Scientia Africana, Vol. 11 (No.2), December 2012. Pp 65-73
 ISSN 1118 - 1931

THE EFFECT OF FEED TYPE ON THE GROWTH OF CATFISH (CLARIA-GARIEPINUS) USING A 2^K FACTORIAL DESIGN

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Received: 01-06-12
Accepted: 07-11-12

ABSTRACT

The effect of feed type on the growth of pond raised catfish (Clarias- garienpinus) is examined using a 2^k factorial design. A period of four weeks was used in experimentation. The four factors represent four feed types namely Sharp, Coppens, Euro, Dizeng-golf. Analysis of the experiment reveal a great variation in the growth for pond raised catfish using a combination of low level of Sharp, high level of Coppens, high level of Euro, and high level of Dizeng-golf.

Key Words: feed types, 2^k factorial design.

INTRODUCTION

In Nigeria, the development of aquaculture has been identified as a national way of augmenting the dwindling fish supply from capture fisheries. The increased intensification of culture methods for warm water fish such as tilapia and cat-fish species has necessitated the provision of balance rations to satisfy their dietary requirements. Natural and artificial feeds are important in aquaculture to promote body building and high yields, particularly under intensive fish culture systems where all nutrients are supplied in complete feeds.

According to Krichgessner et al (1986), the value of supplementary feeds depends on their compositions and the digestibility of the individual feed ingredient. Hence adequate combinations of the various individual feed components would enhance the digestibility and utilization of mixed feeds. Investigations have revealed that protein is the most important component of fish feeds and should therefore be adequately provided both in quantity and quality in order to ensure protein of high biological value in the formulation of feed which will support optimum fish growth and yield (Hepher et al (1979)).

Falaye and Akinyemi (1985) highlighted that shortage of fish feed, constitutes one of the major obstacles to accelerated fish production in the country. Robison and Rushing (1994) compared different feeding strategies for the pond raised channel cat fish (once daily, every other day (EOD), and once daily to half satiation ETD). They reported that maximum production was achieved by feeding to apparent satiation on a daily basis. Further, they observed a 50% and 65% increase in feed consumption (on days feed) of fish fed EOD or ETD, respectively, compared with those fed daily. These data are partly supported by those of Li *et al* (2004, 2006) in that production tends to be highest when channel catfish are fed daily to apparent satiation, and feed conversion ratio (FRC) is improved when fish are fed less than daily. The primary difference in the three studies was the size of fish used. Robinson and Rushing (1994) used larger fish (270-320 grams) whereas Li, *et al* (2004) used fish of about 93-grams, and Li *et al* (2006) used 64-grams fish.

An increase in fish harvest per unit area of production can only be achieved by intensification of the culture methods, which is accompanied by increased addition of balanced supplementary diets to the system. Under certain economic circumstances catfish, producers (farmers) may feed with low quality feed to reduce cost and minimize economic losses. It is on this basis we consider to conduct a 2^4 factorial experiment to know the feed combination best suited to produce good results within the shortest possible time.

MATERIALS AND METHODS

The data for this research work were obtained from a simple designed 2^4 factorial experiment. The 2^4 factorial experiment was conducted to evaluate the effect of treatment combination on the growth of catfish. Three sizes of catfish – averaging 800, 600 and 500 grams per fish – were stocked into 16 ponds with each pond measuring 2x1.5 meter square. The duration for the experiment was one month. Each fish was fed to apparent satiation with a commercial – 42% protein feeds.

The four randomly selected feed types namely Sharp, Coppens, Euro and Dizen-golf were each at two – levels, namely low and high levels. The low level of the factor is signified by the use of 5 grams of the feed while the high level of the factor is signified by the use of 10 grams of the feed. Feeds were distributed into each pond manually and the fishes were allowed to eat as much as they would consume in 20 minutes to achieve apparent satiation. The fishes were fed twice daily 8.00am and 6.00pm and the amounts of feed consumed by the fishes in each pond were recorded daily. Observation on the body weight and the length of individual fish was taken weekly for the period of one month using two standard scales and a measuring tape. Data on body weight were analyzed using analysis of variance and graphical techniques.

