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PROTEIN SPARING EFFECTS OF CARBOHYDRATE IN CATFISH, CLARIAS BATRACHUS

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Abstract

Feeding trial was conducted to examine the protein sparing effects of carbohydrate in Clarias batrachus. an attempts to reduce the feed cost. Clarias batrachus fingerlings mean weights of 8.32 ±0.04g were randomly allotted into a group of 15jishcs per tank in triplicate of 10 treatment. They were fed on nine experimental diets and a commercial catfish reference diet (CRD). The formulated diets have three levels of carbohydrate (5, 10 and 20%) of thre carbohydrate source (cornfibre, cornstarch and glucose) and three levels of crude protein (30% 25% and 2()%). The results of the trial showed significant difference (/9<0.05) in all the carbohydrate soures fed to C.

Clarias batrachus at different levels of carbohydrate/ protein ratios. However, of the three carbohydrate sources, corn starch and glucose spared protein growth while corn fibre did not.

Keywords: Protein sparing, effects, Carbohydrate sources, Clarias batrachus

INTRODUCTION

Carbohydrates are important nonprotein energy sources for fish and should be included in their diets at appropriate levels which maximize the use of dietary protein for growth. The amount of non-protein energy sources that can be incorporated in fish diets is not fully understood and as such no dietary requirement for dietary carbohydrate has been demonstrated in fish; however, certain fish species exhibit reduced growth rates when fed carbohydrate free diets(1994). Carbohydrate utilisation is much more variable and probably is related to natural incorporation nutrient may add beneficial effects to the pelleting quality of the diet and to fish growth (Wilson, 1994•, NRC, 1993). Excessive dietary carbohydrate in fish diet may also lead to fat deposition by stimulating the activities of lipogenic enzymes (Likimani and Wilson, 1982). Thus, rainbow trout (Brauge et al., 1994), Tilapia zillii (El-sayed and Garling, 1988), and red drum, sciaenops (Serrano et al.. 1992; Ellis and Reigh, 1991) have been reported to have poor utilization for carbohydrate than Oreochromis niloticus (Shimeno etal., 1993)

Information on nutritional studies in catfish Clarias batrachus seems limited and have been dealt mainly with dietary protein and energy requirements using semi purified diets (Degani et al., 1989; Uys, 1989; Henken et al., 1986; Machiels and Henken, 1985). Until now, carbohydrate utilization has not been studied, although Clarias batrachus is reported to be omnivorous and might utilize carbohydrate well. The objective of this study is to determine the carbohydrate sparing effects of protein in catfish Clarias batrachus.

MATERIALS AND METHODS

Experimental System

The study \vas conducted in a recycling water system of the Department of \Vater Resources, Aquaculture and Fisheries Technology of School of Agriculture and Agricultural Technology, Federal University of Technology, Minna. Water quality paranwters of the set up were monitored.
(Temperature:
Conductivity (p/cm) x 10-2: 74.12-103.34;
Dissolve oxygen
Ammonia nitrogen Ong/L): 0.07 - 0.36±0.05:Nitrate nitrogen (mg/L): 0.39 - 6.07 ± 250.00;
Nitrite nifrogen (mg/L): 0.02-0.24 :k0.25.

Experimental Diets

The experimental design was complete randomized design (C RD). Nine experimental diets and one commercial reference dict [(CRD)- Coppcns Catfish fccd from Netherland)] were used for the feeding trial. The experimental diets were formulated using equational method of two unknowns. Nine experimental diets of three levels of protein (30%, 25% and 20% CP) were formulated with three sources of carbohydrate; complex, moderately complex and simple sugar (Cornfibre, Corn starch and Glucose-D) at 5, 1 0 and 20% inclusion levels. The Table of formulation and its proximate analysis is shown in Table l .

