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NUTRITIONAL AND ENVIRONMENTAL TOXICOLOGICAL INVESTIGATIONS ON FISH FARMS IN FAYOUM GOVERNORATE, EGYPT

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SUMMARY

This study was carried out in two fish farms in El-Fayoum Governorate to investigate water quality, evaluate the effect of chemical fertilizers and artificial diet on the performance and feed efficiency of *Oreochromis niloticus* and *Mugil cephalus*, and determine pesticide residues in water and reared fish. Average values of water temperature in fish farms and water source ranged between 25.6 and 30.6°C. The highest values of dissolved oxygen were observed during April while the lowest values were found in June and July. There was a negative relationship between water temperature and dissolved oxygen, a positive relationship was found between temperature and water salinity. The highest values of weight gain (270.90, 269.20g), specific growth rate (1.15,1.16), feed consumption (240.60, 270.48g) and feed conversion ratio (0.89, 1.01) of *O. niloticus* and *M. cephalus*, respectively were found in fish fed on artificial feed and reared in fertilized ponds when compared to fish fed on artificial diet only or reared in fertilized ponds without supplementary feed. The pesticide residues of chlorpyrifos ethyl and fenpropathrin were detected in water at mean levels ranged 0.10 - 0.25 mg/l. Both fish species contained fenitrothion residues at values (0.525 mg/kg and 0.255 mg/kg for *O. niloticus* and *M. cephalus*, respectively) which are higher than permissible limits. Although the residues of fenitrothion and carbaryl were not detected in water, they were found in both fish species which could be attributed to the ability of these pesticides to bioacumulate in the aquatic organisms.

Keywords: Fish farms, *Oreochromis niloticus*, *Mugil cephalus*, artificial feeding, pond fertilization, fish performance, water quality, pesticide residues.

INTRODUCTION

Fish is an important source of protein for El-Fayoum Governorate due to the presence of Qaroun Lake (55 thousand feddans) , lakes of Wadi El-Rayan (43 thousand feddans). Abd El - Rahman (1997) reported that, there are about 74 private fish farms (870 feddans) which located at the southern part of Qaroun Lake . Qaroun Lake production was reported to be 1500-1800 ton/year and this of lakes of Wadi El-Rayan is 700 ton/year (General Authority Report, 1977). Fish farms production ranged 600-1000 kg /fed./year. In such resources, different fish species are produced, among them are tilapias and mullets, which have been introduced to pond-fish-culture system many years ago and showed good growth and survival rates.

Fertilization of fish farms is the simplest and most economic way for increasing planktonic organisms, which used as natural food for increasing fish production. Also, fish yields on natural food alone are too low to cover fixed economic costs, and so supplemental or artificial feeding is required. (Collins and Delmondo, 1976).

It is recognized that nutrients content in agricultural drainage water will be beneficial in fish farms, and therefore effluent reuse is to be encouraged, but unacceptable health and environmental risks cannot be tolerated (El-Sharkawi, 1992).

The present study was carried out in two f farms irrigated by agricultural drainage water a stocked by two fish species (*Oreochromis nil cus* and *Mugil cephalus* in El-Fayoum Gover rate to cover the following points: (1) investi tion of some parameters of water quality dur the growing season of fish; (2) evaluation of effect of artificial feeding only, artificial feedi with inorganic fertilizers and inorganic ferili only on the fish performance and feed efficien and (3) determination of pesticide residues in w ter and reared fish.

MATERIAL AND METHODS

Experimental Design:

Two commercial private fish farms located at t southern part of Qarun Lake in El-Fayoum Go ernorate were investigated. Each fish farm co sists of three earthen ponds (3 feddans each) ar irrigated by Dayer El-Berka drain. In the first fi farm, artificial diet was offered in the first pon The artificial feed consists of 40% wheat bra 10% soybean meal, 21% fish meal, 27% me meal, 1.5% cotton seed oil and 0.5 vitamin a mineral premix with a total crude protein percen age of 30.0 (Table, 1). The second pond was su plied by artificial diet and inorganic fertilizer (750 g urea and 1500 g superphosphate/fed). Th third pond received the inorganic fertilizers onl which was added every ten days. All fish ponds o the second farm were left as a control with neith artificial feeding nor chemical fertilization.

