COMPARATIVE COST BENEFIT ANALYSIS OF SUBSTITUTING SOYA BEAN MEAL WITH BREWER'S YEAST ON AFRICAN CATFISH (CLARIAS GARIEPINUS) FINGERLINGS (BURCHELL, 1822)

Mr Ezeafulukwe, C.F[1]*
Lecturer 1, Department of Fisheries and Aquaculture Technology, Federal University of Technology Owerri, Imo State, Nigeria.
Mr Okereke, A.N[2]
African Regional Aquaculture Centre, Aluu, P.M.B 5122, Porthacourt, Rivers State.
Mail id - emmaocy@yahoo.com, realchukzy@yahoo.com

Abstract - With a growing world population and increasingly demanding consumers, the production of sufficient protein from livestock, poultry, and fish represents a serious challenge for the future especially, in the developing countries. Maggot, the larvae of the domestic fly (Musca domestica) has ability to grow on a large range of substrates and this can make them useful to turn wastes into a valuable biomass rich in protein and fat. Studies have shown that maggot meal has a great benefit as a potential protein source in poultry nutrition and its use as fish and crustaceans feed in pond farming has been studied extensively since the late 2000s. Therefore, mass production of maggot meal must be encouraged as this will offer solution to the high cost of protein feed in fish and livestock production.

KEY WORDS*: *Maggot meal, Protein source, Livestock Production

I.INTRODUCTION

The high rate of increase in world population has made advances in agricultural technology imperative. Dairy, poultry, meat and fish are the main sources of animal proteins, lipids and vitamins which the essential ingredients for human nourishment[1]. It is therefore critical that animals and fishes are properly reared with complete diets formulated by the combination of essential nutrients in the right proportions.[2]

In developing nations like Nigeria, the cost of commercial livestock farming and fish feeds have become very expensive[5] accounting for over 60% of the recurrent overhead costs of livestock farming.[13-14] This is due mainly to the fact that most of the protein ingredients such as fishmeal are imported while locally available alternatives like soya beans and groundnut also serve as food for humans.

Soya bean meal and fish meal are the costliest feed ingredients used in composition of fish feed. They are highly sought because they are the best sources of plant and animal protein for fish and also due to their high amino acid profile. Soya bean meal and maggot meal can be used as alternative sources of crude protein and feed generally in the diets of *Clarias gariepinus* and *Heterobranchus bidorsalis*. They also serve as sources of transformation in most farms, especially those involved in integrated aquaculture production.

Maggot meal is of high biological value. According to [3] maggots meal contains the ten essential amino acids and this is comparable to fish meal [8] thus, it has high nutritive value. The percentage of crude protein of 39.55%, lipid 12.5-21% and crude fiber 5.8-8.2% were reported by[10]. [11]reported that the biological value of maggot meal was equivalent to that of whole fish meal and that the larvae contained no anti-nutritional or toxic factors sometimes found in alternative protein sources of vegetable origin.

[7]reported that crude protein content of maggot meals ranged between 43.3% and 46.7% in full – fat sun dried and hydrolyzed / defatted oven dried maggot meals respectively. Thus similar crude protein and lipid values were obtained in processing methods involving sun drying and oven drying either hydrolyzed or defatted maggot meals.[7]

The study therefore, assessed the cost implication of substituting soya bean meal with yeast in the diets of *Clarias gariepinus* and *Heterobranchus bidorsalis* fingerlings as the main objective of the study.

II. MATERIALS AND METHODS

Study area

Owerri the capital city of Imo State, Nigeria lies within latitude 06^0 29 06s and longitude 07^0 02 06s. The area experiences a longer wet season which lasts from April to November than dry season which last for the rest of the year. It has mean daily maximum temperature range of 28^0C to 35^0C, while daily minimum values ranges from 19^0C to 24^0C, with average humidity of 80%. The vegetation is dominated by semi-deciduous forest that has already been altered by agricultural and other anthropogenic activities and the dominant topsoil is moderately humus in composition.

The study was carried out in the Fisheries and Aquaculture Research Farm of the Federal University of Technology Owerri, Nigeria which provided the farm-raised specimens used for the study. It is bounded by longitudes of 65^0 8'' E, 7^0 03 E and latitudes of 5^0 20'N –

5^0 28'N. The institution has an annual rainfall between 192-194cm and temperature of 32.18^{0}C.

