JOURNAL OF THE
ARABIAN AQUACULTURE SOCIETY
Vol. 5 No 2 December 2010

Effect of Feeding Rates and Frequencies on Growth Performance, Feed Efficiency and Body Composition of African Catfish, Clarias Gariepinus (Burchell, 1822)

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ABSTRACT

African catfish Clarias gariepinus (average initial weight 3.46 ± 0.08g) were fed a diet containing 32% crude protein (284.61 kcal DE/100g) and raised in 18 aquariums (75 liter each) at stoking density of 25 fish per aquarium with three replications per treatment for 90 days using a 3×2 factorial experimental design. The two factors evaluated were: daily feeding rates (2%, 3% and 4% body weight /day) and feeding frequencies once per day at 9:00 or Twice per day divided into two equal parts at 9:00 &13:00 hr. The present results indicated that fish at the feeding rate of 4% BW/day, twice per day showed significantly ($P < 0.05$) increase in body weight gain, survival rate, hepato somatic index and carcass composition . Fish fed at a rate of 2% BW/day once and twice per day were significantly decreased most response variable, but feed intake, feed conversion ratio and PER were improved when compared with another treatments. Regardless of feeding frequencies increasing daily feeding rate from 2 to 4% BW/day significantly ($P < 0.05$) improved body weight gain, survival rate, HSI and carcass composition ; however, there were no significant differences in specific growth rate, feed conversion, PER and carcass composition of crude protein between fish fed 3 and 4% BW/day. Also, fish fed twice per day had significantly better body weight gain, SGR, survival rate, feed conversion, ratio PER and carcass composition . The present study concluded that optimum feeding rates and feeding frequencies for African catfish (an initial weight of 3.64 ± 0.08 g) were 4% BW/day offered twice daily.

Keywords:

INTRODUCTION

More than 100 species of the genus *Clarias* have been described in Africa, the most are the species *C. gariepinus* (Burchell, 1822), and *C. lazera*, are important for aquaculture. It distributed, from the Nile to West Africa and from Algeria to Southern Africa (Teugels 1984). African catfish can survive in extremely poor conditions and to stock at significantly higher stocking densities than any other fish species. High environmental tolerance and wide food spectrum are the main reasons why African catfish is excellent for tropical and subtropical pond fish culture (Haylor, 1989). Channel catfish can be raised in still waters, floating water raceways, tanks, troughs, pens or cages. These fish can utilize wet or dry feeds as meals, sinking pellets, floating pellets, blocks or crumbles (Brown, 1977).

Since diet cost represents 30-70% of the total operating cost of an aquaculture enterprise (Webster, *et al*. 2001), determination of the appropriate daily feeding rate and frequency required to give optimal growth and feed efficiency could reduce the amount of diet fed, decrease the amount of time involved in feeding, and may increase profits. Results of feeding studies with channel catfish suggest feeding rate or frequency may significant influence growth rate and body composition. Hogendoorn (1981) and Hogendoorn, *et al* (1983) reported that a daily rate of 10% BW/d was optimum for juvenile channel catfish, *C. gariepinus* (average body weight 0.5 g). Also, Anderson and Fast (1991) reported that, optimum growth of *C. fuscus* could be with 6% feeding rate at 25˚C. Al-Hafedh and Ali (2003) compared different feeding rates (2, 4, 6, 8 and 10% BW/day) for juvenile *C. gariepinus* (average weight 0.64–65.4 g), for 112 days. They found that, although a feeding rate of 10% BW/day gave the highest yield, fish should be fed at the rate of 6% BW/day, taking growth, feed conversion efficiency, survival rate and minimum cannibalism into account. Robinson and Li (2007) revealed that, feeding channel catfish to satiation improves feed efficiency and reduced aeration time, but weight, carcass yield, and fillet yield were reduced compared with fish fed daily to satiation. In addition Lovell (1989) noted that, channel catfish fed twice daily had higher 20% of feed consumption and a comparably faster rate of growth than fish fed once daily. Li, *et al* (2005) found that, channel catfish fed twice daily had higher carcass and fillet yields than those fed once daily.