Experimental Fish

150 fingerlings of catfish, Clarias batrachus of mean weight 8.32±0.04 g were obtained from the hatchery unit of the Department of Water Resources, Aquaculture and Fisheries Technology. The fishes were acclimatized for one week and fed on commercial catfish diet (crude protein 45%). At the commencement of the feeding trial, a group 15 fishes were randomly selected, weighed and assigned to 50 litres cylindrical tank. The treatments were randomly assigned to a triplicate group of the tanks. The duration of the experiment vvas 8 weeks. Before the commencement of the feeding trial, 7 fishes from the acclimated lots were randomly sacrificed for determination of initial whole.

Experimental Analyses and Growth Parameters

Proximate analysis for moisture, crude protein, crude lipid and ash of carcass, feed ingredients and experimental diets were determined according to the methods of AOAC (2000). Final values for each group represent the arithmetic mean of the triplicates. Feed intake was monitored to measure average feed intake and their effects on growth. The growth and nutrient utilization parameters measured include weight gain, specific growth rate (SGR), feed conversion ratio (FCR), protein efficiency ratio (PER), Apparent Net Protein Utilization (ANPU). The growth parameters were computed as stated below;
Mean weight gain = Mean final weigh - mean initial weight
Specific Growth Rate (SGR)=

(LogeW2-Loge IOO
UT2-Tl.
Where, Wa and WL- final and initial weight,
T2 and TL- final and initial time Feed conversion ratio - Feed fed on dry matter/fish live weight gain
Protein efficiency ratio (PER) —Mean weight gain per protein fed

Protein intake (g) Feed intake x crude protein of feed.
Apparent net protein utilization (ANPU %) ¯ (P2 - P l) / Total protein consumed (g) x 100 Where, PI is the protein in fish carcass (g) at the beginning of the study and P2 is the protein in fish carcass (g) at the end of the study.
body composition. The fishes were bulk weighed fortnightly and at the end of the experiment, all fishes were weight and counted individually.

Statistical Analysis

The experimental design was experiment, all fishes were from weighed each tank and the data was subjected to one way analysis of counted were collected individually. for determination 5 of final variance to test their significant levels at 5% whole body composition. The fishes were fed probability. The mean were separated using twice daily between the hours 10.00 and Turkey's method. The regression coefficients 16.00 to apparent satiation. were analyzed using Minitab Release 14 whilc the graphs were drawn using the Microsoft excel windows 2007.
RESULTS Survival and Feed Performance The insignificant cornstarch diffcrcnces based (p>0.05) diets exhibited in thc Tablcs I and 2 show reed composition/ M WG for trcatmcnts 5:35 and 10:25 C/P
proximate analysis and results of growth paratncters for various carbohydrate sources fed Clarias batrachus. The growth performance ol' Clarias batrachus fed cornfibre at three levels of carbohydrate and protein (CIP) ratios indicated no significant differences (p<0s05) between treatinent 10:25 and 20:20 C/P ratios both or were significantly lower (p<0.05) than 5: 30 in mean weight gain (MWG) and specific growth rate (SGR). There were no significant differences (p>0.05) in the feed conversion ratios (FCR) for all the treatments. There were significant differences (p<0.05) in the protein efficiency ratios (PER) of treatments 15:25 and 20:20 C/P ratios, which were significantly higher (p<0.05) than 5:30 CIP ratio. There were significant differences (p<0.05) in the apparent net protein utilization (ANPU) for all the treatments, which was highest for diet 20:20 C/P ratio. The survival percentages also indicated significant differences (p<0.05) between diets 15:25 and 20:20 both of which were significantly higher (p<0.05) than 5:30 C/P ratio.

The cornstarch based diets did not exhibit significant differences (p>0.05) for all the treatments, however, dict 20:20 C/P ratio gave the lowest mean weight gain (MWG). There were significant differences (p<0.05) in the SGR for all the treatments, which was highest in 10: 25 CIP ratio. The FCR values also indicated significant differenccs (p<0.05) for all the treatment but diet 10:25 gave the lowest FCR value. There were significant differences (p<0.05) in the PER
highest for 20:20 C/P ratio. However, the ANPU values also showed significant differences (p<0.05) for all the treatinents but dict containin ° 10:25 C/P ratio gave the highest value.
ratios both of which were significantly higher (p<0.05) than 20:20 C/P ratio. There were significant differcnccs (p<0.05) for the treatments in the SGR values which was highest with 10: 25 CIP ratio. The FCR values also were significant (p<0.05) for all the treatments, which was lowest for 10:25 C/P ratio. There were significant difTerences (p<O.05) in the PER and ANPU values for all the treatments, which were highest for 20:20 and 10:25 C/P ratios respectively. The survival percentage was significant (p<0.05) for all the treatments but was lowest for 15:25 C/P ratio.
The glucose based diets indicated insignificant differences (p>0.05) for all the treatments in the M WG and SGR values. There were significant differences (p<0.05) in the FCR for all the treatments but was