The two fish farms were stocked with two fish species, *Oreochromis niloticus* and *Mugil cephalus* . 8000 fingerlings of *O.niloticus* (20.00g±0.12, 9.5 cm) plus 8000 fingerlings of *M. cephalus* (23.00 g ± 0.20, 10.5 cm) were stocked in each pond of the two fish farms.

Water quality (Physico-chemical analysis):

Composite water samples were monthly collected from each fish pond to measure the following physico-chemical parameters.

1- Temperature and Hydrogen Ion Concentration (pH).

Water temperature was measured using thermometer and pH was measured using a digital (HI 8424 microcomputer pH meter).

2- Chloride Salinity:

The water salinity (Chloride) was calculated by multiplying the value of chlorosity by a factor of 2.47 and adding 0.216 according to the chloride salinity equation for Qaroun lake (Meshal 1973) as follows:

$$S\text{‰} = [Cl\text{‰} \times 2.47] + 0.216.$$

where :

S‰ : The (chloride) salinity and Cl ‰ : the chlorosity.

The chlorosity was determined according to Moharís method as described by APHA (1992).

Table (1): The experimental feed formulation.

Ingredient	%
Wheat bran	40
Soy been meal	10
Fish meal	21
Meat meal	27
Cotton seed oil	1.5
Vitamin and mineral premix*	0.5
Nutrient composition : (Determined on dry matter basis)	
crude protein %	30.00
Ether extract %	13.89
Ash %	23.38
Gross energy (K cal/Kg)	4500
Protein/energy ratio	90

* Vitamines and Mineral mixture each 1 Kg of mixture contains: 4.8 m.I.U. Vit. A., 0.8 m I.U Vit. D3, 4.09., Vit. E, 0.8 g. Vit. K., 4.0 g., Vit B124.0g. Vit B2,0.6g Vit B6, 0.49 Selenium., 4.0g Vit. Pantothenic acid, 8.0 Vit. Nicotinic acid, 400 mg. Vit. Folic acid, 20mg Vit, Biotin, 200 g Chloride, 4.9. Copper, 0.49 Iodine, 12 g. Iron, 22 g. Manganese, 22 g. Zinc.

3- Dissolved Oxygen (D.O.):

Dissolved oxygen in water was measured in mg/l according to modified Winkelerís method (APHA 1992).

Pesticide Residues in Fish and Water:

A total of 14 random composite fish samples (7 samples *O. niloticus*, 7 samples *M. cephalus*) were collected during the growing season of fish and used to detect of pesticide residues in fish flesh according to AOAC (1980). Detection of pesticide residues in composite water samples was carried out according to the method described by Keith (1976).

Fish Performance:

Random fish samples from each pond were monthly caught to determine fish weight and to measure fish length.

1- Average Daily Weight Gain :

Average daily weight gain of fish was calculated using the following equation:

Average daily gain (ADG) =

Final weight (g) - initial weight (g.) / period (days).

2- Feed Consumption and Feed Conversion Ratio (FCR):

Feed intake (about 3% of fish weight) were recorded monthly and feed conversion ratio was calculated as the amount of dry food fed per unit live weight gain of fish.

3-Specific Growth Rate (SGR):

Specific growth rate (SGR) was calculated using the following equation:

$$SGR = (\ln W2 - \ln W1/T) \times 100$$

where : W2= the final body weight (g), W1 = the initial body weight (g),

T = period in days (30 days).

Statistical Analysis:

Statistical comparisons between means was made using one way analysis of variance (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Water Quality Data:

The average values of water temperature in all treatments of fish farms and water source are shown in table (2). Temperatures in fish farms ranged between 25.6 ± 0.23 and 30.6 ± 0.18°C.which are around the recorded temperature of El Fayoum fish farm (Mageed 1996).

It is well known that water temperature can affect food metabolism and fish growth. In this respect. Eid *et al.* (1991) reported that increasing water temperature from 16 to 27°C improved growth rate and protein efficiency ratio for tilapia (*O. niloticus*). Rackocy and Mcginty (1989) indicated that the optimum growth rates of tilapia (*O. niloti-*

cus) were obtained in temperature ranged from (28-30°C).