However, Overfeeding is wasteful financially and could adversely affect water quality. As the

African catfish industry expands, there are a need to know what feeding rate and frequency are optimal, both body quality and in terms of production. So this, study was conducted to evaluate the influence of feeding rates and frequencies on the growth performance, feed efficiency and body composition of African catfish juvenile (3.46g).

MATERIALS AND METHODS

This study was conducted at the Central Laboratory for Aquaculture Research (CLAR), Abbassa, Sharkia Governorate, Egypt

Experimental design

The experimental facility consisted of 18 glass Aquaria (75 – 60 – 45cm in diameters). Each aquarium was supplied with aerated and dechlorinated tap water, which was stored in tanks for 24 hours and aerated by air pump (Model-Rina 301) during the experimental period. The water exchange rate was maintained to a fixed rate by the addition of new well-aerated dechlorinated fresh water. (daily feeding rates × daily feeding frequencies) 3×2 factorial experimental design were conducted evaluated Six treatments . The two factors evaluated were: daily feeding rates (2%, 3% and 4% BW/day of total biomass) and feeding frequencies once per day at 900 or twice per day divided into two equal parts at 900 &1500 hr.

Fish and feeding regime

African catfish *Clarias gariepinus* juvenile with an average initial weight of 3.46 ± 0.08gm, were transferred from Hatchery (CLAR), to the wet lab of (CLAR) and acclimatized in fiberglass tanks for three weeks before to be used in the experiment Fish were randomly allocated into the aquaria (25 fish / aquarium). Each treatment was represented in three aquariums (3 replicates).

Fish were fed diet containing 32% crude protein and 284.61 kcal DE/100g, particle sizes of 0.8 mm in diameter for 90 days. The amount of feed was calculated and readjusted every 15 days according to change in the body weight. Composition and proximate analysis of the experimental diet are shown in Table (1). At the end of the experiment, fish in each aquarium were counted and weighed, growth parameter and feed utilization were calculated .Also, analysis of diet and fish fore moisture, crude protein, fat and ash were determined by standard methods according to AOAC (1990), while nitrogen free extract was calculated by difference, nitrogen free extract = 100 — (moisture + protein + lipid + fiber +ash) . Also the gross energy (kcal / kg diet) was calculated

Table 1. *Composition and chemical analysis of the experimental diet.*

Composition	% dry weight
Fish meal	8
Soybean meal	30
Corn ground	41.3
Wheat bran	15.65
Dicalcium phosphate	1
Caboxy methyl cellulous	2
Oil	1.5
*Mineral mix	0.25
*Vitamin mix	0.25
Vitamin C	0.05
Total	100.00
Chemical analysis (on dry matter basis)	
Crude protein	32
Ether extract	6.73
Crude fiber	6.69
Ash	7.34
Nitrogen free extract	47.24
**Gross energy kcal/100g	438.17
***Digestible energy kcal/100g	284.61

Each 100 gram of vitamin and mineral contained:
Mineral : Zn, 2.50 mg; Mn, 16.00 mg; Fe, 31.50 mg; Cu, 5.50; I, 0.55 mg; Ca, 1.15 gm and P, 450 mg. Vitamins : A, 7500000 Iu; Bi, 100 mg; B3, 500 mg; B6, 150 mg; B12, 2.5 mg; E, 100 mg; K, 100 mg; Pantothnic acid, 275 mg; Folic acid, 100 mg and vit. D3, 7500 Iu.

(kcal/100g diet); based on 5.64 kcal/g protein, 9.44 kcal/g lipid, and 4.11 kcal/g carbohydrate. NRC (1993)

****(kcal/100g diet); based on 3.5 kcal/g protein, 8.1 kcal/g lipid, and 2.5 kcal/g carbohydrate. NRC (1977)***

using factor 5.64, 9.44 and 4.11 for crude protein, fat and carbohydrate, respectively according to NRC (1993).