Data Presentation

The data collected on the weight of pond-raised fish are summarized in table 1 below. The treatment combinations are written in standard order. The interpretation of the standard notation is written alongside. The letter S represents Sharp feed, C represents Coppens feed, E represents Euro feed, D represents Dizeng-Golf feed, H represents High level (10grams) and L represents Low level (5grams).

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Table 1: Weight of Pond-Raised Fish over the Period of the Experiment

Treatment	Treatment Combination	Treatment Combination Interpretation	Fish1	Fish2	Fish3
1	(1)	$S_LC_LE_LD_L$	50	125	100
2	a	$S_HC_LE_LD_L$	100	100	125
3	b	$S_LC_HE_LD_L$	200	125	125
4	ab	$S_HC_HE_LD_L$	125	100	150
5	c	$S_LC_LE_HD_L$	75	100	100
6	ac	$S_HC_LE_HD_L$	100	125	150
7	bc	$S_LC_HE_HD_L$	200	175	125
8	abc	$S_HC_HE_HD_L$	150	100	100
9	d	$S_LC_LE_LD_H$	50	100	75
10	ad	$S_HC_LE_LD_H$	100	75	125
11	bd	$S_LC_HELD_H$	200	150	150
12	abd	$S_HC_HE_LD_H$	100	150	125
13	cd	$S_LC_LE_HD_H$	75	125	75
14	acd	$S_HC_LE_HD_H$	100	100	125
15	bcd	$S_LC_HE_HD_H$	300	150	200
16	abcd	$S_HC_HE_HD_H$	200	125	175

Data Analysis

We employ the Yates' algorithm for the analysis of variance we also present some graphical analysis. Considering the data in Table 1, columns designated fish 1, fish 2 and fish 3 are redesignated, Replicate I, Replicate II and Replicate III, respectively, in table 2. The column labeled "Response" contains the total of all observations under the respective treatment combinations. Since there are four factors in the experiments, we shall create four columns labeled Column1, Column2, Column3, and Column4. The first half of column1 is obtained by adding the responses in adjacent pairs. The second half of column1 is obtained by changing the sign of the first entry in each pairs in the response column and adding the adjacent pairs. Column2 is obtained from column1 in the same way as column (1) is obtained from the response column. Column (3) is obtained from column (2) and column (4) is obtained from column (3) similarly.

Table 2 below is obtained using n = 3, k = 4 and N = 48.

Hence,

$n2^{k-1} = 24$

$n2^{k} = 48$

$SS\mu = \sum y^2_{ijk} / N = \frac{6075^2}{48} = \frac{36905625}{48} = 768867.19$

$SST = 50^2 + 125^2 + \ldots 175^2 - SS\mu$

$= 869375 - 768867.19 = 100507.81$

$SSE = SST - SS_{ABCD} - SS_{ABC} - SS_{ABD} - SS_{ACD} - SS_{BCD} - SS_{AB} - SS_{AC} - SS_{AD} - SS_{BC} - SS_{CD} - SS_A - SS_B - SS_C - SS_D$

$= 100507.81 - 325.52 - 325.52 - 13.02 - 13.02 - 1054.69 - 12513.02 - 117.19 - 117.19 - 638.02 - 4700.52 - 1575.52 - 1054.69 - 36575.52 - 3763.02 - 1054.69$

