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Physiological and Nutritional Studies on Improving Growth of Nile Tilapia (Oreochromis Niloticus) Fingerlings Using Alpinia Meal (Alpinia Galanga) As a Feed Additive

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Abstract

A total of 40 fish with average initial body weight 6.48±0.15 g and, were randomly stocked into eight glass aquaria. To illustrate the effect of four different levels (0.00; 0.50; 1.00 and 2.00 %) of Alpinia meal as a feed additive on the performance, nutritional and physiological parameters of Nile tilapia fingerlings. Each diet was fed two randomly duplicate aquaria for 12 weeks where each aquarium was stocked with 10 fish. Fish in all treatments were daily fed the experimental diets at a level of 20, 15, 10, 5, 3 and 3% of the (BW) daily for the 1-2, 3-4, 5-6, 7-8, 9-10 and 11-12 week and fish fed 2 times daily in equal proportions. Feeding was performed for six consecutive days with no food being given on the seventh day when the fish were weighed.

Results showed that lower final body weight in Nile tilapia fish which fed on control diet compared to the different levels used. Results showed that fish fed on diet (2), containing 0.05% Alpinia meal a good increase in body weight and growth rates compared to other treatments, respectively. The rate of feed conversion, the utilization rate, productivity of the protein and efficient use of energy were the same, the fish fed on a diet (2) was the lowest one, the levels tend to a dropping with increased levels of Alpinia meal and the differences between treatments were significant. Also, data indicated that, there were no significant differences ($P< 0.05$) between all treatments in dry matter content, crude protein, ether extract, ash and energy content. For physiological parameters showed that no significant differences ($P <0.05$) in plasma total protein, plasma albumin and plasma total globulins of fish fed the experimental diets in comparison with the control diet.

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Keywords: Alpinia meal; Nile tilapia; Oreochromis niloticus and growth parameters

1. Introduction

The global aquaculture industry currently accounts for over 45% of all sea food consumed. That will have been projected to increase to 75% over the next 20 years (FTU, 2007). Tilapia is an ideal candidate for warm-water aquaculture. They spawn easily in captivity, use a wide variety of natural foods as well as formulated feeds, tolerate poor water quality, and grow rapidly at warm temperatures. These attributes, along with relatively low input costs, have made tilapia the most widely cultured freshwater fish in tropical and subtropical countries (Borgeson et al., 2006; Tsadik and Bar, 2007 and Tahoun, 2007).

Medicinal and aromatic plants have been used as spices and medical additives. In recent years, these plants have received increasing attention as spices for human and additive in diets for animals. Spices are well known appetizers and add flavor to otherwise insipid foods. Some of them possess antioxidant properties, antimicrobial and antibiotical activity (El-Emary, 1993; Hanafy, 1995 and Morsy, 1995).

Alpinia is the root/rhizome of an herbaceous plant which is native to China. Similar in appearance and uses to ginger, to which it is related, there are two main types: Greater, (Alpinia galanga), found in Malaysia and Indonesia.

Alpinia anti-bacterial effect acts against germs, such as streptococci, staphylococci and coliform bacteria. This plant is used to treat loss of appetite, upper abdominal pain, and sluggish digestion. It relieves spasms, combats inflammation and has stress reducing properties. In Asia, this herb is also used for arthritis, diabetes, diarrhea, stomach problems and difficulty swallowing. It is especially useful in flatulence, dyspepsia, nausea, vomiting and sickness of the stomach, being recommended as a remedy for sea-sickness. It tones up the tissues and is sometimes prescribed in fever. Alpinia is used in cattle medicine, and the Arabs use it to make their horses fiery. It is included in several compound preparations, but is not now often employed alone. The reddish-brown powder is used as a snuff for catarrh (Chopra, 1992).The root contains a volatile oil (0.5 to 1.0%), resin, galangol, kaempferid, galangin and alpinin, starch, etc. The active principles are the volatile oil and acrid resin. Alpinia has been obtained synthetically. Galangal oil is useful in respiratory troubles, especially those of children and is used as a flavouring agent in French liqueurs, in bitters of the angostura type and in some tobacco. It is used in Russia for flavouring vinegar and the liqueur 'nastoika': it is a favourite spice and medicine in Lithuania and Estonia. Tartars prepare a kind of tea that contains it, and it is used by brewers. In India, the oil is valued in perfumery (Vasudevan Nair, et al., 1982).

