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RESPONSE OF NILE TILAPIA TO DIETARY ANIMAL PROTEIN LEVEL AND POULTRY MANURE FERTILIZER LEVEL IN EARTHEN PONDS.

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Key words: Nile tilapia, dietary animal protein, feeding rate, poultry manure, growth performance, feed utilization, body composition, economic evaluation.

ABSTRACT

Nile tilapia, *Oreochromis niloticus* juveniles averaging about 6.02 g in weight, were assigned in earthen ponds, one feddan (fdn) each. Fish were stocked at a rate of 5500/fdn. The work was conducted at commercial fish farm at Fayoum Governorate for 22 wk started at March, 15. Treatments were arranged factorally to contain two animal protein levels (24 and 35%) in the diet and two fertilizer levels in ponds (30 and 60 kg N from poultry manure / fdn.), forming four treatments. Diets were isonitrogenous and isocaloric. Data on diets chemical composition, fish growth performance feed utilization and fish body composition as well as a simple economic evaluation were illustrated.

The main effects for animal protein level (AP) and poultry manure (PM) levels showed insignificant differences in growth performance, feed utilization and body chemical composition. The simple effects showed significant differences. Generally, growth performance, feed utilization and body composition were positively affected by increasing AP and PM in the diet, even though the diet continued was the lower animal protein (24%), and the higher fertilization rate (60 kg N/ fdn) showed better revenue and revenue/ total production costs (%).

INTRODUCTION

El-Sayed (1999) cleared that tilapia fish constitutes the third largest group of farmed fish in the tropical and subtropical regions.

The source of protein in their diets is still a matter of debate. This is due to that aquaculture profits are closely related to feed supply and dietary protein costs. Regarding animal protein sources, Kawamura and Migazono (1978) found that growth of *O. niloticas* tended to be better with animal than with vegetable protein. Davies and Stickney (1978) working on the same fish reported that 33% of the total protein requirements for *O. aureus* must be covered from animal protein. Chamberlain (1992) has described fish meal as the single most critical ingredient in aquaculture feeds.

Fertilizing a pond with organic or inorganic fertilizer is often done to initiate an algal bloom, which is another term for an increased population of algae (Conte, 2000). The natural and artificial fertilizers provide principal chemical nutrients necessary for algal growth and reproduction. The principal nutrients are nitrogen, phosphorus and potassium. The microscopic plants that make up the phytoplankton population take up these chemical nutrients and at the proper temperature undergo rapid population growth (Conte, 2000). Algal blooms are encouraged for a number of reasons, including increasing the pond's primary productivity. As for poultry manure, Abdel-Hakim *et al.*, (2002) indicated that poultry manure contains 26.5% CP on dry matter basis. They compared different formulas containing manure alone or along with artificial feed. Their result pointed out to the positive effect of organic fertilizer with artificial feed in general.

The present study aimed to investigate the effect of level of animal protein in the diet combined with two levels of poultry manure on Nile tilapia productivity.

MATERIALS AND METHODS

Nile tilapia, *Oreochromis niloticus* Juveniles averaging about 6.02 g $\pm$ 0.01 in weight were assigned in earthen ponds, one feddan (fdn) total area each. Fish were stocked at a rate of 5500/fdn. The work was conducted at a commercial fish farm at Fayoum Governorate. Treatments were arranged foctorially to contain two animal protein levels (24 and 35%) in the diet and two fertilizer levels in ponds (30 and 60 Kg N/from poultry manure/fdn.), forming four treatments. Diets were isocaloric and isonitrogenus (the design is presented in Table 1).

Ingredients and the chemical composition of the tested diets are presented in Tables 2 & 3 respectively. The trial was started at March 15 and terminated after 22 weeks. Brackish water (6 ppt) was used and ponds were aerated. Water turnover rate was 5 cm height every two weeks. Average water temperature, pH and dissolved oxygen during the experimental period were 27.5 ± 0.3°C, 8.23 ± 0.03 and 5.61 ± 0.20 mg/l respectively. Fish were fed twice daily at 0800 and 1400 h.

