

MODEL FOR CALCULATING FEED INTAKE OF FISH IN AQUACULTURE NUTRITION EXPERIMENTS

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ABSTRACT

In aquaculture nutrition experiments, mortality is inevitable as the experiment progresses. Thus feed consumed by live and dead fish may erroneously be assumed as feed consumed by live fish. This error manifests when measuring feed intake as a component of nutrient utilization parameters. In order to accurately evaluate feed intake with due consideration of mortality encountered during aquaculture nutrition experiment, a model was developed which is :

Total feed consumed by number of survived fish = $DL \sum_{i=1}^n \left(\frac{F_i}{N_i} \right)$. Where D = Number of

Days fish were fed within each period before it is adjusted (e.g fortnight), it is constant throughout period of experiment. F = Quantity of feed fed per day for a fortnight before the quantity is adjusted, it changes every fortnight. L = Number of Live fish at the end of experimental period. N = Number of fish at each weighing period, it may change every fortnight or may be constant if no mortality occurred. While n = Number of times fish were weighed and quantity of feed was adjusted but this does not include the final weighing at the termination of experiment. However, if the fish were weighed weekly, then D = 6.

Keywords: Feed Intake, Mortality, Model, error, dead fish.

INTRODUCTION

In aquaculture nutrition experiments, parameters measured for growth and nutrient utilization include: weight gain, survival percentage, Specific Growth Rate (SGR), Protein Efficiency Ratio (PER), Feed Conversion Ratio (FCR), Gross Feed Conversion Efficiency (GFCE), Apparent Net Protein Utilization (ANPU) and Protein Productive Value (PPV). Weight gain, weight gain percentage, SGR, FCR, GFCE and ANPU are based on standard formulae as described by De Silva and Anderson (1995) while PPV can be according to Moore *et al.* (1988). From the aforementioned formulae, determination of FCR, PER, GFCE, ANPU and PPV require the calculation of feed intake (FI). Several models have been designed by previous researchers on various organisms (Osho, 2012) and different aspects of fishes (Shearer, 1995). Feed intake of the fish may be expressed as food eaten per unit time over a short interval, or as

total feed intake per day (Joblin *et al.*, 2001). However, it was observed during an aquaculture nutrition experiment that these standard formulae do not take into consideration mortality encountered during the aquaculture nutrition experiment. This erroneously estimated feed consumed by all experimental fish (both dead and living) as feed consumed by living fish. Apparently, this is an over estimation of the actual quantity consumed and according to Joblin (2001), the importance of having accurate information about feed consumption cannot be stated too strongly because errors in measurements of feed consumption may have serious consequences for estimates of feed efficiency. Thus this study has thus come up with a mathematical model to address this challenge.

MATERIALS AND METHODS

An aquaculture nutrition experiment was conducted on utilization of solid state fermented

palm kernel sludge in *Clarias gariepinus* diets at University of Ibadan, Nigeria following standard methods. There were 11 treatments with three replicates each. But data presented here were raw data from replicates of two different treatments. These two sets of data presented as Tables 1 and 2 were then used to represent four different scenarios after which a mathematical model was developed. This study examined four scenarios: A situation where all the fish survived till the end of the experiment and FI was estimated using conventional method (Table 1).

A situation where all the fish survived till the end of the experiment and FI was estimated using new model (Table 1).

A situation where some of the experimental fish died during the course of the experiment and FI was estimated using conventional method (Table 2).

A situation where some of the experimental fish died during the course of the experiment and FI was estimated using new model (Table 2).

RESULTS AND DISCUSSION ON MODEL DEVELOPMENT

From the data presented in Table 1, all the fish survived till the end of the experiment. The fish were weighed every fortnight and 5% body weight of feed was fed. The 5% body weight fed is equivalent to actual feed consumed by number of survived fish. With conventional method, summation of feed fed at 5% body weight was used to estimate FI. On the other hand, summing values of the actual feed consumed by number of survived fish was used in the new method. Since the values are the same, there was not any difference. In other words, scenario 1 was equivalent to scenario 2. Table 2 (when some experimental fish died) shows FI with conventional method (scenario 3) using the values of feed fed at 5% body weight.

