



ISSN: 2347-5129

(ICV-Poland) Impact Value: 5.62

(GIF) Impact Factor: 0.352

IJFAS 2016; 4(1): 276-279

© 2016 IJFAS

www.fisheriesjournal.com

Received: 18-11-2015

Accepted: 20-12-2015

**Ahmad MK**

Department of Biological Sciences, Bayero University, Kano, P.M.B. 3011 Kano, Nigeria

**Ibrahim S**

Department of Biological Sciences, Bayero University, Kano, P.M.B. 3011 Kano, Nigeria

## Local fish meal formulation: Its principles, prospects and problems in fishery industry

**Ahmad MK, Ibrahim S**

### Abstract

This review summarizes the current understanding on local fish meal formulations. The review describes the use of local ingredients in fish meal formulations, its principles, prospects and problems in Fishery Industry. The first part of the review describes the prospects of local meal formulation, the place of Nigeria in local fish meal formulation, low cost, availability of suitable site for rearing of fish, suitable climatic condition for local fish meal formulation, macroeconomic, industrial growth, export potentials and employment opportunity while the second part deals with the problems of local fish meal formulation, suitable composition to attain balance diets, stability, palatability, harmless, unconventional feedstuffs and lack of high protein. This will enhance fish farmer awareness and knowledge on the local fish feed formulation with the ultimate aim of reducing the cost of fish feed, thereby lower the cost of fish production and also provides a good template for research work on fish nutrition.

**Keywords:** Fish meal, formulation, local ingredients, economic growth, employment.

### Introduction

Nowadays there are increasing attempts to develop standard practical diets for farmed fish in Nigeria. A wide range of feed stuffs are produced as a by-products from animal processing industries. Some of these feed stuffs are currently used in rations for both terrestrial animals and fish (Udo and Umoren, 2011) <sup>[18]</sup>. Since fish feeds are generally represent the largest single cost item of most fish farm operations, it follows that the selection of meal ingredients for use within diets will play a major role in dictating its ultimate nutritional and economic success (Ovie and Eze, 2013) <sup>[15]</sup>. Two sources of fish feeds have been identified namely, farm-made and commercial feeds. There are few commercial sources of fish feeds which specialized only in animal feeds and also engage in fish feed production on demand, as such the majority of fish feeds produced (69-75%) are farm-made (Adikwu, 1992) <sup>[2]</sup>.

There are two main types of fish feeds being produced by fish feed industry namely herbivorous fish (Tilapia) feeds, which contain 30-35% crude protein and carnivorous fish (cat fish) feeds which contain 45-50% crude protein (Royes and Chapman, 2003) <sup>[16]</sup>. The primary objective of feed formulation is to provide fish species under culture with an acceptable diet that meets its nutritional requirement at different stages of life, with the aim to obtain maximum production at minimum cost (Ahmad *et al.*, 2012) <sup>[3]</sup>. The feedstuffs used in fish feeds are derived from crop residues, mill by-products, food processing wastes or agro-industrial by-products. Feedstuff resources in Nigeria are declining due to stagnant or diminishing output of certain traditional crops (Fasakin *et al.*, 2001) <sup>[8]</sup>. Hence, in recent years, Nigeria has relied heavily on imports to supplement domestic production of conventional feedstuffs in order to meet the needs of the expanding livestock, poultry and fishery industries (Gabriel *et al.*, 2007) <sup>[9]</sup>. The aim of this review is to document information on local fishmeal formulation, its problems and prospects in fishery industry with the objective of revising the past literature on local fishmeal formulation, its problems and prospects in fishery industry.

### Principles of Local Fish Meal Formulation

This is the method whereby the fish farmer combine different selected feed ingredients in varying proportions to comply with predetermined nutrient requirements of the culture fish, when feedstuffs for desired percentage (%) crude protein content have been chosen. They can be prepared or compounded through a process of milling, mixing and pelleting. Milling can be carried out with hammer milling machine (Madu and Ufodike, 2003) <sup>[13]</sup>. Mixing of

**Correspondence**

**Ahmad MK**

Department of Biological Sciences, Bayero University, Kano, P.M.B. 3011 Kano, Nigeria

