Methodology In Production Of Local Integrated Fish Meal: Our Affordability In Abraka, Delta State, Nigeria

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Abstract: Fish for food is a vital resource for indigenous people in Nigeria, known for their hyper-prolific proteins and immerse contribution in rich dietary symbolism for daily nutritional healthiness. Due to high cost and shortage in commercialized fish meal, it was deemed to design a formulated preparation and processing techniques for local integrated fish meal which would provide a guide to unmarketable production and the catalyst for commercialization of integrated fish feed production process to lessen financial stress on fish farming. Macronutrients including carbohydrates, protein and fat feedstuffs were partitioned in category B, A and C respectively while category D indicated micronutrient feedstuffs. Preparation techniques and formulations for selected feedstuffs stacked in categories involve proper milling, thorough mixing, packing in cellophane at considerable quantity, steaming for recommended hours, sun drying to cake, cutting into pellets or desired sizes and storing in dry cool non-freezing sections of the refrigerator for storage longevity before use. Calculations to justify that integrated feed product meets standard requirement adopted the Pearson square method. Fresh cow blood is the familiar waste vital product known as the principal feed-meal ingredient for the feedstuff integration in this study. Therefore, it is recommended that the incorporation of local integrated fish meal to supplement for high-cost of feed meal and fish nutritionist in mass production of the local integrated at affordable cost be encouraged, that more supplementary feed production techniques be sorted and reported by local fish farmers to allow for continuity in fish farming. Finally, more research to explore the susceptibility and impact of integrated fish meals on increasing length-weight gain of fish species for successes in fish mass production and fish sustainability for high quality protein requisite of indigenes is required.

Keywords: Methodology, local integrated fish meal, affordability and Delta State

1. Introduction

Fish is a vital resource with hyper-prolific protein. Fish, when cultured in controlled conditions like other animals require high-quality protein, good source of vitamins and minerals, mono- and poly-saturated fatty acids, and calories for optimum growth, survival and many other biological functions. The varied nutritional aspects of fish has implicated its increased demand throughout the world and culture in various media to increase employment for many farmers bridging the gap between demand and supply of fish from capture fisheries (Tingman *et al.*, 2010; FAO, 2010; 2012; Gabriel *et al.*, 2007). The cost of purchasing compound feed or production including purchase of raw feedstuffs, milling, and transportation drive the need to preserve foreign exchange in most developing countries through the use of locally available ingredients as fish feed (Chow, 1980). Due to this high cost and scarcity in fish meal, many scholars have identified the use of animal protein feedstuffs including earthworm, insects, snails, maggots, and frogs as potential possible alternative (Tacon et al., 1983; Lim and Dommy, 1989; Fagbenro, 1993). These identified raw feedstuffs are often mixed and milled into powder and made into pellets to be fed to fish. The primary aim of milling feed raw materials into processed form is to maximize the nutritional value of various feed components to meet nutrient requirements (Robinson. *et al.*, 2001). Although when compound feed are administered following recommended concentration as presented in front-of-pack labels by the manufacturer, it is reported to meet the nutrient requirements of physiologically defined farm animals for a sustainable level of production (Balogun, 1992, Falayi, 2003). The success of fish farming consistently depends on providing suitable and economical fish feed (Delgedo and Minot, 2003). The sustainable use of high-cost, imported fish meal-based diet in capture fisheries can result in financial failure to underprivileged fish farmers rearing in small scale and little or no profit for large scale farmers. Thus, the need to identify raw materials and integrating them in processed form for use as cheaper non-conventional method that attracts less costs and opposition. In considering animal nutrition, blood meal from abattoirs is one major sustainable sources of protein because large quantities are still being thrown out as wastes since man cannot purchase, cook and eat blood (Otubusin *et al.*, 2009). Unlike other raw feedstuffs, blood meal has a poor essential amino acid balance with lysine being relatively high and isoleucine being very low (Sauvant, 2004). Thus, integrating blood meal with other feedstuffs to attain a balanced fish feed compositions will complement for the observed deficiency that prevents their use as wholesome substitute for fish feeds. The combination of plant-based food ingredients low in lysine with a relatively high level (7-8%) of lysine in blood meal makes it an excellent supplemental protein source to feed fish (Sauvant, 2004). Apart from the use of blood meal, cattle rumen digesta alone used as abattoir waste, and a combination of blend of bovine blood meal and rumen digesta (BBRDM) has been reported in various animal feed formulation and to supplement the amino acid deficiency as fishmeal replacements for some fishes (Agbabiaka *et al.*, 2012; Odunsi, 2003, Dairo *et al.*, 2005; Adewumi, 2012). Soltan et al. (2008) reiterated that majority of alternative protein feedstuffs are deficient in one or more essential amino acids and/or contained various quantities of anti-nutritional factors. This reported deficiency has been the basis to which blends of animal by-product meals have been mixed with other feed elements with complementary amino acid profiles to satisfy the nutritional prerequisite of various farmed fish species (Laporte *et al.*, 2009). For example, nutritional evaluations of blended animal by-product mixed in aqua-feed indicated promises of sustainable, ecological and ethical bio- industry in the aquaculture industry (Glencross *et al.*, 2007). The integration of raw feedstuffs into mass production system as defined local fish feed is yet to be commercialized probably because its utility and value have not been elucidated. The few studies on its utilization in replacing fish meal in fish diets are inconclusive, especially with particular reference to catfishes. This present study was designed to formulate the preparation and processing strategies for local integrated fish meal. It is deemed that this study would provide the catalyst for commercialization of integrated fish feed production process and thus provide an inexpensive animal protein source.