Therefore, the present study aimed to evaluate the effect four different levels (0.00; 0.50; 1.00 and 2.00 %) of Alpinia meal as a feed additive on the performance, nutritional and physiological parameters of Nile tilapia (O. niloticus) fingerlings.

2. Materials and Methods

The present work was carried out in fish Research Unit established in the Department of Animal Production Faculty of Agriculture, Kafr El-Sheikh University, in order to improving the growth of Nile tilapia (Oreochromis niloticus) fry by using Galangal meal as a feed additive for 12 weeks.

Experimental System and Animals:

Eight glass aquaria with dimensions of 60×35×40 cm were used. The experimental treatments were tested in two aquaria for each. Each aquarium was marked by 3 marks (top, middle and bottom marks).Each aquarium was filled with dechlorinated water to the top mark (35cm) and this gives a water volume of 73.50 liters. Every day 8 liters of water was removed (middle mark) and 8 liters of dechlorinated fresh water was added .At the day of fish weighing ,after removal of the fish from the aquarium by net ,16 liters of the water of the aquarium was removed and equal amount of dechlorinated fresh water was added.

Each aquarium was supplied with automatic heater (Rena, French made) to maintain the water temperature at 28±1 ˚C, air pump and stone to provide continuous aeration to water. The dissolved oxygen was 7-8 ppm. Also the aquarium was supplied by automatic filter (280 PF Taiwan made) to filter the faces and fine matter out from the water .Therefore, the water aquarium is always clear and clean .Water pH was in the range of 7.2 -7.5 during the experimental period .Fry of the Nile tilapia (O .niloticus) fingerlings was obtained from Mr .Salah Ibrahem Hachary at Tolombat 7, Kafr El-Sheikh and transported to the wet lab at the Department of Animal Production Faculty of Agriculture, Kafr El-Sheikh University . Fish were fed the control diet for a month as a conditioning period before starting the experiment.

Experimental diets:

Diet ingredients, formulation and proximate and proximate analysis:

For formulation of the eight experimental diets (about 30 % crude protein) the following ingredients were used: Fish meal, soybean meal, wheat bran, yellow corn, corn oil, vitamin mixture and mineral mixture. To illustrate the effect four different levels (0.00; 0.50; 1.00 and 2.00 %) of Alpinia meal as a feed additive on the performance, nutritional and physiological parameters of Nile tilapia fingerlings.

The ingredients and medical plant (Alpinia meal) were bought from the local market in Kafr El-Sheikh. The amount of diet required was calculated according to the number of fish used, growth expected, dietary regime, experimental period and losses due to processing and grinding of the experimental diets.

Fine ingredients were weighed out together and thoroughly mixed for 10 min. followed by the addition of corn oil and further mixing for 10 min. Distilled water (300 ml/kg) was then added until stiff dough resulted and this was passed through mincer (Oster, USA made) with a 3 mm (die) and the resulting material was dried in an oven at 65 ˚C .The dried diets were broken up into convenient pellet size.

Table (1). Ingredients (%) of the experimental diets.

Ingredients	Diets No.			
	1	2	3	4
Herring fish meal	15	15	15	15
Soybean meal	30	30	30	30
Yellow corn	35	34.5	34	33
Wheat bran	12	12	12	12
Corn oil	5	5	5	5
Vitam. and min. mix. *	3	3	3	3
Galangal meal	-	0.5	1.0	2.0

*Vitamins composition/100 gm mixture, VA (960000 IU), VD3 (160000 IU), VE (0.8 g), VK (0.16g), VB1 (80mg), VB2 (0.32g), VB6 (0.12g), Pantothenic acid (0.8g), VB12 (0.8 mg), Niacin (1.6g), Folic acid (80mg), Biotin (4 mg) and Choline chloride (40g).
* Composition of mineral mixture (g\100 g mixture). Mg SO4 7H2O (12.75), Ca HPO4 2H2O (72.85), Zn SO4 7 H2O (0.55), Ca l2O6 H2O (0.25), KCl (0.02), Fe SO4 7 H2O (5), Cu SO4 5 H2O (2.5), Co SO4 7 H2O (0.08), Cr Cl3 6 H2O (0.05), Na Cl (0.01) and Folic acid (6).