Data calculation

Daily weight gain = $(W_1 - W_0) \div T$

Specific growth rate (%) = $[(Ln_{w1} - Ln_{w0}) \div T] \times 100$.

Where: Ln = natural log, W_0= Initial body weight (g), W_1= Final body weight (g) and T= Time(day)

Protein efficiency ration (%) = Body weight gain ÷ protein intake

Feed intake = Total feed intake during the whole experimental period

Feed conversion ratio = Feed consumed (g) / Total weight gain (g).

Hepato somatic index (HSI) = [liver weight ÷ fish weight] × 100

Survival rate (%) = (Fish No. at the end ÷ Fish No. stocked at the beginning)/100

Statistical analysis

Statistical analysis was performed using the Analysis of variance (ANOVA) two way classification and Duncan's multiple Range Test, (Duncan 1955) to determine differences between treatments means at significance rate of $P < 0.05$. The standard errors of treatment means were also estimated. All statistics were carried out using Statistical Analysis System (SAS) program (SAS, 2000).

RESULTS AND DISCUSSION

Growth performance

The average values of growth performance of African catfish, feeding rate and frequency are presented in Table (2).The results indicated that, fish fed at a rate 4% of biomass, divided into two equal parts twice daily had significantly ($P < 0.05$) increased final body weight (38.24), bodyweight gain (34.67gm), survival rate (98.96%), hepato somatic index (3.05%) and differences were not significant ($P < 0.05$) in SGR with those fish fed of biomass 3% twice daily. In general The lower significant value ($P < 0.05$) of final body weight, body weight gain, SGR survival rate, HSI were obtained by fish feeding rate 2% once or twice daily. These data are in agreement with those of Robinson, (1994); Robinson and Li (1999); Robinson, *et al* (2004) and Li, *et al* (2004, 2006) the production tends to be highest significantly when channel catfish are fed daily to apparent satiation than those fish fed once every other day and restricted feeding. Schnaittacher *et al* (2005) found that juvenile Atlantic Halibut displayed improved growth rates when fed to satiation 5 times/d, compared with 1/d.

Table 2. ***Growth performance and feed utilization parameters for African catfish under different daily feeding rates and frequencies during the whole experimental period (90 days).***

Treatments		Items								
Feeding rates	Feeding frequencies	Initial body weight	Final body weight	Body weight gain	SGR	Survival rate	HSI	Feed intake	Feed version	PER
2%	Once	3.64 ± 0.25^{a}	21.59 ± 0.65^{e}	17.95 ± 0.42^{e}	1.98 ± 0.05^{d}	93.55 ± 0.51^{c}	2.01 ± 0.05^{d}	21.24 ± 0.10^{c}	1.18 ± 0.02^{c}	2.64 ± 0.03^{a}
	Twice	3.25 ± 0.13^{a}	23.91 ± 0.48^{e}	20.66 ± 0.61^{de}	2.22 ± 0.07^{cd}	94.12 ± 0.31^{c}	2.22 ± 0.06^{c}	22.93 ± 0.23^{c}	1.11 ± 0.01^{c}	2.81 ± 0.06^{a}
3%	Once	3.50 ± 0.21^{a}	27.02 ± 0.28^{d}	23.52 ± 0.23^{d}	2.27 ± 0.06^{bc}	96.14 ± 0.72^{b}	2.30 ± 0.08b^{c}	36.45 ± 0.63^{b}	1.55 ± 0.11^{a}	2.02 ± 0.02^{c}
	Twice	3.19 ± 0.05^{a}	30.94 ± 0.62^{c}	27.75 ± 0.67^{c}	2.52 ± 0.04^{ab}	97.15 ± 0.39^{b}	2.40 ± 0.03^{b}	38.57 ± 0.57^{b}	1.39 ± 0.02^{b}	2.25 ± 0.02^{b}
4%	Once	3.43 ± 0.28^{a}	34.71 ± 0.93^{b}	31.28 ± 1.17^{b}	2.57 ± 0.11^{a}	97.22 ± 0.41^{b}	2.43 ± 0.07^{b}	47.47 ± 1.21^{a}	1.52 ± 0. 04^{a}	2.06 ± 0.12b^{c}
	Twice	3.75 ± 0.11^{a}	38.42 ± 0.85^{a}	34.67 ± 0.78^{a}	2.59 ± 0.02^{a}	98.96 ± 0.20^{a}	3.05 ± 0.06^{a}	48.06 ± 1.11^{a}	1.39 ± 0.02^{b}	2.25 ± 0.01^{b}