2. Materials and Methodology

This study was conducted at the back of the pond of the Department of Zoology, Delta State University, Abraka, Delta State. The materials needed for integration and preparation include the local feedstuffs available for use, weigh balances for measurement, gas burner for steaming of combinations, a miller, kitchen blender, cellophane to tie up mixtures in measures, big spoon, large cooking vessels and water. All raw feedstuff to be preparation were procured from the local big market at Abraka Delta State, Nigeria and sundried to reduce the moisture of the raw feedstuff.

2.1. Biochemical analysis of feedstuffs

It has been identified in studies that cultured fishes either in intensive or semi-intensive systems require recurrent introduction of additional feed other than the recommended, which justifies for equal to 40 % and 60 % of production costs respectively and reported to sometimes regress the economic feasibility when the unsuitable feed are used (NRC 1993; Fagbenro et al., 2003). Fish feed purchased from the commercial manufacturer is however recommended but sustaining this method could be a serious hurdle. Thus, diverting to the locally available as supplementary feed is called for. When the available local feedstuff are properly integrated into feed formulations and sold at affordable rates in the local markets, the financial pressure posed by high cost of the recommended would be at barest minimal. Although at early reference of fry emergence from egg, commercially manufactured feed could be introduced but as fry attains reach a desirable finger length, the available can be initiated. The need to carry out a proximate analysis before considering an integrated approach was impeded on alighting a comprehensive documentation of the locally available feedstuff for use in Nigeria by Udo and Umoren (2011); Eyo et al (2004); Okanlawon and Oladipupo (2010); Gabriel et al (2007); Sikiru et al (2009); Agbebi et al (2009); Otubusin et al (2009) and Nwokocha and Nwokocha. (2013).

2.2. Categories and selection of local feedstuffs

Fishes like other animals, require balanced nutrients containing macronutrients (high-quality proteins for tissue building, carbohydrate for energy acquisition, and fat content for heat build-up) and various micronutrients (minerals, vitamin and even water) to maintain quality performance in culture media. Biochemical analysis of local available feedstuffs were sectioned into categories with respect to perceived nutrient classifications (Table 2.1).

2.2.1. Category A and B

Category A consist of cow blood the major ingredient that struck this study as local production techniques. Amongst this category are other feedstuffs including Tilapia fish meal or fragments of fish in form of fish debris, soy beans either as raw or processed and shrimp fragments or debris. This category was sectioned as protein class of feedstuff. In considering of feedstuff to be integrated, fresh cow blood, tilapia fish debris, slightly processed soy beans, and shrimp waste fragments are selected. Category B consist of carbohydrate-based feedstuff such as maize of yellow or white pigmentation, freshly harvested cassava peeled or unpeeled, cassava peels alone, processed cassava flakes or flour, white grain and guinea corn. Cassava flake or flour, cassava peel alone, wheat grain or yellow maize are selected in this category.