In the present investigation, values of pH in fish farms and water source are shown in table (3). These values in fish farms ranged between 7.95± 0.12 (ponds with artificial feeding only) in November and 8.71± 0.06 (control) in May. In general pH values of fish ponds, especially the control ones were in the alkaline side and higher than the correspoding water source values. Mageed (1996) found that the pH values were around 8.42 when he studied zooplankton assemplages and their role as natural food for the cultivated fishes in El-Fayoum fish farms.

Dissolved oxygen (mg/L) values in fish farms ranged between 6.18+0.17 (control) in July and 10.80+0.08 (ponds with artificial feeding only)in April as shown in table (4). The highest dissolved oxygen values in ponds water were observed during April which could be attributed to the photosynthesis of aquatic plants and algae, while the lowest values were found in June and July due to

Table (2): Averages of water temperature (°C) in water source and fish farms received artificial feeding (AD) only, artificial feeding with fertilization (AD+F), fertilization only (F) and with neither artificial feeding nor fertilization (control) during growing season.

Treatment / Month	Fish farms				
	Water source	AD	AD+F	F	Control
April (±S.E.)	25.6 (0.23)	26.1 (0.20)	26.00 (0.20)	26.2 (0.20)	25.9 (0.14)
May (±S.E.)	29.5 (0.18)	28.0 (0.18)	28.2 (0.18)	28.1 (0.20)	28.0 (0.14)
June (±S.E.)	30.6 (0.18)	28.2 (0.20)	28.3 (0.23)	28.1 (0.20)	28.0 (0.14)
July (±S.E.)	30.0 (0.18)	30.3 (0.18)	30.4 (0.18)	30.0 (0.20)	30.6 (0.18)
August (±S.E.)	29.8 (0.26)	29.5 (0.18)	29.7 (0.18)	29.7 (0.19)	29.9 (0.18)
September (±S.E.)	28.9 (0.14)	28.5 (0.14)	28.8 (0.14)	28.7 (0.15)	28.9 (0.18)
October (±S.E.)	28.7 (0.18)	28.6 (0.19)	28.5 (0.10)	28.7 (0.18)	28.5 (0.18)
November (±S.E.)	28.0 (0.14)	28.2 (0.21)	28.1 (0.20)	28.2 (0.20)	28.3 (0.20)

Table (3) Averages of pH values in water source and fish farms received artificial feeding (AD) only, artificial feeding with fertilization (AD+F), fertilization only (F) and with neither artificial feeding nor fertilization (control) during growing season

Treatment / Month	Fish farms				
	Water source	AD	AD+F	F	Control
April (±S.E.)	7.95 (0.06)	8.05 (0.06)	8.04 (0.06)	8.00 (0.06)	8.32 (0.10)
May (±S.E.)	8.41 (0.06)	8.36 (0.09)	8.33 (0.09)	8.40 (0.08)	8.71 (0.06)
June (±S.E.)	8.58 (0.09)	8.25 (0.09)	8.27 (0.09)	8.20 (0.09)	8.67 (0.08)
July (±S.E.)	8.35 (0.09)	8.40 (0.07)	8.49 (0.07)	8.35 (0.07)	8.45 (0.09)
August (±S.E.)	7.85 (0.12)	8.40 (0.09)	8.37 (0.09)	8.40 (0.10)	8.22 (0.09)
September (±S.E.)	8.21 (0.07)	8.30 (0.07)	8.36 (0.07)	8.30 (0.08)	8.55 (0.10)
October (±S.E.)	8.01 (0.11)	8.25 (0.09)	8.30 (0.09)	8.20 (0.10)	8.30 (0.13)
November (±S.E.)	7.99 (0.07)	7.95 (0.09)	7.96 (0.05)	8.00 (0.08)	8.11 (0.07)

the increase of water temperature. However, Mageed (1996) cited that the values of dissolved oxygen in El-Fayoum fish farms were subjected to wide variations (3.2 mg/L to 12.6 mg/L). In this respect, Broussard (1985) pointed out that the fish tilapia and mullet can tolerate extremely low levels of dissolved oxygen in ponds. For example, Johnson (1986) reported that the tolerance level for tilapia is 3 mg/L.