Means with different superscript letters within a column are significantly different (P<0.05).

Giberson and Litvak (2003) reported that Shortnose Sturgeon grew significantly better when offered a food ration at a rate of 3% ,4 or 8 times/d. On other hand Guen, *et al* (2004) suggested that feeding to satiation once a day resulted in optimum growth performance when compared with 1 meal every 2 d or 2 meals/d in Black Rockfish. This difference my be due to the differences in culture, fish size and species .

The average value of growth performance of African catfish under different daily feeding rate are given in Table (3). Results obtained showed that, increasing daily feeding rate from 2 to 4% significant increased live body weight, body weight gain, survival rate, HIS except SGR which was not significant differed with fish feeding rat 4 and 3% of biomass . These results showed the same trend by Jackson, *et*

al (2003), woh showed that in two catfish, strains feeding to satiation increased significantly weight gain and SGR, than restricted feeding (2/3 satiation rate) and not significantly affected survival rate. Al-Hafedh and Ali (2004) stated that, the best growth performance was recorded for the fish fed at 8–10% of body weight, followed by the fish fed at 4–6% in African catfish with an average weight of 0.64–65.4 g poorest growth was found for those fed at the 2% feeding rate. Also survival was significantly higher in fish fed at 6–10% of body weight than those fed at 2–4%.

The average values of growth performance of African catfish under two daily feeding frequencies (once or twice per day) are presented in Table (4). The obtained results indicated that, fish fed twice per day showed significant increase in all growth performance parameters; however HSI was not significantly differed with those fish fed once per day. These results are in agreement with Robinson and Li (2007), who reported that, net production of channel catfish was reduced by 16% when the fish were fed once daily. On the other hand -Jarboe and Grant (1997) found no significant differences were observed between smaller channel catfish fed once or twice per day in weight gain, SGR and survival rate, whereas the mean weight gain of the larger channel catfish in the treatments receiving two daily feeding frequencies was 10 to 15% greater than channel catfish fed once daily. Li *et al* (2005) revealed that, gain per fish and estimated survival of Channel catfish fingerlings (initial weight 22 g/fish) did not influenced by feeding frequencies once or twice per day.

Table 3. ***Growth performance and feed utilization parameters for African catfish under different daily feeding rates during the whole experimental period (90 days).***

Treatments	Items								
Feeding rates	Initial body weight	Final body weight	Body weight gain	SGR	Survival rate	HSI	Feed intake	Feed conversion	PER
2%	3.45 ± 0.15[a]	22.75 ± 0.63[c]	19.30 ± 0.69[c]	2.10 ± 0.06[b]	93.84 ± 0.30[c]	2.12 ± 0.06[c]	22.08 ± 0.39[c]	1.14 ± 0.03[b]	2.73 ± 0.06 [a]
3%	3.35 ± 0.12[a]	29.48 ± 0.72[b]	26.13 ± 1.00[b]	2.42 ± 0.06[a]	96.68 ± 0.44[b]	2.35 ± 0.04[b]	37.51 ± 0.61[b]	1.44 ± 0.04[a]	2.18 ± 0.08 [b]
4%	3.59 ± 0.15[a]	36.57 ± 1.00[a]	32.98 ± 0.98[a]	2.58 ± 0.05[a]	98.06 ± 0.45[a]	2.74 ± 0.14[a]	47.77 ± 0.75[a]	1.45 ± 0.09[a]	2.16 ± 0.05[b]

Means with different superscript letters within a column are significantly different (P<0.05).