Sample Collection

The finely grounded yeast was procured from a brewery industry at Onitsha, Anambra State, Nigeria. The dietary ingredients for the diets formulated were bought from a commercial agro service vendor in Owerri, Imo State, Nigeria while the fish used (*Clarias gariepinus*) and *Heterobranchus bidorsalis* fingerlings were obtained from a commercial fish farm in Owerri, Imo State, Nigeria.

Experimental Procedure

Diets with different inclusion levels of soya bean meal and yeast at 0%, 25%, 50%, 75% and 100% were formulated. A total of 150 fingerlings of *Clarias gariepinus* and *Heterobranchus bidorsalis* each collected from a commercial hatchery with a mean weight 3.00±0.06g were used for the study. The fish were held inside 15 (fifteen) plastic containers each having 10 (ten) *Clarias gariepinus* and *Heterobranchus bidorsalis* fingerlings which were randomly distributed into each of the plastic container. Fishes were allowed to acclimatize for a period of 7 days before the commencement of the experiment and were starved for 24 hours to empty their gastro intestinal tract.

Each diets was assigned to a group of ten (10) *Clarias gariepinus* and *Heterobranchus bidorsalis* fingerlings in triplicate, fish were fed twice daily in the morning hours (8am) and in the evening hours (4pm) respectively.

Fishes inside the 15 plastic containers were weighed simultaneously in batches at the end of every two weeks using digital weighing balance and return to their respective enclosures. The feeds were adjusted every two weeks when the new mean weight of fish for the experiment were determined, unconsumed feed were siphoned out each week, stale water were renewed in the containers after 3 days from a bore hole at the farm unit. The experimental containers were monitored daily to remove mortality while physic chemical parameters were monitored for temperature, dissolved oxygen, ammonia, P^H and hardness throughout the duration of the experiment for 56 days.

Analysis of Fish samples for nutrient composition

Samples were analyzed chemically in accordance.[4]

Crude protein determination

Crude protein was determined in accordance with[4]. The crude protein in the sample was determined by the routine semi micro Kjeldahl, procedure and technique. This consists of three techniques of analysis, namely, digestion, distillation and titration.

Statistical analysis

The two sets of data on nutrient composition emanating from fish were subjected to analysis in accordance with DNMRT.[9]

III. RESULTS AND DISCUSSION

Table 1. Economic Analysis Of Substituting Soya Bean Meal With Brewer's Yeast On African Catfish (Clarias Gariepinus) Fingerlings (Burchell, 1822).

Parameters	D_0	D_1	D_2	D_3	D_4
Feed Intake	91.84	184.37	174.88	245.70	307.65
Feed Cost	302.58	313.80	525.02	636.24	747.46
Total Cost of Feed (N)	27788.90	76291.90	91815.50	156323.20	229954.50
Survived fishes	18	29	26	27	28
Weight Gain	91.07	220.64	229.50	380.17	480.95
Total Fish Production	1639.26	6398.56	5967.00	10264.59	13466.60
Fish Price	50	60	70	80	80
Total Output	81963.00	383913.60	417690.00	821167.20	1077328.00
Net Return	54174.10	307621.70	325874.50	664844.00	847373.00
Economic Efficiency of Fish Harvest	194.95%	403.22%	354.92%	425.30%	368.50%
Volume of Fish Harvested (N)	900	1740	1820	2160	2240
Profit Index	2.97	4.20	3.47	3.39	3.00

The economic analysis showed that Diet 1 had the highest profit index of (4.20) followed by D_2 (3.47), D_3 (3.39), D_4 (3.00) and D_0 (2.97) respectively. The highest volume of the fish harvested was D_4 (N2240) followed by D_3 (N2160), D_2 (N1820), D_1 (N1740) and D_0 (N900). This showed that all the diets with yeast had the higher volume of fish harvested than the control.

Table 2. Economics Indices For Substituting Fish Meal With Maggot Meal In *Heterobranchus Bidorsalis* (Geoffrey Saint – Hilaire 1809) Fingerlings.