Alive fish were weighed (50 fish/ treatment) every two weeks and feeding rate was recalculated accordingly, where the fish were fed such diets at a rate of 3% of their body weight. Representative samples of the tested diets and fish (at the start and the end) were taken. For proximate analysis chemical analysis of feeds and fish were conducted according to A.O.A.C. (1990) methods. Diets and fish energy contents were calculated after Omar (1986) and Xtf & Jaksumen (1997) respectively.

Poultry manure was chemically analyzed to determine N percentage (A.O.A.C 1990) to justify N level/fdn. Each Feddan was supplied with about 833 and 1667 Kg poultry manure to a chive the 30 and 60 Kg N levels tested (averege3.6% N). Such quantities were applied in equal portions during the experimental period (at the start and after each water replacement).

Growth rate, feed utilization, fish chemical composition and a simple economic evaluation were calculated after Xtf and Jaksuman (1997). Analysis of variance (factorial design) was made after Steel and Torrie (1980), where the new LSD was used to compare between treatments.

RESULTS

Table (4) and Fig. (1) show the effect of animal protein level in the diet and poultry manure fertilization level on growth performance and feed utilization of Nile tilapia.

The main effect of animal protein level (AP) showed insignificant differences in growth and feed utilization parameters tested (i. e. Average final body wt, Average total wt gain, Specific growth rate, Feed conversion ratio, Protein, efficiency ratio, Protein productive value and Energy utilization). However, the 35% AP tended to show better response than the 25% one.

The main effect of poultry manure (PN) followed a similar trend to that obtained with (AP) level, where the 60 kg N / fdn tended to be better than the 30 kg N/ fdn.

The interaction showed significant effects, but 24/60, 35/30 and 35/60 (AP %/PM) showed insignificant differences regarding growth parameter. Regarding feed utilization parameters, 35/30 and 35/60 showed nearly similar results and tended to show better response than the other treatment in general. The general trend suggest that the lower level of PM could be suggested along with the higher AP level.

Table (5) and Fig. (2) show the effect of the tested levels of animal protein and poultry manure fertilizing level on Nile tilapia body chemical composition.

Results of complete body composition, revealed that animal protein dietary level and poultry manure level regardless of each other, released no significant effects on tilapia body chemical composition. On the other hand, the interaction among both factors (Table 5) show that ponds receiving 35% animal protein diet with 60kg poultry manure produced fish with significant ($P< 0.05$), higher body crude protein, ether extract and gross energy contents, however, ponds receiving 24% dietary CP and 30 kg poultry manure produced fish with significantly ($P< 0.05$) higher ash contents in their bodies.

Table (6) illustrates the economical evaluation at the end of the experimental period. Results of economic evaluation revealed that the total production costs were 5417; 5821; 5540 and 5940 LE for treatment groups 24 AP / 30 PM 24 AP / 60 PM; 35 AP / 30 PM; and 35 AP / 60 PM; respectively. The differences in total production costs were due to the differences in the treatments applied (feed and manuring costs), thus costs of fry and other total production costs were equal in all treatments. The highest revenue was obtained with the treatments 35 AP + 30 PM followed in a decreasing order by 35 AP + 60 PM, 24 AP / 30 PM and 24 AP + 60 PM groups respectively. The relative revenues of the groups cited above were 144; 133; 109 and 100% respectively.

DISCUSSION

In the present study the main effects showed insignificant differences, though the simple effects were insignificant. Simple effects indicated that 24 AP / 60 PM; 35 AP / 30 PM; and 35 AP / 60 PM; treatments were insignificant by different regarding growth and feed utilization parameters. Body composition was in favor of 35 AP /. 30 PM; and 35 AP / 60 PM; treatments. Even though, the economic evaluation was in favor of 24 AP / 60 PM treatment.

Regarding fertilizers, Abdel-Hakim and Sadek (2001) reported that the effect of fertilizers depend on pond area and width, water change rate, turbidity, water temperature, water content of nutrients and pH. Alceste and Jory (2000) reported that fertilization for tilapia ponds caused rapid growth performance. Abd El-Moksoud *et al.*, (1999 a) cleared the effect of chicken manure to certain level in ponds with Nile tilapia and grey mullet reared in polyculture system in eathen ponds, 3 fdn each, where fish were stocked at a rate of 8000 fish (3 tilapia : 1 mullet) per fdn.