Table 4. ***Growth performance and feed utilization parameters for African catfish under different daily feeding frequencies during the whole experimental period (90 days).***

Treatments	Items								
Feeding frequencies	Initial body weight	Final body weight	Body weigh t gain	SGR	Survival rate	HSI	Feed intake	eed ersion	PER
Once	3.52 ± 0.13[a]	28.11 ± 1.92[b]	24.59± 1.97[b]	2.29 ± 0.09[b]	95.61 ± 0.60[b]	2.25 ± 0.07[a]	35.25 ± 3.9[a]	1.43 ± 0.08[a]	2.22 ± 0.10[b]
Twice	3.40 ± 0.10[a]	31.09 ± 2.12[a]	27.69 ± 2.05[a]	2.44 ± 0.06[a]	96.77 ± 0.73[a]	2.56 ± 0.13[a]	36.32 ± 3.6[a]	1.31 ± 0.05[b]	2.45 ± 0.09[a]

Means with different superscript letters within a column are significantly different (P<0.05).

Feed efficiency

In general feed intake, feed conversion and PER were improved significant ($P < 0.05$) when feeding rate was decreased from 4% to 2% at two feeding frequency as showed in Table (2). While, the best significant ($P < 0.05$) value of feed conversion (1.11) and PER (2.81) were recorded for feeding rate 2% twice per day, These data are partly supported by those of Li *et al* (2004, 2006) since conversion ratio (FCR) which improved when channel catfish are fed less than daily. Robinson and Li (1999) and Robinson, *et al* (2004) found that, lower feeding rate improved significantly feed conversion ratio of channel catfish fed daily. On other hand, Guen *et al* (2004) reported that Black Rockfish fed to satiation once a day resulted in optimum food utilization when compared with fish fed 1 meal every 2 day or 2 meals/day.

The average value of feed efficiency of African catfish under different daily feeding rate are revealed in Table (3). It was observed that, feed intake was decreased significant by decreased feeding rate from 4% to 2% but no significant deference in feed conversion and PER were obtained by fish feeding rate 4% and 3%. These results are in agreement with Jackson *et al* (2003) woh showed that, food conversion was increased significantly in two strain catfish fed restricted diets (2/3 satiation). In this concern the authors, the lower feed efficiency for satiated group was likely due to wasted feed rather than an actual reduction in feed utilization, Al-Hafedh and Ali (2004) found that, FCR of African catfish significantly increased from 1.14 to 2.98 by increasing feeding rate

from 2 to 10 % BW/d respectively. In addition, Feed conversion of channel catfish fed to satiation was higher than that of fish under restricted feeding (Li and Lovell. 1992).

The average values of feed efficiency African catfish under different daily feeding frequency are shown in Table (4). Fish feeding twice per day showed the best significant value of feed conversion (1.31) and PER (2.45), and there were no significant differences with fish fed once per day in feed intake. These results are completely agreement with those obtained by Jarboe and Grant (1997) who found that, the mean food conversion value of channel catfish fed two times per day was lower significantly by 15% than fish fed once per day. Also Robinson and Li (2007) found that, Channel catfish fed every other day converted feed more efficiently (11%) than those fish fed daily. On other hand, Li *et al* (2005) found that, Feed conversion ratio was best in fish fed once daily at the morning compared to fish fed once daily at the afternoon or twice daily by catfish.

Carcass composition

The average values of carcass composition of African catfish under daily feeding rate and frequency at the end of the experimental period are presented in Table (5). The obtained results revealed a significant increase in carcass dry matter, crude protein, ether extract and gross energy content, however it had adverse effect in carcass ash. Fish feeding rate 4% twice per day showed the higher significantly dry mater content (24.88), crude protein (66.2), ether extract (16.46) and gross energy (524.94) and in lower content of ash (16.9). These results are in a partial agreement with Li*, et al* (2004, 2006) whos reported that Catfish fed to satiation tend to contain more fillet fat and dry matter than fish fed every other day. Also, fillet yield was reduced in fish fed every other day as compared with those fed daily while no significant differences were found in fillet protein. Results obtained by Robinson (1994) and Robinson *et al* (2004) had the same trend for channel catfish fed daily at different feeding rates.