Values of salinity (‰) in fish farms ranged between 5.2±0.14 in April (ponds with artificial feeding only) and 15.8±0.13 in June (control) (table 5). Mageed (1996) showed that the salinity in the fish ponds of El-Fayoum averaged 5.2‰ The obtained data indicated that there was a negative relationship between water temperature and dissolved oxygen ($P < 0.01$). A positive relationship was found between temperature and salinity ($P < 0.01$). Besides, there was no significant rela-

ionship ($P > 0.05$) between water temperature and pH. Landau (1992) pointed out that heating the water will reduce its capacity to hold oxygen. Also Krant *et al.* (1982) found a good correlation between temperature and salinity. Broussard (1985) reported that tilapia can tolerate a wide range of salinities, but changes in salinity greater than 10-15‰ should be gradual. However the studies by Likongwe *et al.*, (1996) showed that a combination of 32°C and 8‰ salinity was most conductive to maximum growth of tilapia *O. niloticus*.

Pesticide Residues in water

The pesticides residues (mg/L) found in water source and fish farms are shown in table (6). The present data showed that water samples contained chlorphyrifos ethyl and fenpropathrin at mean levels ranged from 0.11 mg/l (ponds with artificial feeding and fertilization) to 0.252 mg/l in water source and control fish farms. However there were no residues of carbaryl, fenitrothion and fenvalerate in any water samples of the water source or fish farms. In this respect, Mehaseb (1996) detected residues of other pesticides in water

Table (4): Averages of Dissolved oxygen(DO) values (mg/l) in water source and fish farms received artificial feeding (AD) only, artificial feeding with fertilization (AD+F), fertilization only (F) and with neither artificial feeding nor fertilization (control) during growing season.

Treatment / Month	Fish farms				
	Water source	AD	AD+F	F	Control
April (±S.E.)	11.20 (0.26)	10.80 (0.08)	10.70 (0.07)	10.68 (0.26)	10.20 (0.09)
May (±S.E.)	10.70 (0.13)	9.00 (0.12)	8.36 (0.12)	8.90 (0.12)	8.45 (0.18)
June (±S.E.)	6.20 (0.18)	7.00 (0.12)	6.60 (0.13)	6.80 (0.14)	6.36 (0.15)
July (±S.E.)	6.23 (0.17)	6.58 (0.16)	6.91 (0.16)	6.90 (0.16)	6.18 (0.17)
August (±S.E.)	7.81 (0.15)	8.20 (0.14)	8.19 (0.14)	8.25 (0.15)	8.20 (0.14)
September (±S.E.)	8.11 (0.12)	8.90 (0.15)	9.41 (0.15)	9.50 (0.16)	8.91 (0.13)
October (±S.E.)	8.00 (0.07)	8.95 (0.07)	8.73 (0.07)	8.90 (0.08)	7.90 (0.16)
November (±S.E.)	8.61 (0.13)	9.30 (0.18)	9.21 (0.18)	9.35 (0.16)	8.16 (0.13)

Table (5): Averages of salinity values (‰) in water source and fish farms received artificial feeding (AD) only, artificial feeding with fertilization (AD+F), fertilization only (F) and with neither artificial feeding nor fertilization (control) during growing season.

Treatment / Month	Fish farms				
	Water source	AD	AD+F	F	Control
April (±S.E.)	3.1 (0.14)	5.2 (0.14)	5.3 (0.13)	5.2 (0.14)	6.6 (0.13)
May (±S.E.)	3.2 (0.08)	6.8 (0.14)	7.4 (0.14)	7.2 (0.13)	9.2 (0.15)
June (±S.E.)	3.9 (0.13)	11.6 (0.15)	11.9 (0.15)	11.8 (0.16)	15.8 (0.13)
July (±S.E.)	3.7 (0.12)	10.8 (0.15)	11.1 (0.15)	10.9 (0.16)	10.7 (0.13)
August (±S.E.)	4.6 (0.09)	10.5 (0.12)	10.8 (0.12)	10.8 (0.14)	14.00 (0.12)
September (±S.E.)	3.1 (0.16)	5.6 (0.12)	5.4 (0.12)	6.00 (0.12)	6.7 (0.11)
October (±S.E.)	3.5 (0.16)	5.4 (0.12)	5.3 (0.12)	5.5 (0.12)	6.4 (0.11)
November (±S.E.)	3.7 (0.13)	4.9 (0.12)	4.8 (0.12)	4.9 (0.12)	6.2 (0.12)

Table (6): Mean values of pesticide residues (mg/L) in water source and fish farms received artificial feeding (AD) only, artificial feeding with fertilization (AD+F), fertilization only (F) and with neither artificial feeding nor fertilization (control).