2.2.2. Category C and D

Category C consist of fat-based foods due to the prerequisite for mono- and poly saturated fatty acids. Whole groundnut or fragments, groundnut shelling and processed groundnut cakes either locally or industrial made selected examples. Whole groundnut or locally made groundnut cake is selected in this category. Category D comprises of trace element-based feedstuffs. Leafy vegetable such as the water leaf and other viable leaves including cassava, pawpaw and sweet potato leaves. Cassava leaf or the water leaf is majorly selected in this category. All of these feedstuffs were sectioned to aid informed selection for proper integration where necessary before the preparation into desired formulation.

Table 2.1. Biochemical nutrient content of some selected local feedstuffs obtainable in Nigeria

S/n	Raw Feedstuff	Crude protein (%)	Fat content (%)	Fibre (%)	CHO (%)	Dry matter (%)	Mineral (%)
	Category A						
1.	Cow blood meal	86.0	0.7	2.1	6.5	92	5.0
2.	Tilapia fish meal	57.7	1.8	5.2	92	N.D	33.6
3.	Soy beans (raw)	40.7	22.0	6.3	16.6	90	6.4
4.	Soybean meal (slightly toasted)	46.2	24.8	4.7	17.2	90	7.9
5.	Soybean meal (really toasted)	48.1	23.9	4.1	20.7	90	7.9
6.	Shrimp waste meal	58.9	N.D	33.5	N.D	79.5	N.D
	Category B						
1.	Millet	9.0	5.0	0.7	83.2	90	2.3
2.	Cassava (flour)	1.6	0.5	1.7	83.3	N.D	N.D
3.	White maize	9.3	5.0	2.4	70.9	88.0	1.8
4.	Yellow maize	10.8	3.6	3.5	71.2	88	1.9
5.	Wheat grain	13.5	1.9	3	N.D	88	N.D
6.	Guinea corn	11.2	2.5	2.3	74.1	88	1.8
7.	Peeled cassava	2.6	0.5	0.4	94.1	88	2.4
8.	Cassava (Peels alone)	5.3	1.2	21.0	66.6	88	6.0
9.	Unpeeled Cassava	2.7	0.5	3.1	91.0	88	16.1
	Category C						
1.	Groundnut shells	4.0	1.0	46.7	46.3	N.D	N.D
2.	Groundnut Cake (Kuli-kuli)	40.6	23.4	6.0	19.0	93	6.2
3.	Industrial ground nut cake	48.0	13.2	8.1	18.9	93	6.3
	Category D						
1.	Water Leaf	21.1	1.5	10.3	87.4	N.D	4.6
2.	Cassava leaf	14.7	8.4	15.6	45.2	88	16.1
3.	Pawpaw leaf	32.6	0.8	17.2	18.38	N.D	N.D
4.	Sweet potato leaf	24.7	3.6	11.5	12.5	N.D	N.D

Source: *Udo and Umoren (2011); Eyo et al (2004); Okanlawon and Oladipupo (2010); Gabriel et al (2007); Sikiru et al (2009); Agbebi et al (2009); Otubusin et al (2009) and Nwokocha and Nwokocha. (2013).*
N.D= no data