ingredients including premixes, it can be performed by hand before adding warm/hot water with stirring to form dough. If cereals in the formula are not adequate to bind the particles of the feed mixture, cassava starch may be added as a binder. A mechanical mixer is used for large scale local fishmeal production (Azim *et al.*, 2012) [4]. Feeding a single type of food is neither complete nor balanced and does not supply all the nutrients fish might need in its diet (Adewumi and Olalaye, 2011) [1]. Hence, two or more ingredients are normally mixed into homemade, laboratory and commercial feed formulations. A diet may be formulated to supplement natural foods already available in the production system or as a complete formulation when no other foods are provided. A complete diet must be nutritionally balanced, palatable, water stable, and have the proper size and texture. If natural foods are not incorporated in fish diets, the feed must be supplemented with natural or synthetic pigments (Madu and Afodike, 2003) [13]. Feeds are formulated to be dry, with a final moisture content of 6-10%, semi-moist with 35-40% water or wet with 50-70% water content. Most feeds used in intensive production system or home aquaria are commercially produced as dry feeds. Dry feeds may consist of simple loose mixtures of dry ingredients, such as 'mash or meal' to more complex compressed pellets or granules (Fasakin *et al.*, 2001) [8]. Pellets are often broken into smaller sizes known as crumbles. The pellets or granules can be made by cooking with steam or by extrusion. Depending on the feeding requirements of the fish, pellets can be made to sink or float. Flakes are another form of dry food and a popular diet for aquarium fishes. Flakes consist of a complex mixture of ingredients, including pigments. These are made into a slurry, which is cooked and rolled over drums heated by steam (Royes and Chapman, 2003) [16]. Semi-moist moist and wet feeds are made from single or mixed ingredients, such as trash fish or cooked legumes, and can be shaped to cakes or balls (Ogunji and Wirth, 2001) [14]. Although the methods of feed formulation vary from one region to another, however it generally involves the combination and blending together of feed ingredients (based on a formula) into nutritionally balanced and economically sound diet that can be used in required amount to provide the level of production desired in fish cultivation (Gabriel *et al.*, 2007) [9].

The processing methods which include sourcing, mixing, pelleting, drying and storing are very crucial as they determinate bioavailability of nutrients, feed acceptability, palatability and durability which often have profound effect on performance of the fish (Adewumi and Olalaye, 2011) [1]. Therefore, there is the need to formulate a diet at the least possible cost so as to maximize profit (Madu and Ufodike, 2003) [13]. This can be done by careful selection of ingredients that are cheap but rich in nutrients for fish growth and optimum performance as protein requirement for varying species of fish differ. Thus, the protein needs of the culturable fish species must be known for effective feed formulation to be achieved (Heuze *et al.*, 2015) [10].

### Prospects of Local Fish Meal Formulation in Fishery Industry

The purpose of formulating local fish meal is to grow fish fast and economically i.e. as cheaply as possible. To achieve this, it is essential that fish is fed with compounded diets to get optimum production for the investment within a short time (Ogunji and Wirth, 2001) [14].

To achieve it, the formulated diet must provide the following:

1. **Protein:** The essence of this component in the feedstuffs is to make the fish to grow well. If the fish is injured, protein ensures repairs of wound (Adikwu, 1992) [2]. Examples of animal protein feed ingredients that provide proteins are poultry feathers, fish meal and shrimps (Eyo, 2001) [6]. Examples of plant proteins include soya beans, cotton seed, ground nut, sesame seed cake and Duck weed (Heuze *et al.*, 2015) [10].
2. **Energy:** Energy can be supplied from maize, rice meals, wheat and other sources like fats and oil. These feedstuffs provide energy for the fish to move round, i.e. swim and do other activities.
3. **Roughages:** These feedstuffs help the fish with digestion by forming bulky materials that move the waste out of the digestive system of the fish. Examples include maize (corn) and wheat bran.
4. **Vitamins:** Vitamins help the fish to remain healthy. Examples include vitamins A, B, C, D, E, and K.
5. **Minerals:** Minerals help in building up the bones, teeth and scales of the fish. Examples include bone meal, oyster, shell, calcium and phosphate (Yilmaz *et al.*, 2004) [19].

### Place of Nigeria in Local Fishmeal Formulation

The use of locally available materials is advantageous in that it reduces the cost of production of the feeds and it impacts on the economy of the country. The cost of producing five kilogram of locally formulated diet is two thousand naira only which was much lower than the imported commercial coppers fish feed costing five thousand naira per five kilogram of feed as given by Keremah and Esquire (2014) [11]. The use of local ingredients also has a possibility to impact on the innovations and growth of micro-technologies as most fish farmers are already making different trials on farms for increased output. For examples, some catfish fry producers use boiled chicken egg yolk to feed fry, the phenomenon which inspired researchers to conduct search on the same (Spinelli, 2014) [17]. Currently, there is an increasing number of catfish growers, who use by-products from poultry industry as feed with good results (Ovie and Eze, 2013) [15].