Treatment / Month	Fish farms				
	Water source	AD	AD+F	F	Control
Carbaryl	n.d.	n.d.	n.d.	n.d.	n.d.
Chlorpyrifos ethyl. (±S.E.)	0.252 (0.02)	1.110 (0.00)	0.110 (0.00)	n.d.	0.252 (0.00)
Fenitrothion	n.d.	n.d.	n.d.	n.d.	n.d.
Fenpropathrin (±S.E.)	0.110 (0.06)	0.110 (0.06)	0.110 (0.06)	0.10 (0.06)	0.250 (0.00)
Fenvalerate	n.d.	n.d.	n.d.	n.d.	n.d.

n.d. not detected.

samples collected from "Qaroun Lake" during summer season where traces of the pesticides B-BCH, lindane, heptachlor, endrin, dieldrin. DDT and malathion at mean levels of 0.38, 0.25, 5.52, 0.001, 0.48, 4.82 and 0.44 mg/l, respectively were found.

Fish Performance and Feed Conversion :

The highest value of final body weight of *O. niloticus* (291.00 g) was found in fish fed on artificial feed and reared in fertilized ponds when compared to of fish fed on artificial diet only or reared in fertilized ponds without supplemental feeding (P<0.01) (table 7). The same trend was observed for specific growth rate (SGR), feed consumption and during growing season (P<0.01) There was slight improvement in fed conversion for fish received artificial feed and reared in fertilized pond as compared by those fed artificial diet only (Figures 1 & 2). These finding be attributed to the increasing of natural food by inorganic fertilizers and availability of artificial feed that accelerated the growth rate of *O. nioticus*. In this respect, Heut (1975) reported that growth of tilapias depends on the available natural and artificial feed. In a recent study in Kenya fish farms, Gupta *et al.* (2001) came to the same conclusion with their experiments tilaplia/Clarias polyculture in fertilized ponds receiving commercial feeds or pelleted agricultural by-products.

Similarly, the highest final body weight of *M. cephalus* (292.20 g) was found in fish fed on artificial feeding and reared in fertilized ponds when compared to the other treatment of fish feed on artificial feeding or reared in fertilized ponds without supplementary feeding (P<0.01) (Table 8). The same trend was observed for specific growth rate (SGR) and feed conversion ratio (FCR) during growing season as shown and Figures (3) and (4). As shown in Figures (1) and (3), the maximum growth rate values of specific growth rate (SGR) for both fish species were found during the period from June to September of the growing season. This mainly attributed to the higher temperature values during these months which accelerated the feeding and metabolic rate of fish. These results are in agreement to a great extent with the findings of Eid *et al* (1991) who reported that fertilization and supplementary feeding combined led to better growth rate of *Liza ramada* compared to supplementary feeding only. However, Sadek et al. (1986) found that the daily growth in weight of *M. cephalus* at El-Baharia Oasis amounted to 0.7 g after 243 days.

Pesticide Residues in Fish:

Data presented in table (8) showed that samples of *O. niloticus* from fish farms during the growing season were found to contain the same concentration of fenitrothion and fenpropathrin in all treatments which were (0.525±0.06) and (0.267±0.19), respectively. No pesticide residues were found in the control except carbaryl which was detected at

Table (7): The average performance parameters of *O. niloticus* reared in fish farms with artificial feeding (AD) only, artificial feeding and fertilization (AD+F), fertilization only (F) and with neither artificial feeding nor fertilization (control).

Parameters \ Treatment	AD	AD+F	F	Control	± SE
Initial Wight (g)	20.10	20.10	20.10	20.30	0.12
Final weight (g)	281.30^{B}	291.00^{A}	271.00^{C}	210.40^{D}	0.60
Gain in weight (g)	261.20^{B}	270.90^{A}	250.90^{C}	190.10^{D}	0.59
Specific growth rate (% day)	1.14	1.15	1.12	1.08	0.02
Feed consumption (g)	234.00^{B}	240.60^{A}	n.d.	n.d.	0.59
Feed conversion ratio (FCR)	0.90	0.89	n.d.	n.d.	0.01

• n.d. not detected.