Regarding animal protein level in the diet Kesamara & Migazono (1978) and Rodriguez *et al.* (1996) and El-Sayed (1999), found that growth of *O. niloticus* tended to be better with animal than with oilseed plant or vegetable protein. Davis and Stickney (1978) and Gunasekera *et al.*, (1995) showed that 33% of total protein requirements for *O. aureas* would come from animal protein. Also, Hafedh, (1999) found that the increase in dietary protein level fed to Nile tilapia gave higher growth, feed conversion ratio, protein efficiency ratio and body composition. Moreover, Hussein and Abdella (2002) reported that combined fertilization and feeding for Nile tilapia reared in ponds related to highest cost prices but was more economic. Abd El-Maksoud *et al.* (1999 b) reported that the combination of a balanced diet with fertilizers produced higher growth, feed efficiency and net returns. However, Cupta *et al.* (1996) working on Nile tilapia found that increasing both of animal protein sources and fertilization by poultry manure in fish ponds caused higher growth performance, body composition and lower costs when compared with low levels of both animal protein source and poultry manure. Balfour and Hepher (2000) stated that good management, (growth, feed utilization and economic) of ponds receiving manure with artificial feeds can increase the net profit.

In conclusion, under the experimental conditions, the diet that contained ·24% animal protein showed better growth and body protein with the higher level of poultry manure (60 kg N/fdn). But with the higher level of animal protein (35%) both levels of poultry manure fertilization (30 and 60 Kg N/ fdn) had insignificant effects, eventhough there are a tendency to the more effect of 60 kg N/fdn.

The economic evaluation showed that the dietary protein is a limited factor, especially when received from animal protein, so that such evaluation recommended the 24% animal protein along with the higher fertilization rate (60 kg N/fdn).

REFERENCES

Abdel-Hakim, N. ; Bakeer, M. and Soltan, M. (2002). Water quality of fish farms (In Arabic)., Azhar Univ., Fac. Agric.

Abdel-Hakim, N. and Sadek, S. (2001). Scientific principles of fish production and breeding (In Arabic), Azhar Univ., Fac. Agric.

Abd El-Maksoud, A. ; Hassouna, M. ; Allam, S. ; Aboul-Fotouh, G. and Shandweiliy M. (1999 a). Effect of fertilizer with chicken manure on performance of Nile tilapia (*Oreochromis niloticus* L.) and Grey mullet (*Mugil cephalus* L.) reared in polycultue earthen ponds. Egyptian J. Nutr. & Feeds, *2*: 123-133.

Abd El-Maksoud, A. ; Hassouna, M. ; Allam, S. ; Aboul-Fotouh, G. and Shandweiliy M. (1999 b). Effect of feeding regime on the performance of Nile tilapia and grey mullet reared in polyculture earthen ponds. Egyptian J. Nutr. & Feeds, *2*: 134-143.

Alceste, N. and Jory, E. *(2000). Tilapia some fundamentals* of tilapia nutrition, A quacult. Mag. 26(3):74-78.

A.O.A.C. (1990). Official methods of analysis. (ed. by k. Helrich) Association of Official Analytical Chemists, Arlington. USA.

Balfour, H. and Hepher (2000). Commercial fish farming, 162-190.

Chamberlain, G. (1992). Shrimp culture in Indonesia. 4. Feeds for the shrimp industry. World Aquacult, 23: 36-40.

Conte, F. (2000). Pond fertilization : initiating and algal bloom. Western Regional Aquacult. Center (WRAC) No. *104*: (02).

Davis, A. and Stickney, R. (1978). Growth responses of *Tilapia aurea* to dietary protein quality and quantity. Trans. Am. Fish. Soc., *107*: 479-483.

EL-Sayed, A. (1999). Alternative dietary protein sources for farmed tilapia, *Oreochromic* spp. Aquacult., *179*: 149-168.