Feeding Regime:

Each diet was fed to two randomly duplicate aquaria for 12 weeks where each aquarium was stocked with 10 fish with an average weight of 6.48 ±0.15 g. Fish in all treatments were daily fed the experimental diets at a level of 20, 15, 10, 5, 3 and 3% of the (BW) daily for the 1-2, 3-4, 5-6, 7-8, 9-10 and 11-12 week and fish fed 2 times daily in equal proportions. Feeding was performed for six consecutive days with no food being given on the seventh day when the fish were weighed. The necessary adjustment in the quantity of food intake was carried out at the end of every weighing period .Fish were observed during the feeding period.

Proximate chemical analysis of feed ingredients and four medical plants:

Feed ingredients and medical plant were subjected to proximate analysis to determine the moisture, ash, crude protein (CP), crude lipid (CL), crude fiber (CF), and nitrogen free extract (NFE). These determinations were carried out

according to AOAC (2000). Gross energy content of diets were calculated according to gross caloric values of NCR (1993) using the values of 5.65, 9.45 and 4.12 kcal /g diet crude protein, crude fat and total carbohydrate, respectively.

Body composition analysis:

At the starts of the experimental, about twenty fish were collected and immediately frozen and reserved for initial body proximate chemical analysis. At the termination of the study, five fish in each aquarium were netted, weighed, frozen and kept for final body composition analysis. Fish samples were pulverized, and homogenized with Ultra-Tunax .The homogenized samples were oven dried at 60 -80°C for 48 hrs . Proximate analyses of whole body, protein, lipid, and ash were performed according to standard [3] methods .

Blood parameters determination:

At the end of the experiment, fish in each aquarium were weighed and five fish were taken randomly for blood sampling .Anti-coagulated blood samples were performed immediately for counting red and white blood cells .Then, the blood samples were centrifuged at 3000 rpm for 5 minutes to separation of plasma which was subjected by bio Merieux, France), glucose enzymatique PAP-Kit produced by bio Merieux vitek Inc,USA), Glutamic oxaloacetic transaminase (GOT) and glutamic pyruvic transaminase (GPT) were determined using the method of Reitmen.et al., (1957). Total plasma protein (g/100ml) was determined by using a commercial kit Spain React Company, Spain (according to the method recommended by Gornall et al., 1949).

Measurement of growth:

Total weight gain, average daily gain, specific growth rate, feed conversion ratio protein and energy utilization was determined according to Castell and Tiews, (1980).

Total gain (g/fish) = (WT-WI)

Where :WT :Final means weight of fish in grams and WI :Initial means weight of fish in rams

Average daily gain (ADG) (g/fish/day) = (total gain /experimental period)

Specific growth rate (SGR/ % /day) = (100 × Ln WT – Ln WI)/ duration period .

Where: Ln : Natural log and n is the duration period

Measurement of feed and nutrient utilization:

1. Feed conversion ratio (FCR) = dry matter intake (g)/ total gain(g)
2. Protein efficiency ratio (PER) =total gain (g) / protein intake (g)
3. Protein productive value (PPV) = (PT – PI)×100 /protein intake

Where: PT :Protein content in fish carcass at the end and PI : Protein content at the start.

4. Energy utilization (EU) = (%ET–EI) ×100/Energy intake (kcal)

Where :ET :Energy in fish carcass (kcal) at the end and EI :Energy in fish carcass (kcal)at the start .

Statistical analysis:

F-test and analysis of variance of treatments difference was performed according to Duncans (1955). Statistical analysis was done by, ANOVA, F-test, and L.S.D procedures available within the SAS software package (version 9.0, 2004).

3. Results and Discussions

Proximate Chemical analysis (%) of the experimental diets and Alpinia meal:

The proximate chemical analysis on dry weight basis of the tested diets used in the experiment are shown in Table 2. The mean of dry matter % ranged from 92.40 % in diet No.4 which containing 2.00 % Alpinia meal (AM) to 94.35 in diets No.2 which containing 0.50%. The averages of crude protein % in all diets were 29.50%. The averages of ether extract in all diets were 6.21%.

The mean of crude fiber ranged from 6.11% in the diets No.4 to 6.52 % in diet No. 1, respectively. The mean of ash ranged from 11.80% in the diet No.2 to 12.14% in the diet No.4, respectively. The mean of nitrogen free extract (NFE) ranged from 46.00% in the diet No.4 to 46.43% in diet No.1, respectively. The averages of gross energy (Kcal/g) in all diets were 4.20 Kcal/g.