Table (8): The average performance parameters of *M. cephalus* reared in fish farms with artificial feeding (AD) only, artificial feeding and fertilization (AD+F), fertilization only (F) and with neither artificial feeding nor fertilization (control).

Parameters \ Treatment	AD+F	AD	F	Control	Control
Initial Wight (g)	23.00	23.10	23.12	23.20	0.30
Final weight (g)	292.20^{A}	285.20^{B}	272.00^{C}	216.40^{D}	0.59
Gain in weight (g)	269.20^{A}	262.10^{B}	249.88^{C}	193.20^{D}	0.57
Specific growth rate (% day)	1.16^{A}	1.13^{A}	1.07^{B}	1.04^{B}	0.02
Feed consumption (g)	270.48^{A}	255.11^{B}	n.d.	n.d.	0.53
Feed conversion ratio (FCR)	1.01	0.97	n.d.	n.d.	0.03

• n.d. not detected.

a mean level of 0.141±0.08. On the other hand, carbaryl, chlorpyrifos ethyl and fenvalerate were not detected in any of fish samples collected from fish ponds.

While samples of *O. niloticus* collected from fish farms (except control) contained fenitrothion at values higher than the permissible limits (0.05 mg/kg in meat of mammales), fenpropathrin residues in all fish samples gave values lower than the permissible limits (0.5 mg/Kg for cattle meat), according to FAO (1997). In this respect, Dogheim *et al.* (1990) found that tilapia samples collected from El-Fayoum Governorate contained pesticides residules of lindane, aldrin, endrin, dieldrin, β-β-DDE and (DDT at mean levels of 0.2, 0.19, 5.06, 0.42, 0.22 and 6.61 mg/Kg, respectively.

Concerning mullet fish *M. cephalus*, the results presented in table (10) showed that samples collected from fish farms during the growing season contained carbaryl at the same concentrations in all treatments (0.203+0.14 mg/Kg) except control ponds . Similarly, fenitrothion was detected in all fish samples and its concentrations ranged between 0.255 and 0.319 mg/kg. However, the pesticides fenopropathrin, fenvalerate and chlorphyrifus ethyl were not detected in all fish samples.

It could be noticed that carbaryl residues in *M. cephalus* were as the same values of the permissible limits (0.2 mg/Kg for cattle meat) according to FAO (1997). Concerning fenitrothion, fish samples gave higher residues values than the permissible limits (0.05 mg/Kg for meat, FAO 1997)., Mehaseb (1996) found that mullet samples collected

Table (9): Mean values of pesticide residues (mg/kg) in *O. niloticus* reared in fish farms received artificial feeding only (AD)(, artificial feeding and fertilization (AD+F), fertilization only. (F) and with neither artificial feeding nor fertilization (control).

Parameters \ Treatment	AD	AD+F	F	Control
Carbaryl (± S. E.)	n.d.	n.d.	n.d.	0.141 (0.08)
Chlorophyrifos Ethyl	n.d.	n.d.	n.d.	n.d.
Fenitrothion (±S.E.)	0.525 (0.06)	0.525 (0.06)	0.525 (0.06)	n.d.
Fenpropathrin (± S.E.)	0.267 (0.19)	0.267 (0.19)	0.267 (0.19)	n.d.
Fenvalerate	n.d.	n.d.	n.d.	n.d.

• n.d. not detected.

Table (10): Mean values of pesticide residues (mg/kg) in *M. cephalus* reared in fish farms received artificial feeding only (AD), artificial feeding and fertilization (AD+F), fertilization only (F) and with neither artificial feeding nor fertilization (control).

Parameters \ Treatment	AD	AD+F	F	Control
Carbaryl (± S. E.)	0.203 (0.14)	0.203 (0.14)	09.203 (0.14)	n.d.
Chlorophyrifos Ethyl	n.d.	n.d.	n.d.	n.d.
Fenitrothion (±S.E.)	0.255 (0.07)	0.255 (0.07)	0.255 (0.07)	0.319 (0.08)
Fenpropathrin (± S.E.)	n.d.	n.d.	n.d.	n.d.
Fenvalerate	n.d.	n.d.	n.d.	n.d.

• n.d. not detected.