lowest for 20:20 CIP ratio. The PER values indicated no significant differences (p>0.05) between diets 5:30 and 10: 25 both of which were significantly lower (p<0.05) than 20:20 C/P ratio. The ANPU values were significant
for all the treatments but highest for 20:20. The survival percentages indicated no significant differences (p>0.05) between diets 5:25 and 20:20 but were significantly high (p<O.05) for 10:25.

Nutrient Utilization

Table 3 showed the results of the nutrient utilization. There were no significant differences (p>0.05) between diets 15:25 and 20:20 in the body protein and signiticantly higher (p<0.05) than 5:30. The body fat showed significant difference (p<0.05) for all the treatments, which was highest for 5:30 CIP ratio. The body ash indicated significant di [Terences (p<0.05) for all the treatinents but was lowest for 20:20 C/P ratio. There were significant differences (p<0.05) in the nooisture content but lowest for 10:30 C/P ratio, The cornstarch based diets exhibited significant differcnccs (p<0.05) in the body protein for all the trcatlncnts. which was highest for 15:25 C/P ratio. Similarly, the body fat indicated significant differences (p<0.05) for all treatments but was lowest ror 20:20 CIP ratio. The body ash also expressed significant differences for all the treatments, however, diet 10:25 gave the lowest body ash. There xvas also significant differences (p<0.05) in the body moisture contents, which was lowest ror diet 20:20 C/P ratio. The glucose-based diets indicated significant differences (p<0.05) in the body protein for all the treatments but was highest for 20:20. The body fat also showed significant differences (p<0.05) for all treatments but was lowest for 5: 30 CIP ratio. Similarly, there were significant differences (p<0.05) in the body ash and body moisture, which are lowest for 10:25 and 20:20 C/P ratios respectively.

However, the growth responses för cornfibre and glucose shown in figures I and 3 indicated a bundle growth curve while, the corn starch appeared to have a better protein sparing toward the end of the feeding trial at 10:25 CIP ratio (Figure 2). The regression coefficient showed positive relationship between weight gain and the glucose levels (x =0.154 + 0.0052y; r^2=O.40•, p<O.05) (Figure 4a) and negative relationship with protein levels (x = 0.443-0.088y•, r^2=O.54, p<O.05) (Figure 4b). The cornstarch showed a negative relationship in its weight gain and the inclusion levels of corn starch (x = 0.800 0.0178y; 0.26, p<0.05) (Figure 5a) and a positive relationship with protein levels (x =0.052 + 0.0216y; 0.16, p<O.05) (Figure 5b) while the cornfibre based diets indicated a negative relationship between the weight gain and the cornfibre levels (x=l .540.088% r^2 = 0.66, p<O.05) (Figure 6a) and positive relationship with protein levels (2.37 + O. 124y; 0.82, 13<0.05) (Figure 6b).

DISCUSSION

The results on growth performancc observed indicated protein sparing effects of various carbohydrate sources fed Clarias batrachus. However, the protein sparing was influenced by both complexity and inclusion levels (Rawles and Garlin 111,4 998). The cornfibre based dict least spared protein as obscrvcd from the growth response. The cornfibre based diets gave the best growth at the highest inclusion lcvcl of crude protein (40 %) and at lowest levels of fibre. This showed that Clarias batrachus cannot utilize fibre at high inclusion level. Moreover, the cornsatarch spared protein at 10 % inclusion level thereby lowering the crude protein to 25%. Moreover, .the growth response (Figure l) indicated a better protein sparing towards the end of the feeding trial, which presumes possibility of high protein sparing beyond 8 weeks. The glucose gave the best protein sparing at 20% inclusion level in view of the bundle effects of the growth response (Figure 2) which was an expression of protein sparing in view of the fact that, inclusion of glucose at highest level gave equal performance as other levels without negative impact on the growth.