$= 3666.6$

Table 2: Estimates of Effects and Sum of Squares Using Yates' Algorithm

Treatment Combination	Response	Column 1	Column 2	Column 3	Column 4	Effects	Estimate of effects col(k)÷ $n2^{k-1}$	Estimate of sum of square $col(k)^2 \div n2^k$
(1)	275	600	1425	2925	6075	1	-	-
a	325	825	1500	3150	-225	A	-9.38	1054.69
b	450	650	1400	-75	1325	B	55.21	36575.52
ab	375	850	1750	-150	-775	AB	-32.29	12513.02
c	275	525	-25	425	425	C	17.71	3763.02
ac	375	875	-50	900	-75	AC	-3.13	117.19
bc	500	600	-50	-375	175	BC	7.29	638.02
abc	350	1150	-100	-400	-125	ABC	-5.21	325.52
d	225	50	225	75	225	D	9.38	1054.69
ad	300	-75	200	350	-75	AD	-3.13	117.19
bd	500	100	350	-25	475	BD	19.79	4700.52
abd	375	-150	550	-50	-25	ABD	-1.04	13.02
cd	275	75	-125	-25	275	CD	11.46	1575.52
acd	325	-125	-250	200	-25	ACD	-1.04	13.02
bcd	650	50	-200	-125	225	BCD	9.38	1054.69
abcd	500	-150	-200	0	125	ABCD	5.21	325.52

The analysis of variance is summarized in table 3 below. The normal probability plot of effects is presented in Figure 1.

Scientia Africana, Vol. 11 (No.2), December 2012. Pp 65-73
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Table 3: Anova Table for the 2^4 Factorial Experiment

SV	df	SS	MS	F-ratio
Trt A	1	1054.69	1054.69	0.92
Trt B	1	36575.52	36575.52	31.92 *
Trt C	1	3763.02	3763.02	3.28 **
Trt D	1	1054.69	1054.69	0.92
Inter AB	1	12513.02	12513.02	10.92 *
Inter AC	1	117.19	117.19	0.10
Inter AD	1	117.19	117.19	0.10
Inter BC	1	638.02	638.02	0.56
Inter BD	1	4700.52	4700.52	4.10 **
Inter CD	1	1575.52	1575.52	1.38
Inter ABC	1	325.52	325.52	0.28
Inter ABD	1	13.02	13.02	0.01
Inter ACD	1	13.02	13.02	0.01
Inter BCD	1	1054.68	1054.68	0.92
Inter ABCD	1	325.52	325.52	0.28
Error	32	36666.67	1145	-
Total	47	100507.81	-	-

$f_{1,32}$ (0.05) = 4.17 ; $f_{1,32}$ (0.10) = 2.88
* Significant at 5% Level ; ** Significant at 10% Level