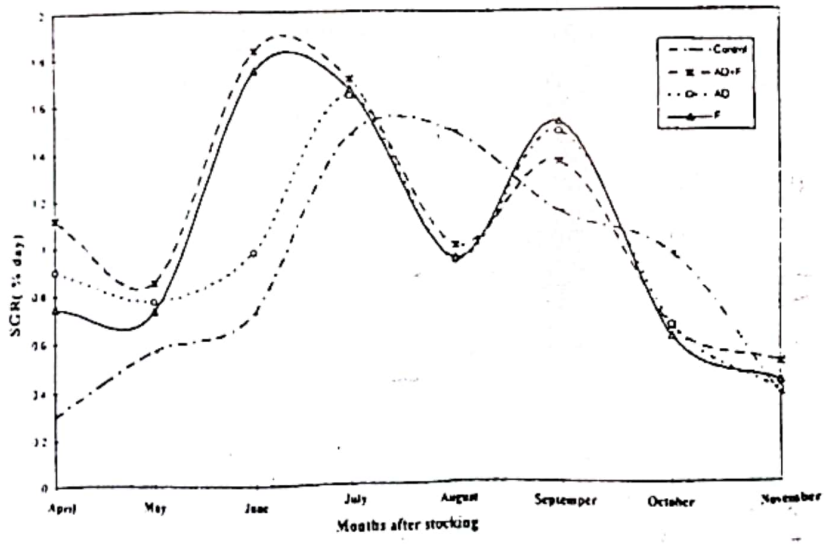

Figure (1): The average specific growth rate (SGR) of *O. niloticus* reared in fish farms with artificial feeding (AD) only, artificial feeding and fertilization (AD+F), fertilization only (F) and with neither artificial feeding nor fertilization (control) during growing season.

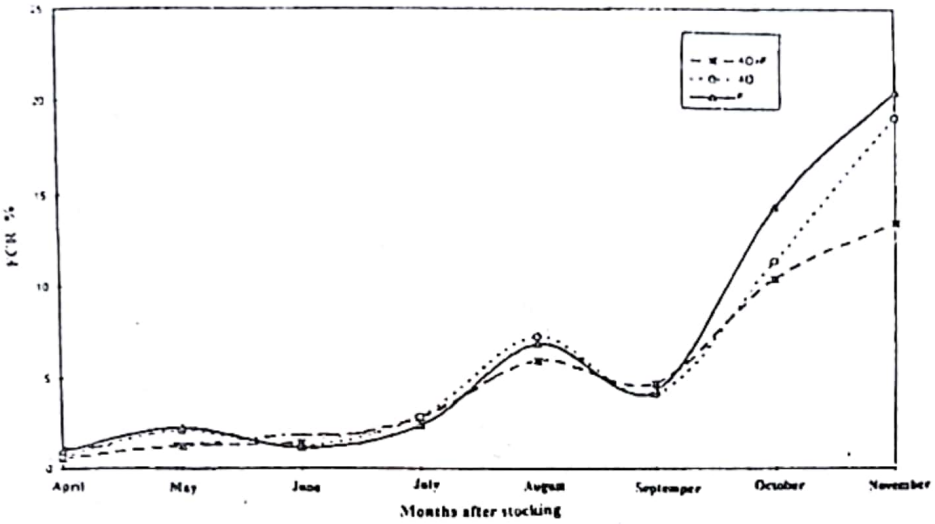

Figure (2): The average feed conversion ratio (FCR) of O. niloticus reared in fish farms with artificial feeding (AD) only, artificial feeding and fertilization (AD+F_, fertilization only (F) and with neither artificial feeding nor fertilization (control) during growing season.