Hafedh, Y. (1999). Effect of dietary protein on growth and body composition of Nile tilapia *Oreochromis niloticus* L. Aquacult. Research, *30*(5):385-393.

Hussein, A. and Abdella, R. (2002). Economic analysis of different tilapia pond culture systems in Egypt. A quacult., *2*:33-45.

Gunasekera, R. ; Shim, F. and Lan, J. (1995). Effect of dietary protein level on puberty growth and chemical composition in the tilapia.*Oreochromis niloticus.* A quacult., *134*(1/2):169-183.

Gupta, N. ; Akht. W. ; Shah, F. (1996). Nile tilapia *Oreochromis nitloticus* culture in water bodies under different feeding and fertilization regimes. ICLARM. *41*: 500-504.

Kessamarer, K. and Migazono, I. (1978). Study on the nutrition of *Tilapia nilotica* on diets containing various dietary proteins. Bul. Fac. Agric., Migazaki Univ., *25*: 341-349.

Omar, E. A. (1986). Studies on trapping feeding. II. Effect of different protein sources on growth performance and feed utilization of fry. Egypt. S. Anim. Prod., *26*: 171-183.

Rodriguez, S. ; Serna, M. ; Olvera, N. and Carnona, C. (1996). Nutritional value of animal source in diets for Nile tilapia *Orechromis niloticus.* Aquacult. Res., *27*(1):67-73.

Stell, R. and Torrie, J. (1980). Principles and Procedures of statistics. Mc. Grew. H. LL.Inc. London. UK.

Xtf, N. and Jakounsem, A. (1997). Replacement of fish meal potato protein concentrate in diets for rainbow trout "*Oncorunchus mykiss*" (Walbsum) growth, feed utilization and body composition. Aquaclt. Nutrition, *3*:65-70.

Table 1. The experimental design

Kg N/fed from poultry manure (PM)	Animal protein level (AP) 24	35
30	24/30 (T_1)	35/30 (T_3)
60	24/60 (T_2)	35/60 (T_4)

Table 2. Ingredient of the tested diets.

Ingredient %	Animal protein level, % 24 %	35 %
Fish meal.	20	25
Poultry by product.	4	10
Soybeen, meal, defated.	40	27
Corn ground.	26	28
Rice bran.	3	2
Wheat bran.	5	6
Fish oil.	1	1
Total Vitamin and mineral premix.*	1	1
Total	100	100

* Each kg diet contained 11000 IU Vit A, 2000 IU Vit. D3, 20 mg Vit. E, 4 mg Vit. K, 20 mg Vit. B1, 15 mg Vit. B2, 13 mg Vit. B6, 12 mg Vit B12, 40 mg Vit. C, 20 mg Fe, 10 mg I, 40 mg Ca, 20 mg p, 4 mg Zn product by Sekum.

Table 3. The chemical analysis of the tested diets on dry matter basis.

Items	Animal protein level, % 24 %	35 %
Crude protein, %.	34.38	34.33
Ether extract, %.	4.23	5.41
Nitrogen free ertract, %.	51.35	48.76
Crude fiber, %.	2.58	2.44
Crude ash, %.	7.46	9.06
Gross energy Kj g^{-1}*.	18.52	18.53
CP/GE ratio.	1.86	1.85

* Gross energy was calculated for protein, lipids and carbohydrates using the values. 23.62, 38.04 and 17.14 kj g^{-1} . Xtf and Jakoumsen (1997).

Table 4. Growth performance of Nile tilapia as affected with the tested animal protein and poultry manure levels.