The utilization of glucose by Clarias batrachus in this study was contraty to the report of Machiels and VanDam (1987) who reported that Clarias batrachus has low glucose utilization. The observed protein sparing effects of carbohydrate of less complex nature by Clarias batrachus is in agreement with the report of Degani and Revach (1991).

CONCLUSION

The results obtained indicated protein sparing by moderately complex carbohydrate and simple sugar. This has further established the ability of Clarias batrachus to utilize carbohydrate in its diets sparing expensive protein for growth.

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Table 1: Formulation and composition of the experimental diets and proximate analysis

Feedstuffs	Corn fibre (5:30)	Corn starch (5:30)	Glucose (5:30)	Corn fibre (10:25)	Corn starch (10:25)	Glucose (10:25)	Corn fibre (20:20)	Corn starch (20:20)	Glucose (20:20)	CRD
Fishmeal	27.92	33.31	36.39	20.97	26.93	30.33	14.03	20.70	24.26	
Corn fibre	67.09	0.00	0.00	74.03	0.00	0.00	80.97	0.00	0.00	
Corn Starch	0.00	61.69	0.00	0.00	68.08	0.00	0.00	74.46	0.00	
Glucose	0.00	0.00	58.61	0.00	0.00	64.67	0.00	0.00	70.74	
V/M premix	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	
Total	**100.01**	**100.00**	**100.00**	**100.00**	**100.01**	**100.00**	**100.00**	**100.16**	**100.00**	
Proximate values	Diet1	Diet2	Diet3	Diet4	Diet5	Diet6	Diet7	Diet8	Diet9	Diet10
Crude protein	29.61	29.86	29.96	24.75	24.69	24.98	19.98	20.69	19.45	44.65
Crude fibre	4.00	7.00	7.00	3.92	7.00	3.00	3.00	5.88	6.93	15.84
C.Fat	10.94	8.78	4.38	5.94	5.88	5.41	5.41	5.97	5.00	12.92
Ash	40.20	41.10	44.00	40.78	40.35	42.87	41.87	32.46	35.95	5.34
NFE	5.45	3.16	5.77	14.83	12.10	13.98	20.98	25.50	24.00	11.15
Moisture	9.80	10.10	8.89	9.78	9.98	9.76	8.76	9.50	8.67	10.10
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100.04**	**100**

Table 2: Mean growth parameters of *Clarias gariepinus* fed various Carbohydrates: Protein ratios for 8 weeks