Table (2): Proximate Chemical analysis (%) of the experimental diets used in the experiment.

Item	Alpinia meal	Control (D1)	Levels of Alpinia meal (%)		
			0.50 (D2)	1.00 (D3)	2.00 (D4)
DM (%)	83.01	94.10	94.35	93.20	92.40
CP (%)	11.12	29.49	29.50	29.5	29.5
EE (%)	11.21	6.18	6.20	6.21	6.25
CF (%)	16.62	6.52	6.19	6.42	6.11
Ash (%)	7.20	11.38	11.80	11.89	12.14
NFE (%)	53.85	46.43	46.31	46.20	46.00
GE (Kcal/g)	3.91	4.21	4.21	4.20	4.20

Growth performance:

The growth performance parameters of monosex Nile tilapia (Oreochromis niloticus) fingerlings which fed diets supplemented with Alpinia meal levels (0.00, 0.50, 1.00, and 2.00%) are shown in Table (3) and figure 1. Average of initial body weight of Nile tilapia fingerlings fed the experimental diets at the start did not differ, indicating that groups were homogenous. At the end of the experimental period (84 days), the group of fish fed the supplemented diets grew as well or better than the group of fish fed the control diet. Whereas, the final body weight of the fish groups fed on diets 2, 3 and 4 had significantly ($P<0.05$) higher final body weight than the control group. However, the lowest final body weight (16.22 g) was achieved by the group of fish fed the control diet Table (3) and figure 1.

On the other hand, the fish groups fed on diets 2, 3 and 4 had significantly ($P<0.05$) higher TWG, RGR and ADG than the control group. However at the end of the trial, TWG, RGR and ADG values were (9.72, 125.68 and 0.12) (control diet), (13.34, 174.96 and 0.155),(12.93, 167.91 and 0.155) and (12.20,157.71 and 0.145) for fish groups fed on diets containing 0.00, 0.50 ,1.00, and 2.00% AM , respectively.

There were a positive correlation (r= 0.99, 0.99 and 0.87 between levels of Alpina meal and final weight gain (g/fish), total weight gain (g/fish) and specific growth rate (%) respectively (Fig.1) These results are in agreement with the results of El-Dakar et al., (2008); Shalaby ,(2004) and Sakr ,(2003) . El-Dakar et al., (2004) reported that the Nile tilapia O. niloticus fingerlings fed on diets supplemented by medicinal plants exhibited greater growth than those fed with the control diet. On the other hand, the fish groups fed on diets 2, 3 and 4 had significantly ($P<0.05$) higher SGR than the control group. However at the end of the trial, SGR values were 1.10 (control diet), 1.35, 1.30 and 1.25 %/d for fish groups fed on diets containing 0.00, 0.50, 1.00, and 2.00%, respectively Table (3) and figure 1. However No significant differences between Diets 2, 3 and 4 which contents 0.5, 1.0 and 2.0 % AM ($P<0.05$). Fish fed diet contained 0.50 % AM (diet No.2) showed significantly ($P<0.05$) superior in growth performance parameters values to the other fish groups.

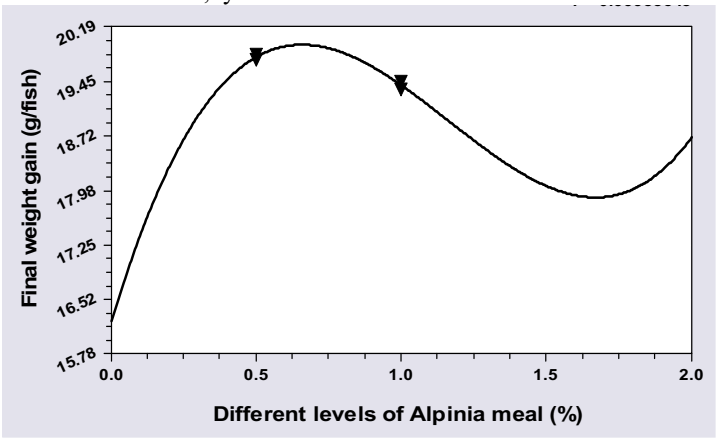
Also, the highest relative growth rate (%) was recorded by fish fed 0.50 % (diet No.2) followed by 1.00 and 2.00 % AM Table (3) and figure 1.Similar trend was found, in this respect with El-Dakar et al., (2004) they studied the effect of supplementing Nile tilapia fingerlings feeds with different additives (0.00, 0.50 ,1.00, 1.50 and 2.00% Fennel seed meal (FSM) . They observed better growth with 0.05 % FSM supplemented diets.