Items	Main effects				Interaction effects of			
	AP, %		PM, kg PM/fdn		AP x PM[*]			
	30	35	30	60	30/30	30/60	35/30	35/60
Average initial body wt, g/fish.	6.02	6.02	6.01	[illegible]	6.01	6.02	6.01	6.02
Average final body wt, g/fish.	191.2[illegible]	203.99	193.16	202.0[illegible]	186.0[illegible] ^{b}	196.22 ^{ab}	195.7[illegible] ^{ab}	202.27 ^{a}
Average total wt gain, g/fish.	185.18	[illegible]	187.15	196.99	180.55 ^{b}	189.80 ^{ab}	190.[illegible] ^{ab}	20[illegible] ^{a}
Specific growth rate, day, %.	2.75	2.80	2.76	[illegible]	2.72 ^{b}	2.76 ^{ab}	2.77 ^{ab}	2.8[illegible] ^{a}
Feed intake/fish/period, g.	248.15	263.64	250.0	[illegible]	24[illegible] ^{b}	254.51 ^{ab}	252.10 ^{ab}	269.09 ^{a}
Feed conversion ratio.	1.34	1.33	1.34	1.3[illegible]	1.34 ^{a}	1.34 ^{a}	1.32 ^{ab}	1.3[illegible] ^{b}
Protein efficieny ratio	2.170	2.187	2.445	2.47[illegible]	2.302 ^{b}	2.225 ^{ab}	2.215 ^{b}	2.33[illegible] ^{a}
Protein productive value, %.	39.25[illegible]	41.420	38.590	41.58[illegible]	38.89 ^{bc}	39.62 ^{b}	40.29 ^{ab}	42.5[illegible] ^{a}
Energy utilization, %.	27.570	30.155	28.325	29.4[illegible]	27.32 ^{bc}	28.02 ^{b}	29.33 ^{ab}	30.88 ^{a}

Averages in the some row for each parameter having different superscripts differ significantly, $P \leq 0.05$.

*Abbreviations as indicated in Table [illegible]

Table 5. Body chemical composition of Nile tilapia as affected by tested and used different levels of animal protein and fertilization poultry manure levels.

Items	Star	AP %		PM kg N/fed.		AP×PM**			
	C	24	32	30	60	24/30	24/60	32/30	32/60
Dry matter, %.	22.0[illegible]	25.72	27.28	25.90	27.8[illegible]	27.[illegible]0	26.50	25.80	[illegible].30
Crude protein %.	5[illegible].27	64.17	66.82	64.72	66.2[illegible]	63.14[c]	6[illegible].[illegible]4[b]	65.32[ab]	67.32[a]
Ether extract, %.	15.14	18.84	20.42	19.16	20.[illegible]	18.16[bc]	19.59[b]	20.14[ab]	2[illegible].[illegible]0[a]
Ash, %.	27.59	16.95	12.76	16.12	13.64	18.70[a]	16.89[b]	1[illegible].[illegible]2[c]	[illegible][d]
Gross energy KJ g^{-1}.	19.25	22.32	23.44	22.57	22.30	21.82[b]	22.82[abc]	22.32[ab]	22.[illegible]2[a]
Crude protein/Gross energy ratio.	2.97	2.83	2.84	2.87	2.85	2.89[a]	2.86[ab]	2.84[abc]	[illegible][bc]

Averages in the same row per each item having different superscripts differ significantly, P < 0.05.

** Abbrevations as indicatid in Table 1

Table 6. The economic evaluation of the tested treatments.

No.	Items	Treatments *			
		24Ap/ 30 pm	24Ap /60Pm	35Ap /30Pm	35Ap /60Pm
1	Feed consumed/fdn, Ton.	1.33	1.40	1.42	1.48
2	Fertilizers used / fdn, Kg.	833	1667	833	1667
3	Produced fish/fdn, Kg	924	969	989	1031
4	Fish cost at the start, LE.	660	660	660	660
5	Feed cost/fdn, LE.	1473.4	1544.2	1597.0	1662.9
6	Poultry manure /fdn, LE.	333.2	666.8	333.2	666.8
7	Feed and manure cost/fdn, LE.	1807	2211	1930	2330
8	Other production cost/fdn, LE.	2950	2950	2950	2950
9	Total production costs.	5417	5821	5540	5940
10	Fish selling price/fdn, LE.	6468	6783	6923	7217
11	Revenue, LE.	1051	962	1383	1277
12	Relative percentage of revenue.	109	100	144	133
13	Revenue/total production cost, %	19.40	16.23	24.96	21.50
14	Feed and manure cost/ total costs, %.	33.36	37.98	34.84	39.23

AP, dietary animal protein, N, nitrogen, PM, poultry manure
No 7 = No, 5 + No 6, No 9 = No 4 + No 7 + No 8, No 11 = No 10 – No 9, No 13 = (No 11/No 9) 100; No 14 = (No 7/No 9) 100.
* Abbreviations as indicated in Table 1.