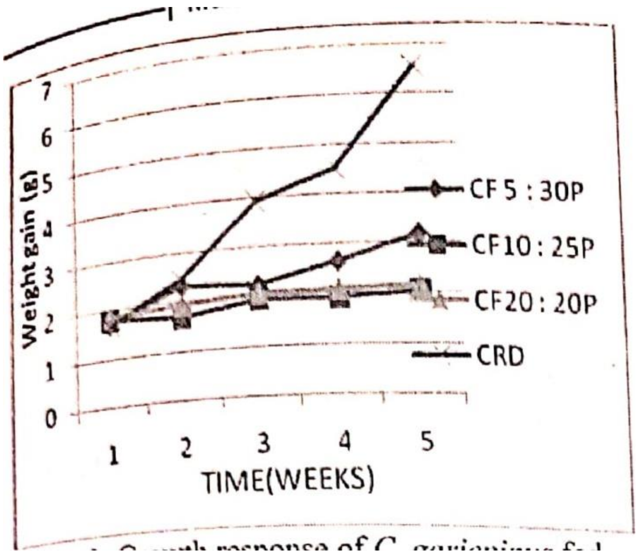
Parameters	5CF:30 P	10CF: 25P	20CF: 20P	5CS: 30P	10CS: 25P	20CS: 20P	5GL: 30P	10GL: 25P	20GL: 20P	
Initial Body Wt (g)	1.72^{a}	1.80^{a}	1.87^{a}	1.72^{a}	1.72^{a}	1.72^{a}	1.68^{a}	1.83^{a}	1.53^{a}	
Final Body Wt. (g)	3.17^{b} ±1.75	2.02^{c} ±0.11	2.14^{c} ±0.37	2.25^{c} ±0.52	2.61^{b} ±0.56	2.04^{c} ±0.16	1.89^{c} ±0.29	2.00^{c} ±0.09	1.83^{c} ±0.35	
Weight gain (g)	1.46^{b} ±1.74	0.37^{bc} ±0.31	0.27^{bc} ±0.10	0.54^{c} ±0.51	0.90^{f} ±0.58	0.32^{bc} ±0.31	0.21^{bc} ±0.31	0.18^{bc} ±0.05	0.30^{bc} ±0.39	2.42^{a} ±0.21
SGR(%)	1.09^{b} ±0.90	0.21^{cd} ±0.48	0.24^{cd} ±0.08	0.48^{d} ±0.40	0.75^{c} ±0.40	0.31^{cd} ±0.33	0.21^{cd} ±0.14	0.16^{cd} ±0.04	0.32^{cd} ±0.38	0.41^{d} ±0.09
FCR	3.06^{c} ±2.32	3.29^{c} ±1.89	3.24^{c} ±2.55	4.02^{b} ±3.22	2.67^{c} ±1.26	4.45^{a} ±1.70	4.32^{b} ±0.00	4.95^{a} ±0.00	2.59^{c} ±0.00	5.19^{a} ±1.25
PER	2.86^{b} ±3.40	0.91^{d} ±0.76	0.73^{d} ±0.28	0.92^{d} ±0.88	1.87^{c} ±1.21	2.94^{b} ±2.74	0.36^{c} ±0.39	0.38^{c} ±0.10	0.81^{d} ±1.04	30.88^{fg} ±0.01
ANPU(%)	43.43^{f} ±0.01	75.91^{c} ±0.01	91.49^{b} ±0.01	1.60^{i} ±0.01	66.26^{d} ±0.01	59.19^{c} ±0.01	13.03^{i} ±0.01	38.51^{g} ±0.01	95.53^{a} ±0.01	
Survival (%)	53.34^{d} ±23.09	60.00^{c} ±6.67	62.22^{c} ±7.70	68.89^{b} ±36.71	46.67^{bc} ±24.04	71.11^{b} ±10.18	40.00^{e} ±0.00	44.44^{bc} ±15.39	40.00^{e} ±24.04	

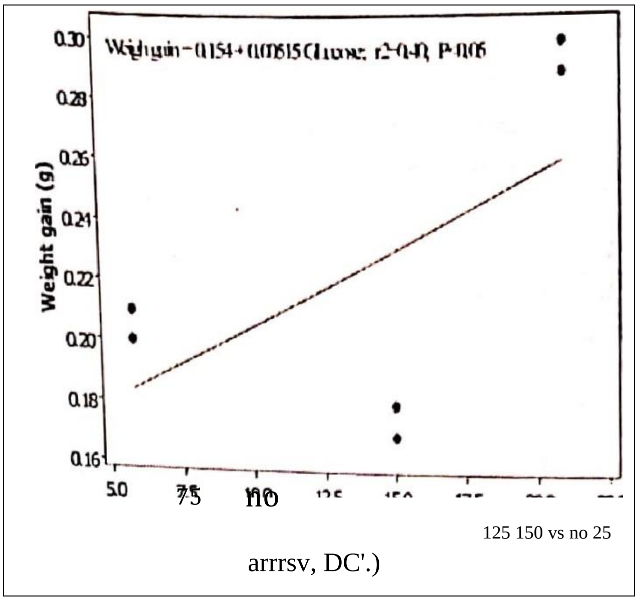
Mean data on the same row carrying letters with different superscripts are significantly different ($p<0.05$) from each other

Table 3: Body composition of *Clarias gariepinus* fed different carbohydrate sources to different Protein ratio.