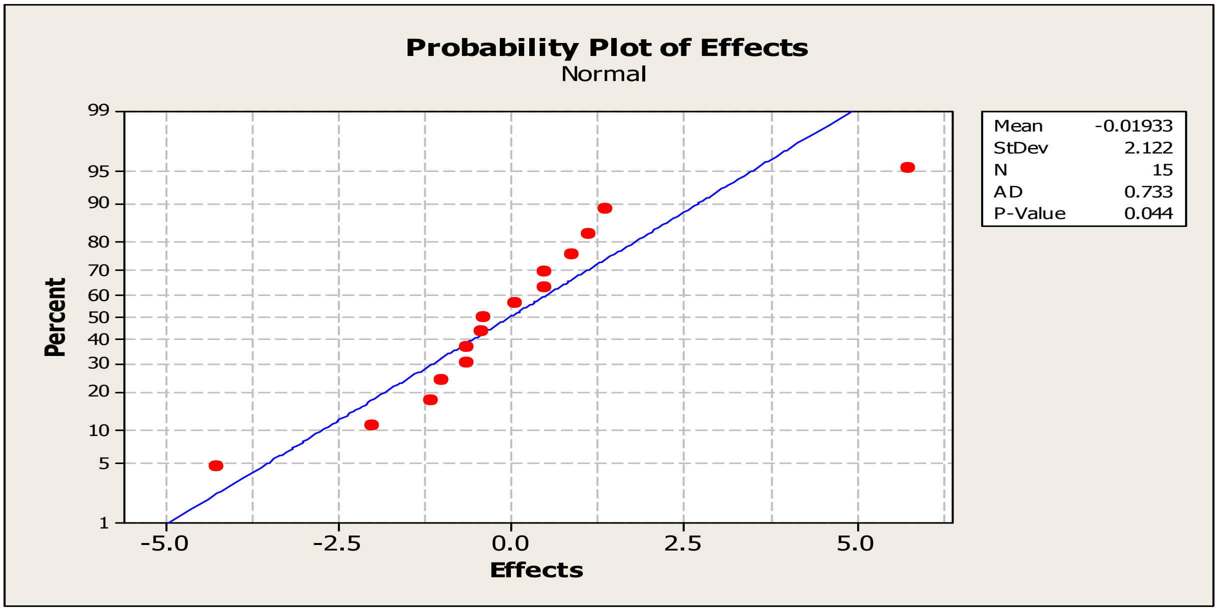

Fig1: Normal Probability Plot of Effects

The p-value 0.044 indicates that the effects are statistically significant. From the normal probability plot of effects, we see that the effects that seem to be statistically significant are the main effects B and C and the interaction effects AB and BD. These effects lie far away from the line.

We shall examine the graphs of main effects and interaction effects presented in Figure 2 below.

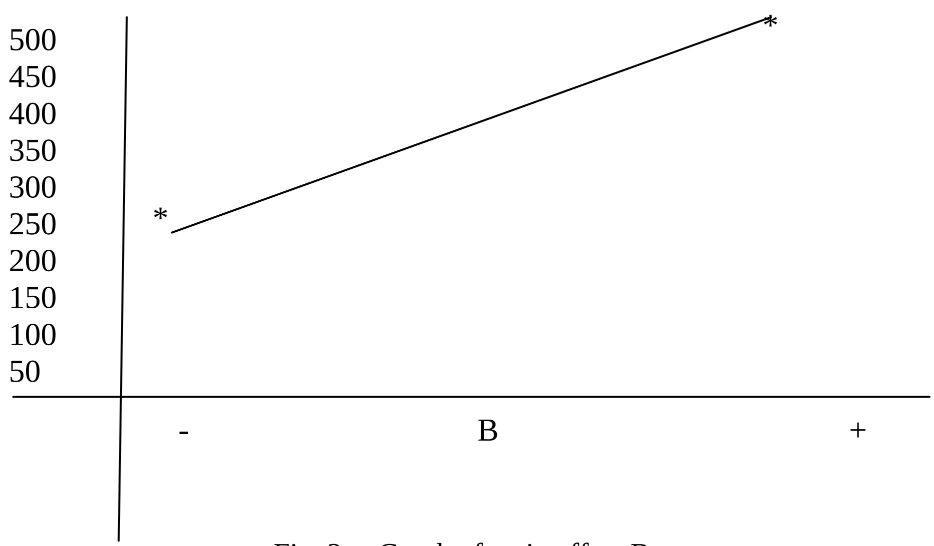

Fig. 2a: Graph of main effect B

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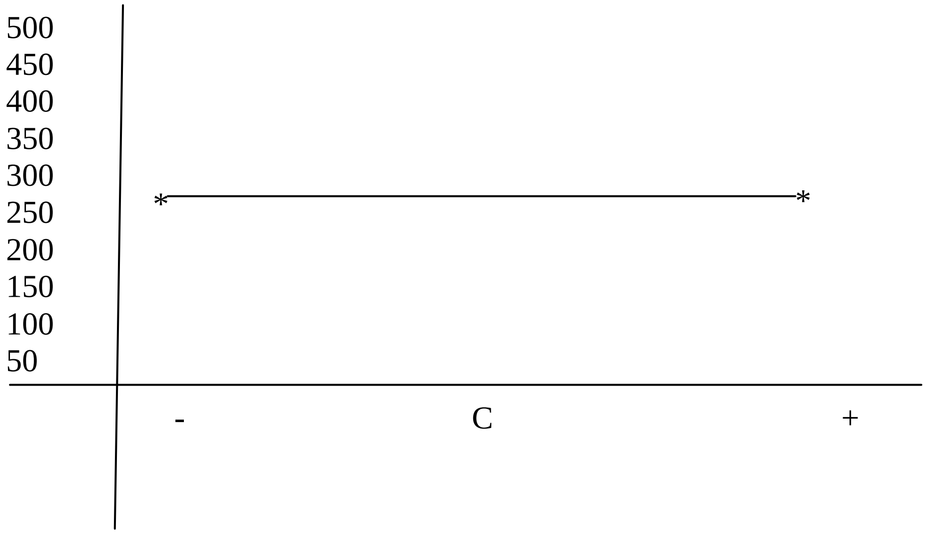