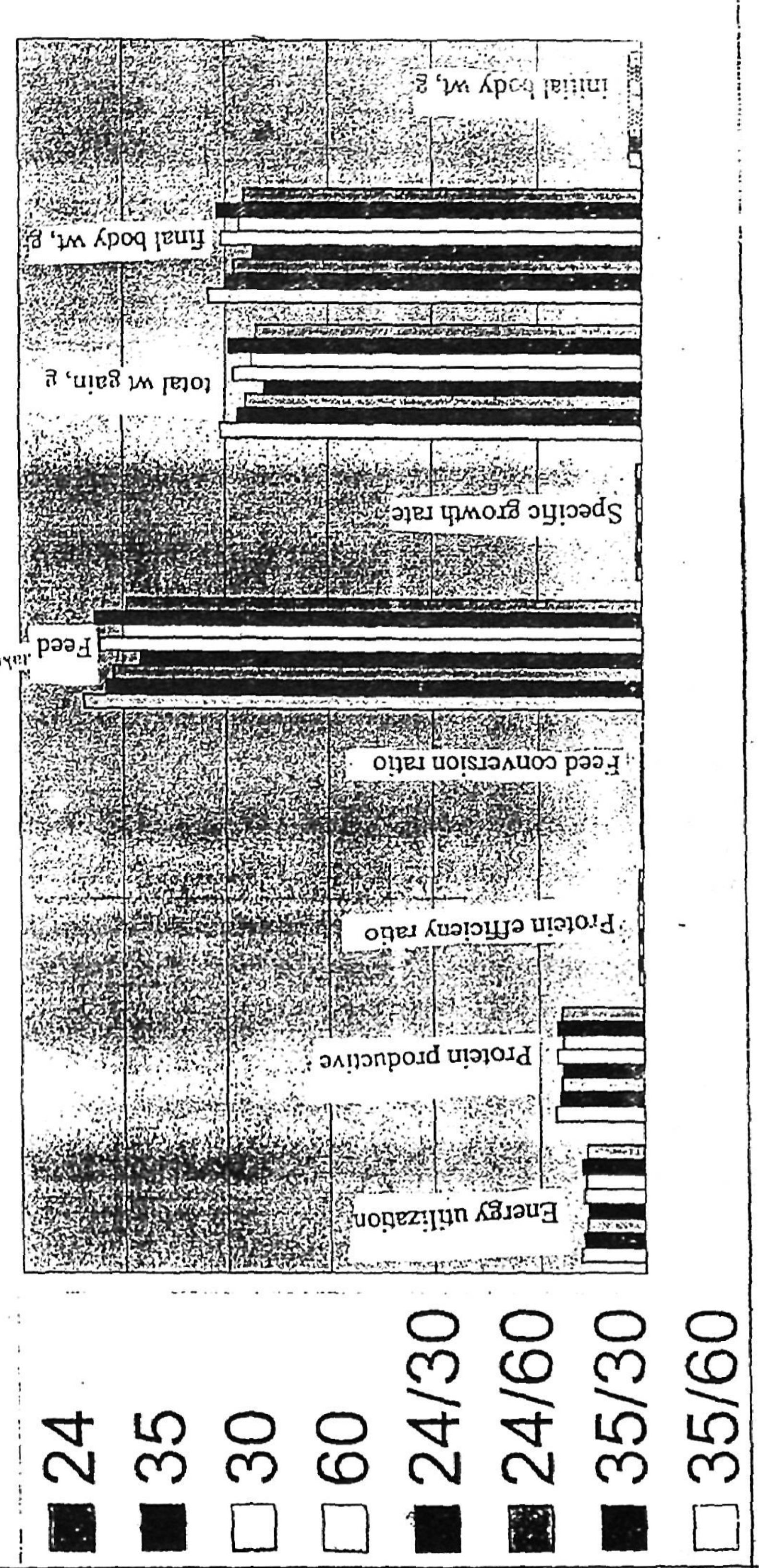


Fig. 1 Growth performance of Nile tilapia fed the tested animal protein and poultry manure levels.