Table 3. Effect of using Alpinia meal as a feed additive on growth performance parameter of monosex (O. niloticus) fingerlings.

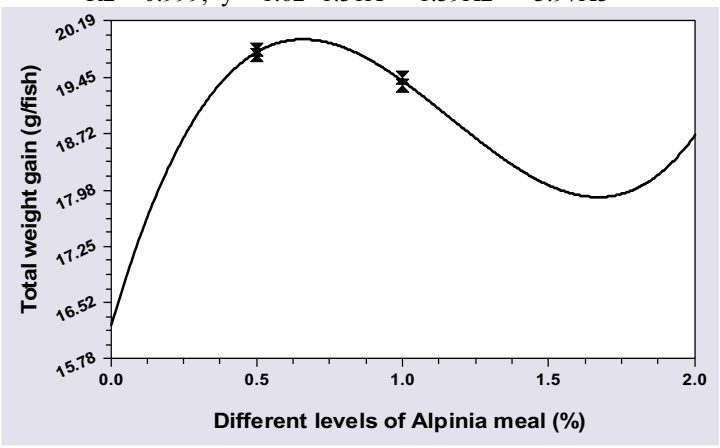
Diet No.	Body weight		Total weight	Relative growth	ADG	SGR
	Initial (g/fish)	Final (g/fish)	gain (g/fish)	rate (%)	(g/fish/day)3	(%/day)4
1	6.50	16.22d	9.72c	125.68b	0.115b	1.10b
2	6.45	19.79a	13.34a	174.96a	0.155a	1.35a
3	6.47	19.40b	12.93ab	167.91a	0.155a	1.30a
4	6.50	18.70c	12.20b	157.71ab	0.145a	1.25a
Mean	6.480	18.52625	12.0463	156.5625	0.1425	1.25

1. Diet 1 (Control diet), diets 2, 3, 4 containing 0.50, 1.00 and 2 .00% Galangal meal, respectively.
2. The mean in the same column bearing different superscript are significantly different at ($P< 0.05$).
3. ADG = Average daily gain (g/fish/day) 4SGR= Specific growth rate (%/day)

R2 = 0.999; ŷ = 1.62+131X**-1.39X2**+3.97X3**



R2 = 0.999; ŷ = 1.62+1.31X**-1.39X2**+3.97X3**



R2 = 0.875; ŷ = 1.10+9.58X**-1.07X2**+3.17X3**

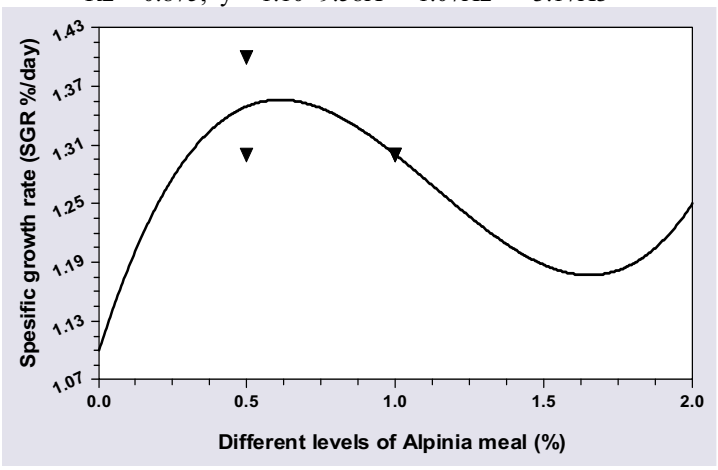


Fig. (1): Relationship between different levels (0.00, 0.50, 1.00 and 2.00 %) of Alpinia meal, growth performance (final body weight, total weight gain, and specific growth rate (SGR%/day) for monosex Nile tilapia fingerlings.