Results presented in Table (6) showed that, fish feeding rate 4% had significant higher dry matter, crude protein, ether extract and gross energy, however it had significant lower of ash content, and there were no significant differences from fish fed at a rate of 3% in crude protein. In this concern, Jackson *et al* (2003) stated that, fillet dry matter, ash and crude protein were not influenced by feeding rate in the two strains of catfish, whereas fat was increased significantly in fish fed to satiation than restricted group, and the

slower growth resulting from reduced feed and energy consumption for restricted group would reduce body fat

Table 5. ***Carcass composition for African catfish under different daily feeding rates and frequencies at the end of the experimental period (90 days).***

Treatments		Items				
Feeding rates	Feeding frequencies	Dry matter	Crude protein	Ether extract	Ash	Gross energy
2%	Once	20.21 ± 0.26^{d}	63.66 ± 0.32^{c}	14.5 ± 0.10^{c}	19.05 ± 0.10^{a}	495.92 ± 2.79^{c}
	Twice	20.71 ± 0.12^{c}	63.81 ± 0.33^{c}	14.56 ± 0.20^{c}	19.00 ± 0.08^{a}	497.33 ± 3.08^{c}
3%	Once	22.65 ± 0.10^{b}	65.02 ± 0.26^{b}	15.12 ± 0.27^{b}	18.22 ± 0.05^{b}	509.45 ± 2.6^{b}
	Twice	22.88 ± 0.15^{b}	65.81 ± 0.49^{ab}	15.37 ± 0.12^{b}	17.81 ± 0.07^{c}	516.26 ± 2.64^{b}
4%	Once	23.00 ± 0.07^{b}	66.01 ± 0.31^{a}	16.17 ± 0.38^{a}	17.18 ± 0.14^{d}	524.94 ± 4.9^{a}
	Twice	24.88 ± 0.08^{a}	66.2 ± 0.50^{a}	16.46 ± 0.14^{a}	16.9 ± 0.04^{d}	528.75 ± 4.15^{a}

Means with different superscript letters within a column are significantly different (P<0.05).

deposition. Li and Lovell (1992) reported that, fat content of channel catfish fed to satiation was higher than that of fish fed at the restricted rate Data illustrated in Table (7) showed that, fish fed twice times daily was significant had higher body content dry mater (22.75), but it had lower significant body content of ash (17.90), with significant differences with fish fed once per day in body crude protein content ether extract and gross energy. These results are in a partial agreement with those of Robinson and Li (2007), who reported that, body composition of channel catfish was similar when the fish were fed every other day compared with fish fed daily, while carcass, fillet, and net yields were reduced in fish fed every other day compared with fish fed daily. Jarboe and Grant (1997) reported that, the body composition of channel catfish in multipass system was unaltered by feeding frequencies. (Li *et al*. 2005) found that, fillet proximate composition of channel catfish was unaltered significantly in fish fed once

daily in the morning compared to fish fed once daily in the afternoon or twice daily.

Table 6. ***Carcass composition for African catfish under different daily feeding rates at the end of the experimental period (90 days).***

Treatments	Items				
Feeding rate	Dry matter	Crude protein	Ether extract	Ash	Gross energy
2%	20.46 ± 0.17^{c}	63.74 ± 0.21^{b}	14.53 ± 0.10^{c}	19.03 ± 0.06^{a}	496.63 ± 1.88^{c}
3%	22.77 ± 0.10^{b}	65.42 ± 0.30^{a}	15.25 ± 0.14^{b}	18.02 ± 0.10^{b}	512.85 ± 2.25^{b}
4%	23.94 ± 0.42^{a}	66.11 ± 0.27^{a}	16.32 ± 0.19^{a}	17.04 ± 0.09^{c}	526.85 ± 3.00^{a}

Means with different superscript letters within a column are significantly different (P<0.05).