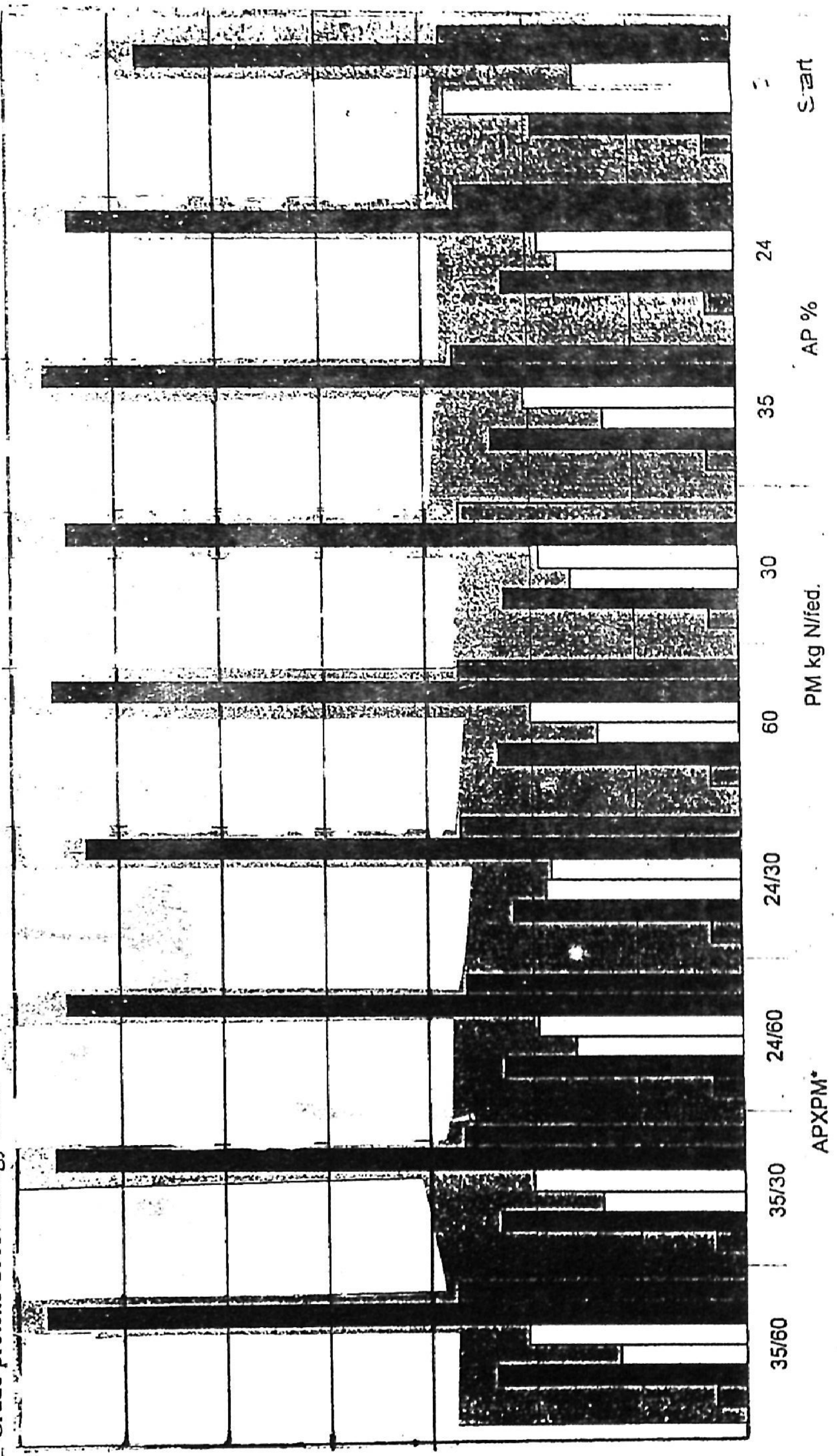
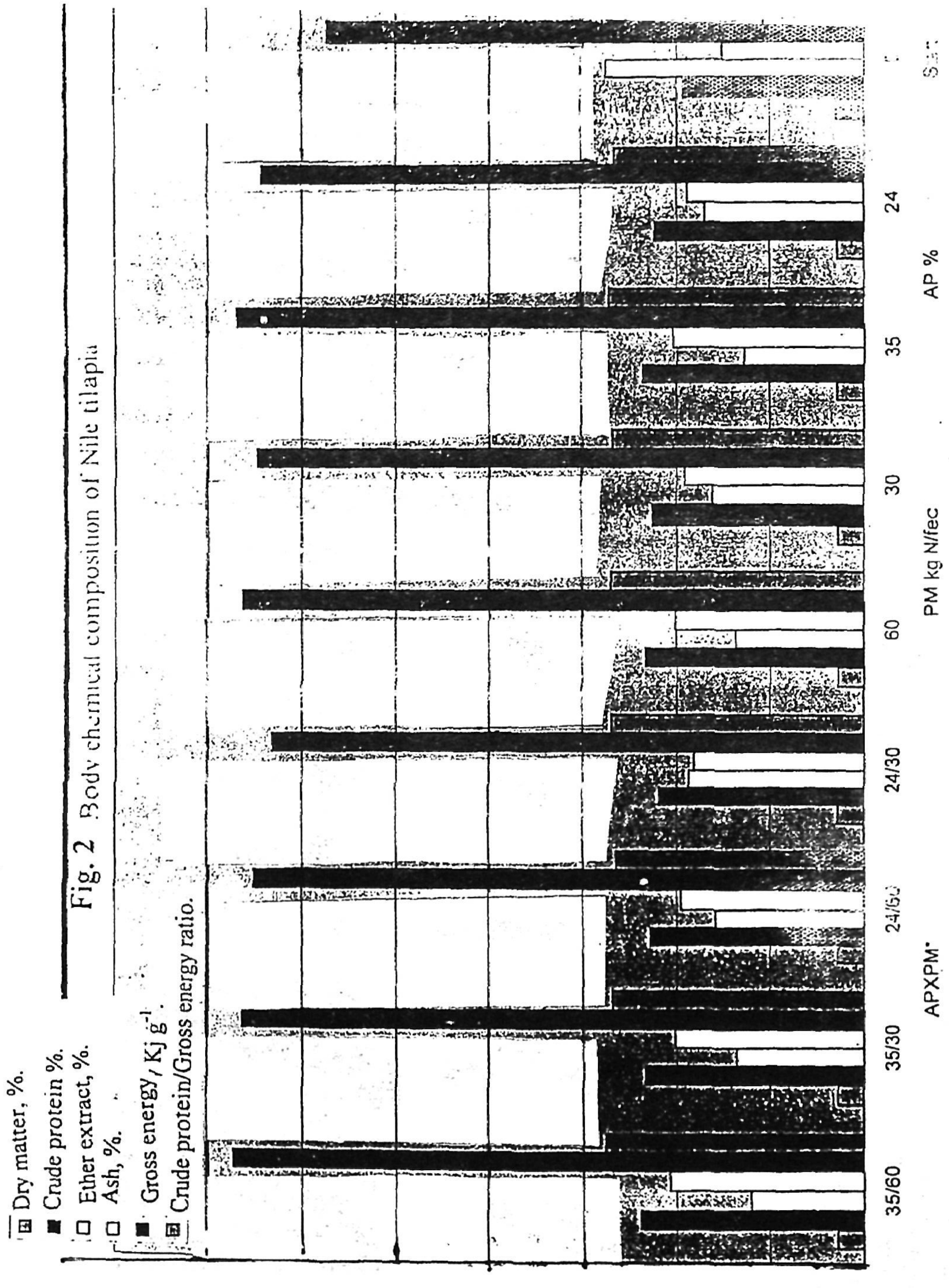


Fig. 2 Body chemical composition of Nile tilapia



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