There are several reasons why Nigeria is a good place for rearing of fish to feed the nation and even for export reasons. Among these reasons are the following:

### Low Cost of Local Feed Ingredients for Fish Farming

Local fish meals are non-competitive in terms of human consumption. Their prices are relatively very low and sometimes command no cost values at all. They are usually by-products or waste products from agriculture and agro-allied industries. Their utilization as feed resources can sometimes help to reduce waste accumulation and thus enhance environmental protection, good sanitation and waste management (Fasakin *et al.*, 2001) [8]. With the increasing gap between demand and supply of the fish in Nigeria, the Nigerian Government embarked on fish feed importation in order to meet up for deficit in supply. But, with the current economic situation in the country, there is need to conserve the foreign exchange used in importation by increasing the domestic fish meals production (Keremah and Esquire, 2014) [11]. Formulation of fish meals from local ingredients offers greatest opportunity for the mass production of fish in Nigeria. The fish farmers cultivated just 25% out of 1.8 million hectares of land suitable for fish farming in Nigeria and at production rate of 5 tonnes per hectare per year, it was

estimated that local fish meal has a potential production of 2,303,600 tonnes annually (Egware and Orewa, 2014) <sup>[5]</sup>. However, the present local diet production is still very short of the estimated potential production which stands at 10,502,000 tonnes annually (Gabriel *et al.*, 2007) <sup>[9]</sup>. Therefore, there is need for the intensification of the local fish diet formulation in order to boost the current production level of the fish meal.

#### Availability of Suitable Sites for Rearing of Fish

Nigeria is often called the land of aquatic splendor. It has networks of abundant natural water resources *vis-à-vis*, rivers, lagoons, creeks, streams, flood plains and coastal waters constituting approximately 25 percent of the total landmass of the country. These resources, in addition to 47, 877 hectares of swamps are potential biomes for fish farming (Ovie and Eze, 2013) <sup>[15]</sup>.

Moreover, indigenous fish species that easily accept the locally formulated diet like Cat fishes (*Clarias gariepinus*, *Heterobranchus* hybrids) and Nile Tilapia (*Oreochromis niloticus* and *Tilapia zilli*) are locally available as the most important indigenous culturable species in Nigeria (Eyo, 2001) <sup>[6]</sup>. The above fishes grow fast, they are highly demanded by consumers, accept wide variety of local meals and they are also practically cultivated in all systems possible like earthen, concrete, plastic tanks, flow through and recycling. In the last decade, Nigeria has been the main catfish producing country in sub-Saharan Africa (Eyo, 2001) <sup>[6]</sup>.

#### Suitable Climatic Condition for Localfish Meal Formulation

Nigeria experiences maximum temperature ranges between 26°C - 43°C, which persists throughout the year and permits all year round local fish feed production and aquaculture, in order to boost the fishery industries (Fagbenro *et al.*, 2000) <sup>[7]</sup>.

#### Macroeconomic, Industrial Growth and Export Potentials

Nigeria has high level of commercial and industrial activities, the seaport, international airport, road networks and telecommunication. Other infrastructure and support services are also available in the country to attract increased private investment in fish farming and local diet formulation. The facilities will increase export potentials of farmed fish to the European Union (EU) (Konyemi *et al.*, 2006) <sup>[12]</sup> among others. Nigeria currency earns appreciable exchange from exportation of catfish and tilapia to many European countries. Consumers demand for aquaculture products e.g. caterers, restaurant chefs, processing industries and middle persons. They tend to prefer aquaculture products for reasons such as availability of the fish, less fishy taste and odour, homogeneity in meal and low cost. It was believed that local feed formulation will encourage export at maximum returns to the fishery industries (Spinelli, 2014) <sup>[17]</sup>.

#### Employment Opportunity

Local fish meal formulation creates employment opportunities to communities where commercial aquaculture exists. Commercial aquaculture is gaining importance as it generates employment to many especially the unemployed youths. Both outputs of the fishing industry and local feed formulation are very important economically. The ultimate goal of development in the fishery industry is to meet the country's demand for fish, feed and fisheries product from local sources and replace imports (Egware and Orewa, 2014) <sup>[5]</sup>.

#### Problems of Local Fish Meal Formulation in Fishery Industry

The problems associated with local fishmeal formulation are many and multidimensional as exemplified below. For instance, the nutritive requirements of fish are such that they offer less flexibility in diet formulation than other land animals. Most carnivores' fish species like *Clarias gariepinus* require a diet of high protein content: these fish type have very poor utilization of carbohydrate as an energy source. The inclusion of certain types of carbohydrates in the diet of fish may be detrimental. Proteins derived from vegetable sources may be deficient in several amino acids such as lysine, methionine and tryptophan needed by the fish. This of course, is not the problem when unconventional sources of protein are used (Karemah and Esquire, 2014) <sup>[11]</sup>. Other problems associated with unconventional feedstuffs include:

##### 1. Formulating a Balanced Diet

The composition of the feed stuffs must be allowed to be compounded into a balanced diet. Physical forms of the feedstuffs must be modified for proper formulation into the diets. Several potential feedstuffs contain compounds that are offensive to the olfactory receptors of the fish.