Feed Utilization:

Results of feed utilization in terms of Feed intake (FI), feed conversion ratio (FCR) Protein efficiency ratio (PER), protein productive value (PPV) and energy utilization (EU %) are presented in Table (4) and figure 2. There were no significant differences in feed intake (g/fish) of tilapia fed the experimental diets Table (4) and figure 2. The average of (FCR) in fish groups fed on diets 3 and 4 followed by groups of fish fed on diet 2 was significantly ($P<0.05$) improved in comparison with the basal diet. The FCR was found to be 2.70 (control diet), 1.95, 2.20 and 2.25, respectively. These results indicated that the best FCR values were observed with 0.50 % AM supplemented diets (diet No.2) Tables (4) and figure 2. Similar results have been reported for medicinal plants in diets for monosex Nile tilapia (O. niloticus) fingerlings by Abd ELmomem et al. (2002), Sakr (2003), Shalaby et al., (2003) and EL-Dakaret et al., (2004). The protein efficiency ratio results indicate that supplementing diets with different levels of AM at (0.00, 0.50, 1.00, and 2.00%) significantly ($P<0.05$) improved protein utilization in commercial diets of Nile tilapia.

The best PER values observed where the fish group fed on diet No.2 showed better PER values compared with the other groups .The PER was found to be 1.30 (control diet) , 1.75 , 1.60 and 1.50 for group of fish fed diets 2, 3,and 4 respectively Table (4) and figure 2. The same trend was observed in protein productive value (PPV %) and energy utilization (EU %) where the fish groups fed on diets No. 2 showed better PPV and EU were found to be 17.70 and 12.10 (control diet), (25.35 and 16.90), (24.50 and 16.25) and (22.35 and 14.90) for group of fish diets 2, 3 and 4 respectively Table (4) and figure 2. The best PER values observed where the fish group fed on diet No.2 showed better PER values compared with the other groups. The PER was found to be 1.30 (control diet), 1.75 , 1.60 and 1.50 for group of fish fed diets 2, 3, and 4 respectively Table (4) and figure 2.

The same trend was observed in protein productive value (PPV %) and energy utilization (EU %) where the fish groups fed on diets No. 2 showed better PPV and EU were found to be 17.70 and 12.10 (control diet), (25.35 and 16.90), (24.50 and 16.25) and (22.35 and 14.90) for group of fish diets 2, 3 and 4 respectively Table (4) and figure 2.

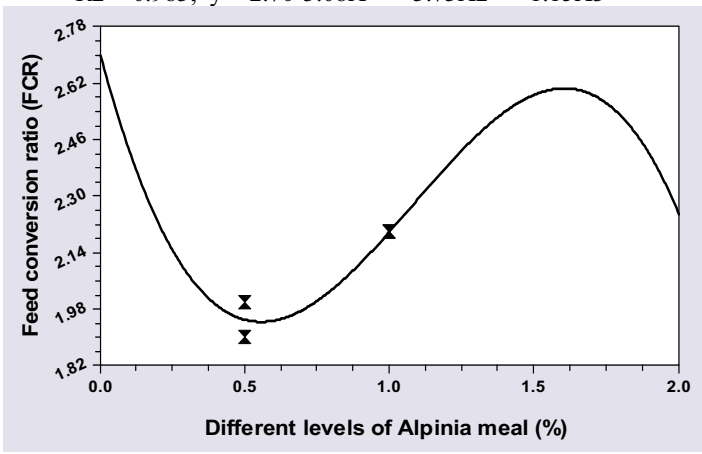
There were a positive correlation (r= 0.98, 0.97 and 0.88 between levels of Alpina meal and FCR, PER and PPV respectively (Fig. 2). In the present study, the commercial feed additives AM used significantly ($P<0.05$) enhanced feed efficiency. These results are in agreements with the findings of (Kanda et al., 1971; Abd Elmonem et al., 2002; Sakr, 2003; Shalaby et al., 2003 and EL-Dakar et al., 2004).

Table 4. Effect of using Alpinia meal (AM) as a feed additive on feed and nutrients utilization parameter of monosex (O. niloticus) fingerlings.