2.3. Preparation Techniques and formulation

Haven made an informed selection from the table 2.1 which are stacked in categories, the foremost processing procedure is milling the selected into a gritty powder. All selected except fresh cow blood in category A, cassava flakes, cassava peels alone and wheat grains or yellow maize grain in category B, locally made ground nut cake are milled while leafy vegetables are left till the end of preparation process. Prior to milling, adequate measurement is required. Small scale integration for a 2 to 3 days feed trial will comprise of a 20 litres fresh cow blood, Soy beans grain of 3-4kg, Tilapia fish or any other fish fragment of at least 2 kg, Shrimp debris is optional where fish fragment exist but adding 0.5kg is allowed in category A. In category B, 0.5-1kg of cassava flake is mixed with 0.3-0.5kg of cassava peel alone and 2kg of wheat grains. Wheat grain is selected to supplement for protein instead of yellow maize. And a 3kg of locally made groundnut cake measured up. After feedstuffs are milled into powder they are sun dried and properly mixed either with the bare hands, using a turner or electrified methods. Thereafter, cow blood is emptied gradually into the mixture and stirred continuously until a reddish semi-solid paste is formed. The paste is then measured up into a small cellophane with a big spoon and tied up. Each of the mixtures tied are placed in a large cooking vessel where they are steamed for 1-2 hours depending on heat intensity. After steaming, it is allowed to cool and then untied. At this point, a dark brownish mould of cooked feed is formed. The untied cooked mould is then placed on a tray and sundried again for at least 2-3 hours so as to properly cake. The final step is the slicing of mould into bit of sizes or pellets for fish and packing. While cassava or water leaf are blended and added as source of minerals. This technique is step-wise as though a farmer was preparing a meal for the family's consumption. Processed feed are fed to fish depending feeding requirements as pellets can be made to sink or float (Alegbeleye and Oresegun, 2009). Where a large quantity is integrated, it can be packed in a sealable sack and stored up in dry cool place preferably a non-freezing section of the refrigerator for durations not more than 3 months (Adikwu, 2003). Calculations to justify that feed integrated meets standard requirement is made by the use of the popular "Pearson square method". This method involves;

i. The ingredients is placed on the left side.
ii. The required protein level is placed at the centre.
iii. Each derived quantity is subtracted from the required feed weight that would give protein level.
iv. Substitution to get the result.

It is reported in studies that the African catfish, *Clarias gariepinus*, requires about 40% crude protein in their diet and all African catfish species also requires 35-50% crude protein for high performance (Wilson and Moreau 1996; Adebayo and Quadri, 2005). For instance, let assume the required protein is 40%, and taking cow blood meal 86% and cassava peel 5.3% (Table 2.1)

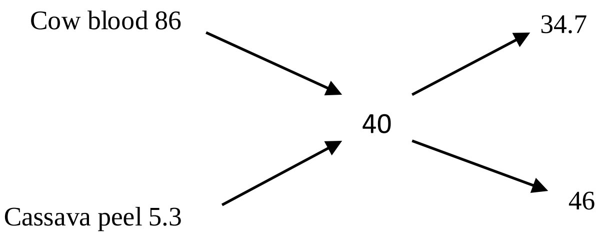
2.3.1. Calculations involved:

Cow blood = 86%, cassava peel = 5.3% and required level of protein= 40% as reported.

Total protein = $1st\ obtained\ \% - 2nd\ obtained\ \%$

Total protein = 86-5.3 = 80.7%

Therefore, $\frac{46}{80.7} x\ 100 = 57kg,\ \frac{34{,}7}{80.7} x\ 100 = 43kg$



2.3.2. In cross checking if calculated meets the required:

86/100 x 43= 36.98
5.3/100 x 57= 3.021
Adding both values 36.98 + 3.021= 40.001= 40%.C

3. Conclusion and recommendations

Fresh cow blood which stroke the need for this study is a familiar waste vital product known by many fish farmers as principal feed-meal ingredient to remedying high-cost in fish production. This research categorized the feedstuff raw materials in order to enable informed choice for unmarketable and commercial integration, identified the preparation techniques for successful integration of the categories into a complete local fish meal and calculations to guide in desirable selection from categories to meet the standards of the required outlined. This research therefore recommends the incorporation of local integrated fish meal to supplement for high-cost of feed meal already estimated to be more than 40 to 60% fish production cost be encouraged and fish nutritionist inspired to mass producing the local integrated at affordable cost for local fish farmers. The research also recommends that more supplementary feed production techniques be sorted by local fish farmers and reported to allow for continuity in fish farming. Finally, more research is required to explore the susceptibility and impact of integrated fish meals on increasing length-weight gain of fish species for successes in fish mass production and fish sustainability for high quality protein requisite of indigenes.

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