Fig. 2b: Graph of main effect C

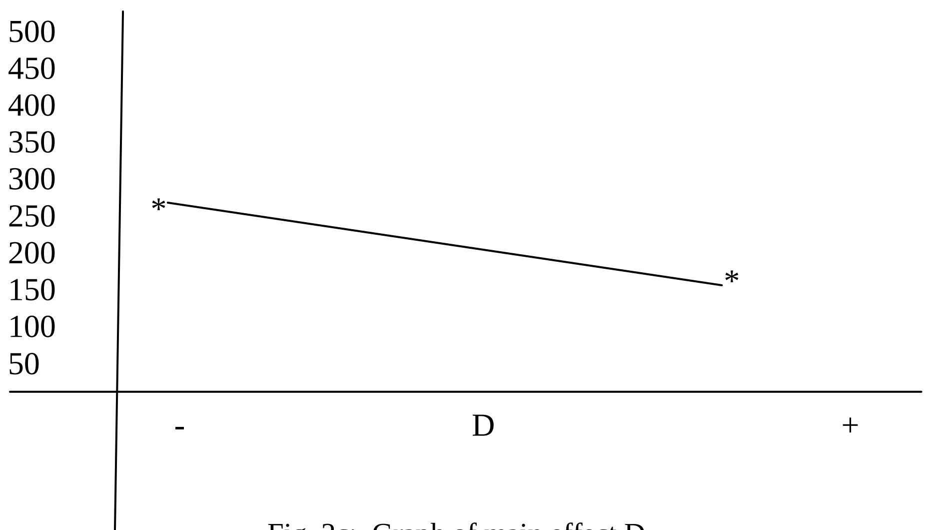

Fig. 2c: Graph of main effect D

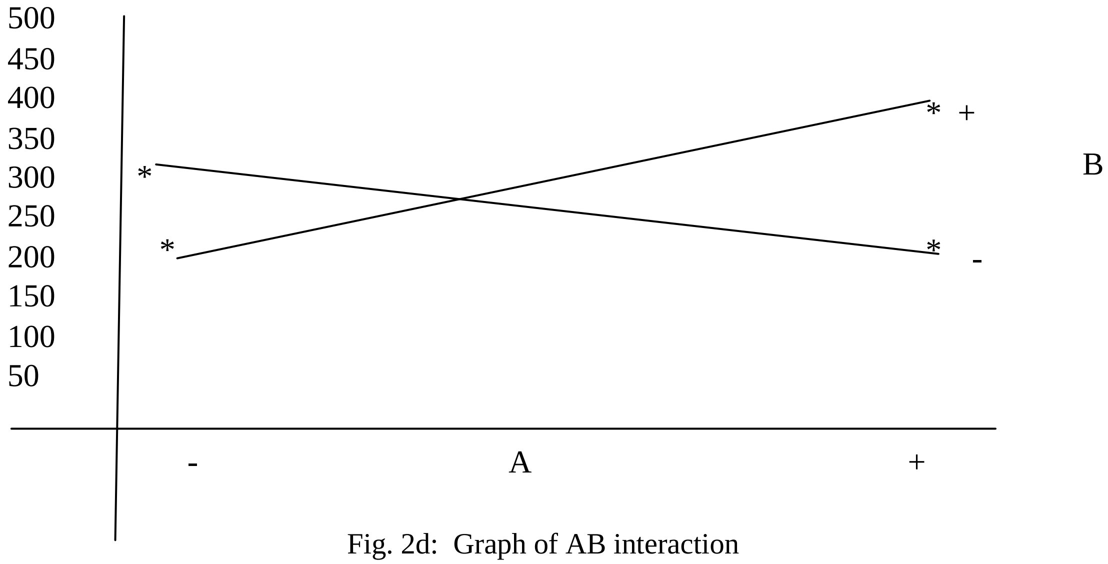

Fig. 2d: Graph of AB interaction

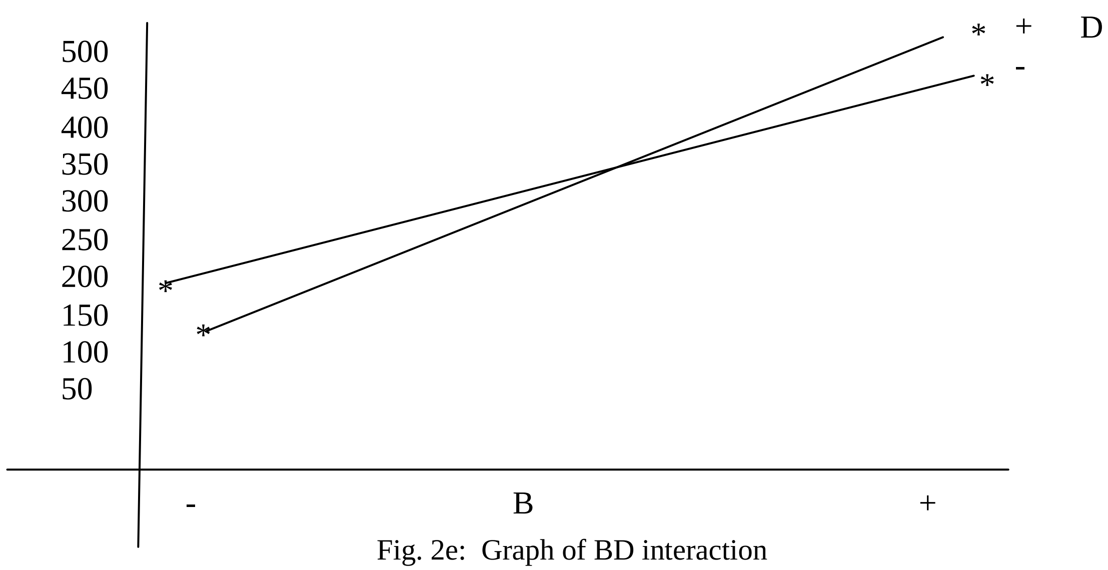

Fig. 2e: Graph of BD interaction

The two effects B and C are positive, and if we considered only these main effects, we would run the two factors at the high level to maximize the growth rate. However, it is always necessary to examine any interactions that are significant since the main effects do not have much meaning when they are involved in significant interactions. The AB and BD interactions have been plotted in Figures 2d and 2e, respectively. These interactions are the key to solving the problem of interest. We note from the graph of AB interaction that the growth rate is very small when sharp feed is at high level and very large when sharp feed is at low level with the best result obtained with low sharp feed and high coppens feed. The BD interaction indicates that Dizeng-Golf feed has little effect at low coppens feed but a large positive effect at high coppens feed. The best growth rates would appear to be obtained when B and D are at the high level and A at the low level.

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 ISSN 1118 - 1931

RESULTS

1. The average growth of fish as measured by its weight is highest using low level of sharp, high level of Coppens, high level of Euro, and high level of Dizeng-golf.
2. The normal plot of effects and the analysis of variance reveal that the effects are not identical. In fact, the effects A, C, AB and BD are significant.
3. Plots of AB and BD interaction effects reveal that the best result is obtained with low level of sharp feed and high levels of Coppens and Dizeng-golf.
4. Overall performance shows that to maximize the growth of pond-raised catfish, feeds constituting of low level of sharp, high level of Coppens, high level of Euro and high level of Dizeng-golf should be used.

CONCLUSION

A feed combination that is best suited for catfish production has been examined. The combination allows the fish to be fed from a variety of feeds. Analysis of the experimental data reveal a great variation in growth of pond raised catfish using a combination of low level of sharp, high level of Coppens, high level of Euro and high level of Dizeng-golf.

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