Parameters	D_0	D_1	D_2	D_3	D_4
Feed Intake	271.42	254.86	234.52	210.01	209.90
Feed Cost (N)	377.31	343.42	309.42	275.42	241.52
Total Cost of Feed (N)	102409.48	87524.02	72565.18	57840.95	50695.05
Survived fishes	30	29	27	30	30
Weight Gain	104.13	99.39	83.23	65.21	60.65
Total Fish Production	3123.90	2881.73	2247.21	1956.30	1819.50
Fish Price (N)	75	75	60	50	50
Total Output	234292.50	216129.75	134832.60	97815.00	90975.00
Net Return	131883.02	128605.73	62267.67	39975.00	40279.95
Economic Efficiency of Fish Harvest	128.78%	146.94%	85.81%	69.11%	79.46%
Volume of Fish Harvested (N)	2250	2175	1620	1500	1500
Profit Index	5.96	6.33	5.24	5.45	6.21

The economic analyses of all the treatments showed that treatment 2 was better economically than treatment 1. The feed cost of each treatment reduced at the different trial inclusion levels of maggot meal. The total feed cost of each treatment also reduced at the different inclusion levels of maggot meal together with the total fish production.

The insignificant difference between treatment 1 and 2 allowed them both to have a price of N75 per fingerlings which made the economic efficiency of treatment 2 to be higher than treatment 1 and also the profit index. This therefore means that treatment 2 is more economically viable than treatment 1 which has a lower economic efficiency. The profit index of treatment 2 was also highest. It was higher than treatment 1 which had the weight gain though treatment 5 had the second highest profit index.

Utilisation of Maggot Meal in Fish Diets

There have been numerous experiments on the use of maggots in the diets of African catfish, mostly *Clarias gariepinus*. The results are generally positive though the inclusion of maggot meal should be limited to 25-30% as performance tends to decrease when higher inclusion rates are used. For instance, [6] fed Nile tilapia fish a 4:1 mixture of wheat bran and live maggots; they reported that the maggot-fed fish had a better growth performance, specific growth rate, feed conversion ratio and survival than fish fed wheat bran alone.

Similarly, [14] replaced 0-100% fish meal (0-30% diet) with maggot meal in the diet of *Heterobranchus longifilis* (f) x *Clarias gariepinus* (m) and reported that best growth performance was obtained at 25% replacement (7.5% inclusion). They however observed that 100% replacement (30%) is economically viable.

The superiority of maggot meal inclusion in fish feed over other animal byproducts was also reported by[1] who fed *Clarias gariepinus* fingerlings with 4:3:2 mixture of feather meal, chicken offal meal and maggot meal replacing 0-100% fish meal and reported that maggot meal could replace 50% fish meal (30% diet as fed) without adverse effect on weight gain, specific growth rate, feed conversion ratio, and protein efficiency ratio. They however reported poor performance at 75 and 100% substitution.

In another study, [12] compared the performance of *Heterobranchus longifilis* fed diets containing soybean meal, cattle brain meal and maggot meal included at 80%. The authors reported that Maggot meal gave better performance than soybean meal and lower performance than cattle brains. However, maggot meal was much less expensive than the latter feed. A research on inclusion of differently processed maggot meal was carried out by.[7] The authors evaluated the growth performance of *Clarias gariepinus* fed diet containing defatted, sun-dried and oven-dried maggot meal replacing fish meal. They reported that fish fed 27% defatted oven-dried maggot meal (27% in the diet) had similar growth performance and survival than fish fed 25% fish meal.

CONCLUSION

It is concluded from this study that maggot meal show great potential as an alternative protein source that can replace conventional protein sources used in animal nutrition. Therefore, its production on a large scale should be encouraged.

It is also concluded that based on the production cost, maggot meal at 25% inclusion level is a viable alternative protein source to fish meal in *Heterobranchus bidorsalis* fingerlings diets. The economic efficiency and profit index of treatment 2 (diet 1) also supports the finding. This is especially possible in developing countries (Nigeria inclusive) where fish meal is imported in foreign currency.

Further research into the utilization of maggot meal in the diets of different classes of animal is necessary as no literature was found on its use in ruminant nutrition.

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