The cumulative of such was: $5.2 + 6.9 + 7.3 + 10.0 + 11.4 + 15.0 + 14.5 + 19.4 = 89.7g$. This was multiplied by number of days each quantity was fed i.e 13 days so $128.35g \times 13 \text{ days} = 1166.1g$. Whereas in the actual sense, estimated actual FI should be: $2.3 + 3.2 + 3.4 + 4.7 + 5.7 + 7.5 + 8.2 + 11.6 = 46.6g$ so $46.6g \times 13 \text{ days} = 605.8g$ (scenario 4). The implication of this is that 1166.1g would have been erroneously used as FI instead of 605.8g. This value of 605.8g will be confirmed using the model developed in this study.

The model is:

$$\text{Total feed consumed by number of survived fish} = DL \sum_{i=1}^n \left(\frac{F_i}{N_i} \right) \dots \dots \text{equation 1}$$

Where D = Number of Days fish were fed within each period before it is adjusted (e.g fortnight), it is constant throughout period of experiment. F = Quantity of feed fed per day for a fortnight before the quantity is adjusted, it changes every fortnight. L = Number of Live fish at the end of experimental period. N = Number of fish at each weighing period, it may change every fortnight or may be constant if no mortality occurred. While n = Number of times fish were weighed and quantity of feed was adjusted but this does not include the final weighing at the termination of experiment.

Expansion of equation 1 gives

Total feed consumed by number of survived fish

$$= DL \sum_{i=1}^n \left(\frac{F_1}{N_1} + \frac{F_2}{N_2} + \frac{F_3}{N_3} + \frac{F_4}{N_4} + \frac{F_5}{N_5} + \frac{F_6}{N_6} + \frac{F_7}{N_7} + \frac{F_8}{N_8} \right) \dots \dots \text{equation 2}$$

Where D = Number of days fish were fed within a fortnight = 13,

L = Number of live fish at the end of the experiment = 9,

F and N varies as shown in Table 2.

n = Number of times fish were weighed and quantity of feed was adjusted = 8. (This does not include the final weighing at the termination of experiment).

Actual feed consumed by number of survived fish shown in Table 2

$$= (13)(9) \left(\frac{5.2}{20} + \frac{6.9}{20} + \frac{7.3}{19} + \frac{10.0}{19} + \frac{11.4}{18} + \frac{15.0}{18} + \frac{14.5}{16} + \frac{19.4}{15} \right)$$

Actual feed consumed by number of survived fish shown in Table 2

$$= (13)(11)(0.26 + 0.35 + 0.38 + 0.53 + 0.63 + 0.83 + 0.91 + 1.29)$$

Actual feed consumed by number of survived fish shown in Table 2 = (13)(9)(5.18)

Actual feed consumed by number of survived fish = 606.06g

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Table 1. Data on fortnight fish growth and feed adjustment of replicate where there was no mortality

Week	0	2	4	6	8	10	12	14	16
Number of fish	20	20	20	20	20	20	20	20	20
Average weight (g)	6.8	7.6	8.0	8.9	9.3	10.6	10.7	12.6	13.0
Total weight (g)	137	151	159	178	187	211	213	251	278
Feed fed at 5% body weight (Scenario 1)	6.8	7.6	7.8	9.0	9.4	10.6	10.6	12.6	
Actual feed consumed by number of survived fish (Scenario 2)	6.8	7.6	7.8	9.0	9.4	10.6	10.6	12.6	

NB: The fish were weighed every fortnight and feed was adjusted until the 14th week but the experiment lasted for 16 weeks.

Table 2. Data on fortnight fish growth and feed adjustment of replicate where there was mortality

Week	0	2	4	6	8	10	12	14	16
Number of fish	20	20	19	19	18	18	16	15	9
Average weight	5.2	6.9	7.6	10.5	12.6	16.7	18.1	25.9	31.6
Total weight	105.2	138	145	200	227	300	290	388	284.6
Feed fed at 5% body weight (Scenario 3)	5.2	6.9	7.3	10.0	11.4	15.0	14.5	19.4	
Actual feed consumed by number of survived fish i.e 9 (Scenario 4)	2.3	3.2	3.4	4.7	5.7	7.5	8.2	11.6	

NB: The fish were weighed every fortnight and feed was adjusted until the 14th week but the experiment lasted for 16 weeks