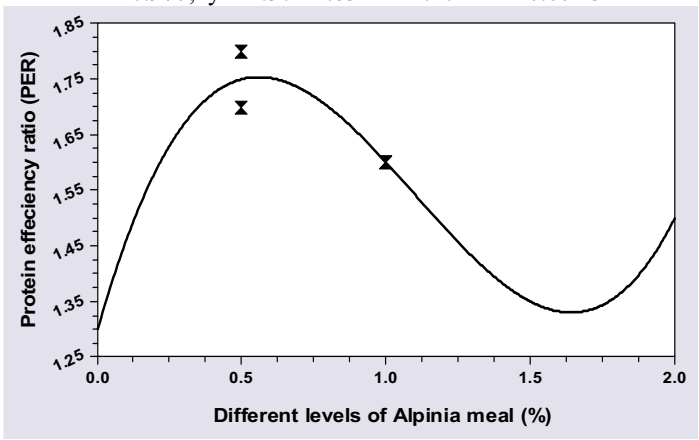
Diet No.	Feed intake	FCR3	Protein utilization		EU%6
	(g/fish)		PER4	PPV%5	
1	25.91	2.70a	1.30d	14.90b	14.90
2	25.63	1.95c	1.75a	25.35a	16.90
3	27.99	2.20b	1.60b	24.50a	16.25
4	27.45	2.25b	1.50c	22.35a	14.90
Mean2	26.745	2.275	1.538	21.775	15.738

1. Diet 1 (Control diet), diets 2, 3, 4 containing 0.50, 1.00 and 2 .00% Alpinia meal, respectively.
2. The mean in the same column bearing different superscript are significantly different at ($P< 0.05$).
3. FCR = Feed Conversion Ratio
4. PER = Protein Efficiency Ratio
5. PPV% = Protein Productive Value
6. EU% = energy utilized

R2 = 0.983; ŷ = 2.70-3.08X**+ 3.73X2**- 1.15X3**



R2 = 0.977; ŷ = 1.30+ 1.83X**-2.20X2**+6.67X3**



ŷ = 1.49+ 7.97X**- 9.25 X2** +2.63X3**

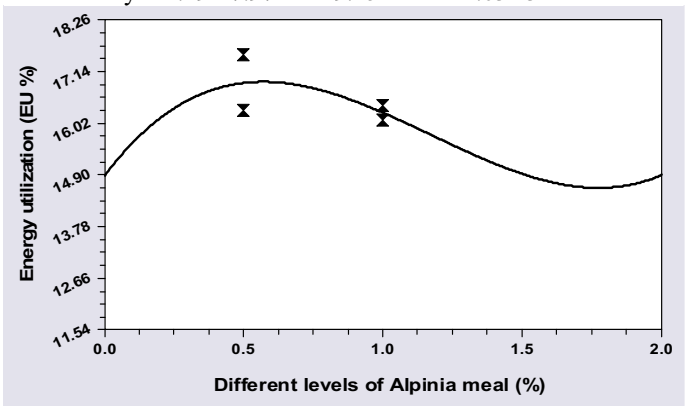
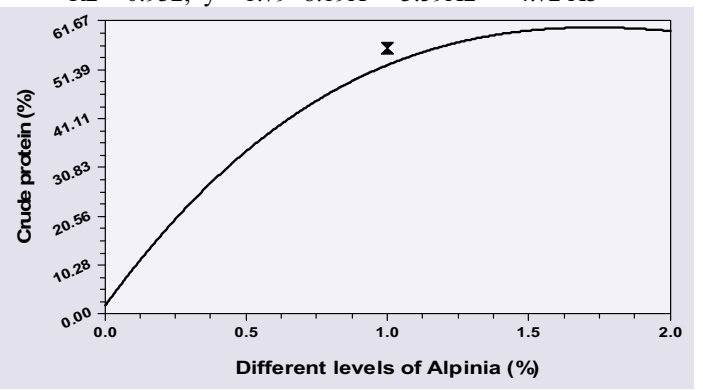


Fig. (2): Relationship between different levels (0.00, 0.50, 1.00 and 2.00 %) of Alpinia meal, feed and nutrient utilization (feed conversion ratio (FCR), protein efficiency ratio (PER) , protein productive value (PPV %)and energy utilization (EU%) protein final body weight ,total weight gain, and specific growth rate for monosex Nile tilapia fingerlings

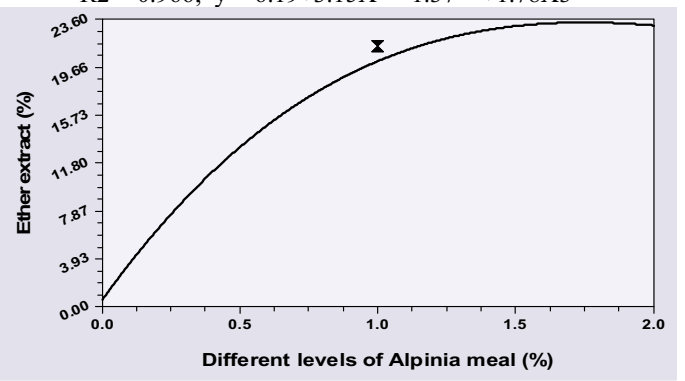
Body composition:

Tables (5) and figure 3 explored that average of whole body composition (%) including Dry matter (DM), crude protein (CP), ether extracts (EE) ash and energy content (ECo.) Kcal /100g) estimated as dry weight basis. There were no significant differences (P< 0.05) were observed in DM, CP, EE, ash content and Eco. These results are in close agreement with the results of Abd El-Maksoud et al., (2002), and EL-Dakar et al., 2004).