Proximate analysis	Initial	CORNFIBRE			CORNSTARCH			GLUCOSE-D			CRD	SD ±
		C5:P30	C10:P25	C20:P20	C5:P30	C10:P25	C20:P20	C5:P30	C10:P25	C20:P20		
Crude protein	52.95^{d} c ±0.01	63.55^{c} ±0.00	66.78^{b} ±0.01	66.33^{b} ±0.01	53.37^{lc} ±0.01	67.15^{b} ±0.01	63.47^{c} ±0.01	55.34^{e} ±1.72	61.04^{d} ±0.01	68.99^{a} ±0.01	66.06^{b} ±0.01	0.52
Crude fat	5.39^{bc} ±0.01	9.52^{a} ±0.01	3.78^{c} ±0.02	4.45^{cd} ±0.01	5.72^{d} ±0.01	5.26^{cd} ±0.01	2.98^{b} ±0.01	2.70^{b} ±0.01	7.04^{ac} ±0.01	5.44^{cd} ±0.01	6.17^{d} ±0.01	0.01
Crude fibre	1.23^{e} ±0.01	6.20^{b} ±0.01	7.17^{a} ±0.04	6.12^{b} ±0.01	5.71^{b} ±0.01	7.02^{a} ±0.01	5.97^{b} ±0.02	3.71^{d} ±0.01	3.99^{d} ±0.01	4.65^{c} ±0.01	3.56^{d} ±0.01	0.02
Ash	5.60^{de} ±0.06	10.13^{c} ±0.01	5.31^{f} ±0.01	3.91^{ef} ±0.01	6.63^{c} ±0.06	4.88^{f} ±0.01	15.95^{b} ±0.01	18.20^{a} ±0.01	7.65^{d} ±0.01	10.93^{c} ±0.06	5.31^{f} ±0.01	0.02
NFE	8.66^{a} ±0.01	0.36^{e} ±0.01	2.01^{c} ±0.01	3.11^{b} ±0.01	1.10^{d} ±0.01	1.99^{c} ±0.01	0.99^{d} ±0.01	0.49^{d} ±0.01	1.00^{d} ±0.01	0.17^{e} ±0.01	1.90^{c} ±0.01	0.01
Moisture	26.15^{b} ±0.01	$10.25d^{f}$ ±0.01	14.91^{e} ±0.01	16.08^{d} ±0.01	27.47^{a} ±0.01	13.68^{e} ±0.01	10.57^{f} ±0.01	18.55^{c} ±0.01	19.25^{c} ±0.01	9.87^{f} ±0.01	16.99^{d} ±0.01	0.01

Mean data on the same row carrying letter(s) with different superscripts are significantly different ($p<0.05$)





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Figutcl: Growth response of C. Batrachus fed different Cornfibre/Protein ratios

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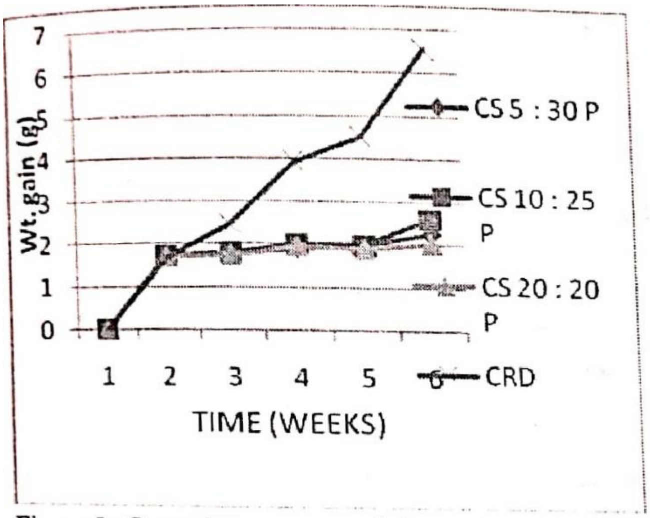

Figure 2: Growth response of *C. gariepinus* fed different Cornstarch/Protein ratios