In conclusion, the results of the present study suggest that the optimum feeding rate for African catfish juvenile with an average initial weight of 3.64 g ± 0.08 was 4% of body weight two times daily in order to obtain highest growth performance, best feed utilization of carcass composition.

Table 7. ***Carcass composition for African catfish under different daily feeding frequencies at the end of the experimental period (90 days).***

Treatments	Items				
Feeding frequencies	Dry matter	Crude protein	Ether extract	Ash	ross energy
Once	22.03 ± 0.46b	64.90 ± 0.37a	15.26 ± 0.28a	18.15 ± 0.28a	510.10 ± 4.56a
Twice	22.75 ± 0.60a	65.27 ± 0.43a	15.46 ± 0.29a	17.90 ± 0.31b	514.12 ± 4.86a

Means with different superscript letters within a column are significantly different (P<0.05).

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تاثير المعدلات المختلفه من التغديه وتكراراتها على معايير النمو والكفاءة الغذائيه وتركيب الجسم لاسماك القرموط الافريقي

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1-قسم بحوث بيولوجي وبيئه الاسماك **2**- قسم بحوث تغديه الاسماك

المعمل المركزي لبحوث الثروة السمكية بالعباسة- ابو حماد – محافظة الشرقية – مصر

اسماك القرموط الافريقي (متوسط وزن ابتدائي 3,45 ± 0,08جم) غذيت بعليقه تحتوى 32% بروتين خام (طاقة مهضومة 284,61 كيلو كالورى/100جم علف) وزعت على 18 حوض زجاجي سعة الحوض 75 لتر,في كل حوض 25 سمكة في ثلاثة مكررات باستخدام التحليل العاملى 3×2 لمدة 90 يوم. تم تقييم عاملين: معدل التغذية اليومي بمعدلات 2% و3% و4% من وزن الجسم كل يوم، و تكرار التغذية, حيث غذيت كمية العلف كلها مرة واحدة الساعة 9 صباحا او وزعت على اجزاء متساوية مرتين الساعة 9 صباحا والساعة 13 بعد الظهر

اشارت النتائج ان الاسماك المغذاة 4% من وزن الجسم موزعة على مرتين في اليوم اعطت زيادة معنوية في عائد وزن الجسم ومعدل بقاء ودليل الكبد ومحتوى الجسم من المادة الجافة ومستخلص الدهن والطاقة الكلية . الاسماك المغذاة 2% من وزن الجسم مع تكرار التغذية سواء مرة او مرتين اعطت انخفاض معنوي في اغلب العوامل المقدرة ولكنها حسنت معنويا معدل استهلاك الغذاء ومعدل التحويل الغذائي و كفائه تحويل البروتين مقارنا مع باقي المعاملات.

بغض النظر عن تكرار التغذية فان زيادة معدل التغذية من 2وحتى 4% من وزن الجسم حسنت معنويا عائد وزن الجسم ومعدل البقاء ودليل الكبد ومحتوى الجسم من المادة الجافة ومستخلص الدهن والطاقة الكلية، ولم يوجد فروق معنوية في معدل النمو النوعي ومعدل التحويل الغذائي ونسبة كفائه البروتين ومحتوى الجسم من البروتين بين معدل التغذية 3 و 4% من وزن الجسم . ايضا الاسماك المغذة مرتين في اليوم زادت معنويا عائد وزن الجسم ومعدل النمو النوعي

ومعدل البقاء ومعدل التحويل الغذائي ونسبة كفائه البروتين ومحتوى الجسم من المادة الجافة والرماد.

تقترح هده الدراسه إن المعدل الغذائي الامثل لاسماك القرموط الافريقى دو متوسط وزن 3,64 جم يكون 4% على مرتين متساويين يوميا .