also affect the fish reproductive cycle [13]. The obtained results from this study was not agreed with the study of [9] where he noticed that the Nile tilapia females refrain from eating during the incubation period of eggs to protect the larvae in its mouth and this refrain can decrease the females condition factor. The HSI is considered as an indicator of the physiological status of the liver and it can be affected by several factors such as physiological status of the fish, environmental factors, the nutrition, and many studies that used different types of dietary fat in fish diet have revealed their effect on the hepato-somatic index. [14] showed that the HSI was increased by increasing the palm oil in the Nile tilapia diet and it agreed with the results of this study which showed that the adding of the Aquafat O to the Nile tilapia diet was significantly increasing the HSI in the males and females.

**Table 7.** The effect of replacing corn oil with graduated levels of Aquafat-O in the Nile tilapia diets on the ovary measurements.

| Ovary Measurements | Levels of Aquafat-O | ±SE | P-Value |
|--------------------|---------------------|-----|---------|
|                    | 0                   | 1   | 2       | 3       |
| Ovary Weight (gm)  | 3.35                | 4.86| 4.7     | 4.63    | 0.789  | 0.521  |
| Ovary Length (CM)  | 3.41                | 4.25| 4.3     | 4.1     | 0.26   | 0.102  |
| Ovary Volume(cm³)  | 2.70                | 4.58| 3.93b   | 3.90b   | 0.187  | 0.0001 |
| Ovary density      | 1.13                | 1.30| 1.29    | 1.36    | 0.087  | 0.192  |
| Diameter of egg (mm) | 1.50               | 1.68| 1.56    | 1.56    | 0.063  | 0.275  |

The results in table (7) showed increase in the ovary measurements values in the diets that contained the Aquafat-O in comparison to the control group. The GSI is considered as a maturity indicator in many fish species [15]. The results of this study indicated that the increasing of the Aquafat-O concentrations in the Nile tilapia diets resulted in enhancement of the GSI for both males and females and an improvement in the females ovary measurements.

**4. Female Fertility**

The results in Figure3. showed that there is a significant increase in both absolute and relative fecundity as a result of increasing the Aquafat-O in the diets where group 4 (3% Aquafat-O) gave the highest and the best value in comparison to the other experimental groups. These differences may be attributed to the Aquafat-O contents of the unsaturated fatty acids that play an important role in the growth and maturation of the ovary tissues, the lipid and the fatty acids in the diet of the mature female play an important role in the success of the reproduction process in addition to the role of the high unsaturated fatty acids in the fecundity and the fertilization rate and improvement of the egg quality [16]. In this study, the improvement of GSI and the ovary measurement values gave an indication that the amount of energy transferred to the ovary was high and that resulted in the highest number of eggs.
Figure 3. The effect of replacing corn oil with different levels of Aquafat-O in the Nile tilapia diets on (a) Absolute Fecundity, (b) Relative Fecundity of Nile Tilapia females.

References

[1] Pompa T. and Masser M. 1999 Tilapia, Life History and Biology. Southern Regional Aquaculture Center, Publication No. 283: 4
[2] Khalil, F.F.M. 2007 Scientific and Practical Principles of Fish Farms, Part II, Breeding, Production and Management of Fish Farms, First Edition, Mansoura University Press, Egypt, 370.
[3] Beveridge M.C.M. and McAndrew, B.J. 2000. Tilapias: biology and exploitation. Kluwer Academic Publisher, Dordrecht.
[4] El-Sayed, A.-F.M. 2006 Tilapia Culture (book). CABI Publishing is a division of CAB International. UK. ISBN-13: 978-0-85199-014-9.
[5] FAO, 2010. The State of World Fisheries and Aquaculture. Rome. 197
[6] Abd-Alhameed, A.A. 2009 Foundations of Fish Production and Culture, Modern University Office Press, Alexandria, Egypt. 291.
[7] Wootton, R.J. 1990 Ecology of teleost fishes. Chapman and Hall Ltd, London.
[8] Sink, T.D. and Lochmann, R.T. 2008. Effects of dietary lipid source and concentration on channel catfish (Ictalurus punctatus) egg biochemical composition, egg and fry production, and egg and fry quality. Aquaculture, 283(1-4):68-76.
[9] Weatherly, N.S., 1987. The diet and growth of 0-group dace, Leuciscus leuciscus (L.), and roach, Rutilus rutilus (L.), in a lowland river. J. Fish Biol. 30:237-247.
[10] AOAC 2000. Association of Official Analytical Chemists of official methods of analysis, 17th Ed. Washington, DC.
[11] Bhujel, R. C. 2000. A review of strategies for the management of Nile tilapia (Oreochromis niloticus) broodfish in seed production systems, especially hapa-based systems. Aquaculture 181:37-59.
[12] Bahurmiz, O.M. and W.K. Ng 2007 Effects of dietary palm oil source on growth, tissue fatty acid composition and nutrient digestibility of red hybrid tilapia, Oreochromis sp., raised from stocking to marketable size. Aquaculture, 262:382-392.
[13] Welcome, R.L., 1979. Fisheries ecology of floodplain rivers. London, Longman 317.
[14] Ochang, S.N., Fagbenro, O. A. and Adebayo, O.T. 2007. Influence of dietary palm oil on growth response, carcass composition, haematology and organoleptic properties of juvenile Nile tilapia, Oreochromis niloticus. Pakistan Journal of Nutrition, 6: 424-429. doi: 10.3923/pjn.2007.424.429
[15] Tyler PA, Billett DSM, Gage JD 1990 Seasonal reproduction in the seastar Dytaster grandis from 4000 m in the north-east Atlantic Ocean. J Mar Biol Assoc UK 70:173-180.
[16] Izquierdo, M.S., H. Fernandez-Palaciosand A.G.J. Tacon 2001 Effect of broodstock nutrition on reproductive performance of fish. Aquaculture, 197: 25-42.