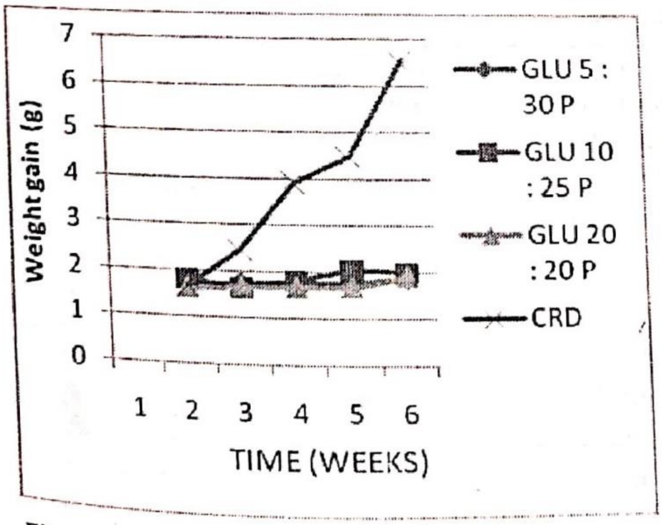

Figure 3: Growth response of *C.gariepinus* fed different Glucose/Protein ratios

Protein based diets

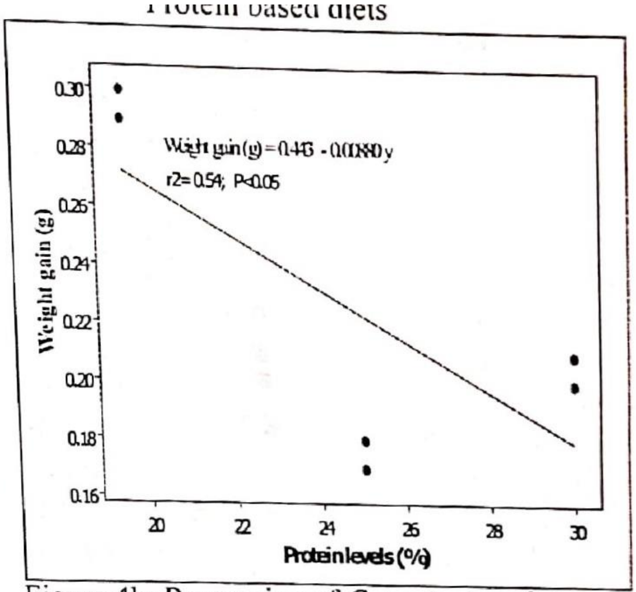

Figure 4b: Regression of *C. gariepinus* fed with different levels of Glucose/ Protein based diets

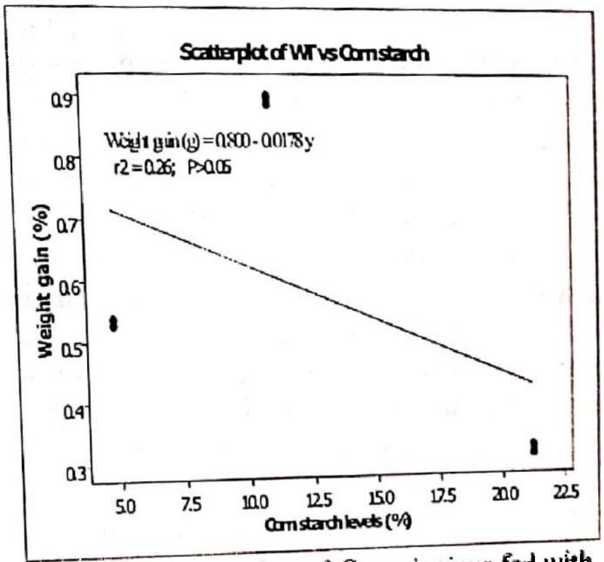

Figure 5a: Regression of *C. gariepinus* fed with different levels of Corn starch/

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Figure 4a: Re o ression of C batrachus fed witn different levels of Glucose/ Protein based diets
Protein based diets