R2 = 0.932; ŷ = 1.79+8.19X**-3.59X2**+4.72 X3**



R2 = 0.966; ŷ = 6.19+3.15X**-1.37**+1.78X3**



R2 = 0.968; ŷ = 5.69+3.57X**-1.53X2**+1.96X3**

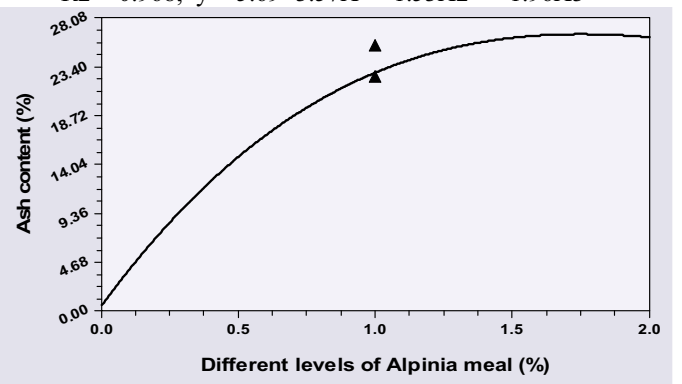


Fig. (3): Relationship between different levels (0.00, 0.50, 1.00 and 2.00 %) of Alpinia meal on chemical composition of whole body for monosex Nile tilapia fingerlings.

Table 5. Effect of using Alpinia meal (AM) as a feed additive on chemical composition of whole body parameter of monosex (O.niloticus) fingerlings.

Diet No1	Dry Matter	% On dry matter basis			Energy Content
	(%)	Crude Protein	Ether Extract	Ash	(Kcal/100g)
1	24.73	56.06	21.45	22.50	519.42
2	24.23	54.19	21.27	24.55	507.10
3	25.00	55.13	21.32	23.56	512.91
4	24.96	55.76	21.44	22.81	517.58
Mean 2	24.73	55.281	21.366	23.353	514.253

1. Diet 1 (Control diet), diets 2, 3, 4 containing 0.50, 1.00 and 2 .00% Cresson meal (CM), respectively.
2. The mean in the same column bearing different superscript are significantly different at ($P< 0.05$).

Blood measurements:

Results of blood measurements in Tables (6) and figures (4 and 5) showed no significant differences ($P <0.05$) in plasma total protein, plasma albumin and plasma total globulins of fish fed the experimental diets in comparison with the control diet.

These findings are in agreement with Soliman, (2000) and Mohamed, (2007) they noted that increasing the plasma total protein indicates the improvement of the nutritional value of the diet.

Table 6. Effect of using Alpinia meal (AM) as a feed additive on some physical parameter of parameter of monosex (O. niloticus) fingerlings

Diet No.	Plasma glucose (mg/dl)	Total plasma protein (g/dl)	Total plasma Lipid (g/dl)	HB (g/dl)	HT (%)	GOT 3 (U/L)	GPT 4 (U/L)
1	50.74	6.12	4.73	7.18	28.85	48.89	51.79
2	38.12	7.83	6.85	7.85	26.57	43.41	47.62
3	41.32	7.60	6.75	7.62	26.31	43.69	47.75
4	44.56	7.23	6.52	7.51	26.10	43.92	47.90
Mean	43.685	7.195	6.2125	7.54	26.9575	44.978	48.765

4. Conclusions

From the above results it may be concluded that a significant growth and FCR were recorded when Alpinia meal was fed to fingerlings of Nile tilapia through supplementation diets. Based on these results, we can recommend the use of the Alpinia meal at level (0.5%) as a feed additive for Nile tilapia to stimulate growth performance, nutritional and physiological parameters of Nile tilapia, Oreochromis niloticus, and fingerlings.

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