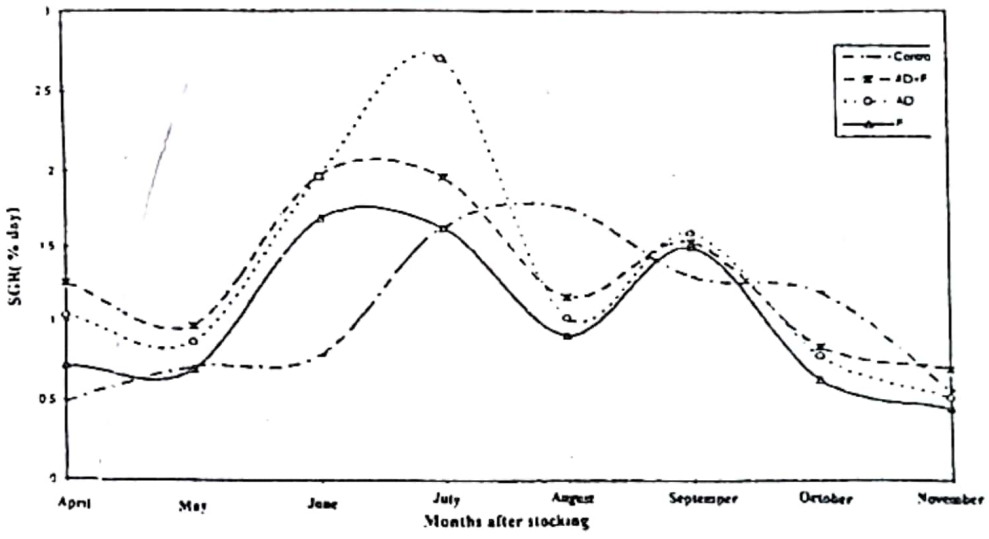

Figure (3): The average specific gross rate (SGR) of M. cephalus reared in fish farms with artificial feeding (AD) only, artificial feeding and fertilization (AD+F), fertilization only (F) and with neither artificial feeding nor fertilization (control) during growing season.

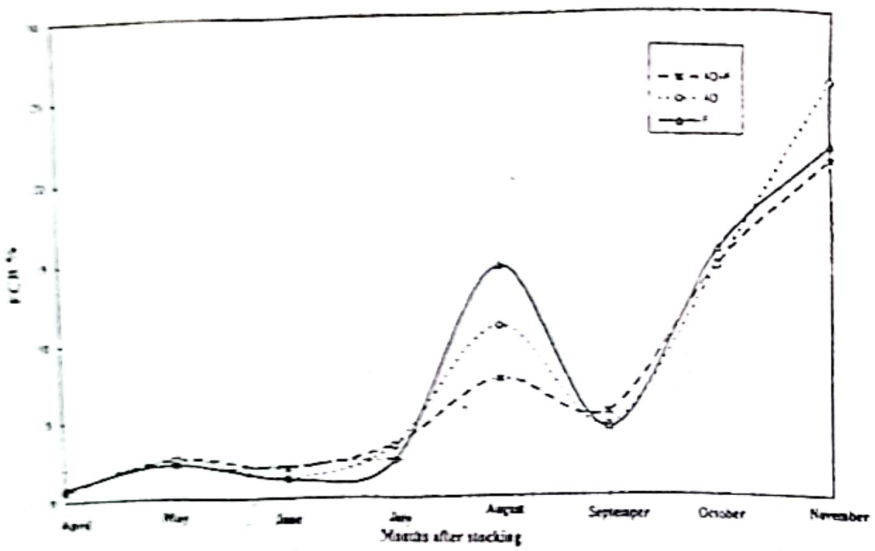

Fig. (4): The average food conversion ratio (FCR) of M. cephalus reared in fish farms with artificial feeding (AD) only, artificial feeding and fertilization (AD+F), fertilization only (F) and with neither artificial feeding nor fertilization (control) during growing season.

from Qaroun lake during summer season contained β-BHC, lindan , aldrin, endrin, dieldrin, β–β-DDE, DDT malathion and dimethoate at a mean values of 0.11, 0.12, 0.02, 0.070, 0.09, 0.02, 0.004, 0.03 and 0.05 mg/Kg, respectively, which are in the permissible range of those pesticides. Also, Shereif and Mancy (1996) reported that the organchlorine pesticides were found at higher levels in tilapias and mullets collected from Manzala fish farms than in fish reared in the treated sewage water of Suez wastewater treatment and reuse facility.

The collective data of pesticide residues indicated that the levels of pesticide residues found in fish reared in fish farms of El-Fayoum Governorate greatly varied according to fish species. It is worthy to mention that although the pesticide fenitrothion was not detected in water (table 5), it was detected in both fish species (table 8). Also, the same findings were observed in case of carbaryl in *O. niloticus* (control) (tables 5 & 9). This could be due to the ability of these pesticides to bioaccumulate in aquatic organisms (Teran and Sierra 1987).

Finally from the present results , one can be concluded that under the Egyptian environmental circumstances in El-Fayoum fish farm , it is better to supplement fish culture by artificial feed plus fertilizers to achieve maximum fish performance.

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