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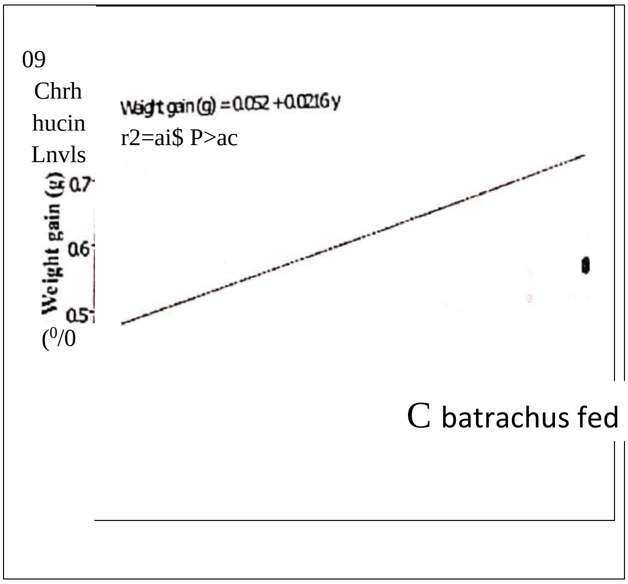

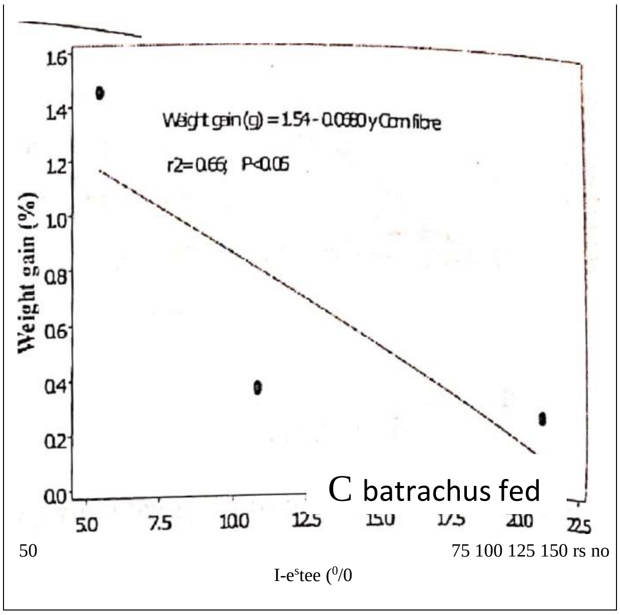

Figure 5b: Regression of C. batrachus fed with levels of Corn starch/ Protein based diets

Figure 6a: Regression of C. batrachus fed with different levels of cornfibre/Protein based diets

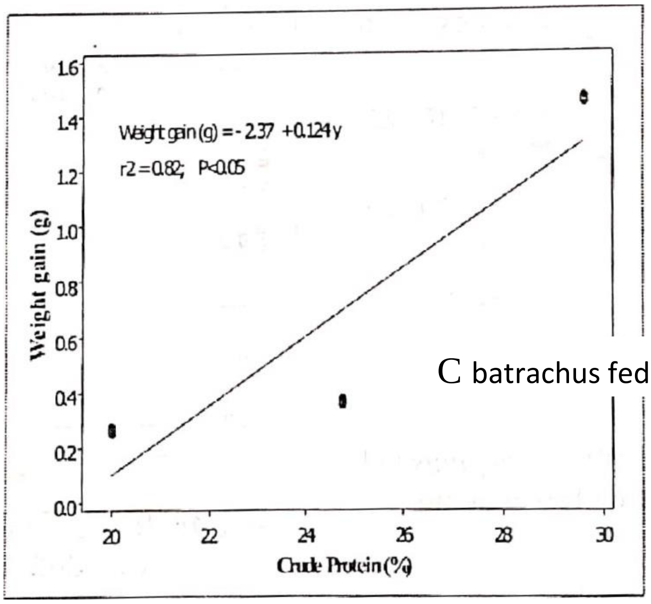

Figure 6 b: Regression of C batrachus fed with different levels of Corn fibre/
Protein based diets