##### 2. Stability of the Formulation

Problem of stability of the local feed occurs during storage. Proper storage facilities must therefore be provided after formulation of the diets to avoid deterioration (Eyo, 2001) <sup>[6]</sup>. There are many difficulties associated with local fishmeal utilization, hence before embarking on evaluating any fishmeal, much information can be gained on the protein, lipid, carbohydrate, mineral, vitamin content as well as antinutritional factors, variability in composition, storage characteristics, pelleting/handling characteristics, palatability to the target species, taste, cost and availability. The most characteristic of feedstuffs in terms of diets formulation is their digestibility, particularly in terms of digestible crude protein and digestible energy (Yilmaz *et al.*, 2004) <sup>[19]</sup>. A fishmeal formulated from local ingredients must provide a suitable energy source and be in proper balance. The commodity must have a composition that allows it to be compounded into a balanced diet. The physical form of many feedstuffs must be modified for proper formulation into diets.

##### 3. Palatability and Harmlessness

The locally formulated diet must be palatable to the fish so that it may not be rejected. The formulated diet must also be stable during storage and non-toxic so that the fish may not be harmed by consumption of such feed (Gabriel *et al.*, 2007) <sup>[9]</sup>.

##### 4. Lack of High Protein

Feedstuffs of vegetable origin are of low protein content when compared with those of animal origin. In addition, the presence of high amounts of carbohydrate, fibre and other organic molecules such as glucosides, phytates, and cyclopropenes in these sources present the nutritionists with problems that are generally not encountered with sources of animal origin. Despite these problems, practically all the commercialized feed stuffs are being used to some extent in commercial aquaculture as fish diets but however fish meal performed very well as an animal protein (Madu and Ufodike, 2003) <sup>[13]</sup>.

The nutritive requirement of fish are such that they probably offer less flexibility in diet formulation than do those of most

land animals, as several species of fish selected for culture are almost pure carnivores, requiring a diet of high protein content. These fish have very poor utilization of carbohydrate as an energy source and some evidence is developing that the inclusion of certain types of carbohydrate in diets is in fact detrimental. Hence, it has been recently reported that soya bean meal extracted with alcohol performed better in rations than unexpected meal. This improvement has been attributed to the removal of low molecular weight carbohydrate by the alcohols (Heuze *et al.*, 2015) <sup>[10]</sup>.

### Conclusion

Fish farmers and fish feed millers should explore and utilize the local fish feed resources maximally so as to make fish farming more economically viable, attractive and sustainable, because they are available, cheap and do not compete with human consumption. This will be a major way forward in commercial fish farming in Nigeria.

### Recommendations

1. It is recommended that further collection and collating of data on their utilization and economic performance should be carried out regularly. Nigeria has the potential for expanding its fish meal resources base, in order to meet the increasing needs for feedstuffs, and the current national production should be increased.
2. The attention of governments (national, state, local) and international donor agencies should be focused on the importance of aqua feeds to aquaculture, particularly to provide affordable cost effective, accessible, highly digestible, water stable and nutritionally complete aqua feeds.
3. As much as possible, fish feeds should be based on locally available meals, that are simple and with cheap method of increasing their nutritional value.
4. In addition, effort should be made towards the development and improvement of simple and cheap machinery for aqua feed production as well as improving the techniques for processing and storage of the local feed formulations.

### References

1. Adewumi AA, Olalaye VF. Catfish Culture in Nigeria: Progress, Prospects and Problems. *Afri. J of Agric Res S.* 2011; 6(6):1281-185.
2. Adikwu AI. Dietary carbohydrate utilization in Tilapia (*Oreochromis niloticus*) *Journal of Agric Sci Tech.* 1992; 2(1):33-37.
3. Ahmad MK, Bichi AH, Gumel MA. Growth Performance of the African Catfish (*Clarias gariepinus*) Fed Varying Inclusion Levels of Cassava Leaf. *Biol. and Environ. Sci. J.1 for the Tropics (BEST)*, 2012; 9(3):51-55.
4. Azim MA, Islam MR, Belal HB, Minar HR. Seasonal Variations in the Proximate Composition of Sillaginopsis panijus Middle East *J of Scientific Res.* 2012; 11(5):559-562.
5. Egware RA, Orewa SI. A Comparative Profit Analysis of Catfish (*Clarias gariepinus*) Production in Ughelli, Delta State, Nigeria. *Custos J of Sci and Techn.* 2014; 10(1):74-79.
6. Eyo AA. Chemical Composition and Amino Acid Content of the Commonly Available Feedstuff Used in Fish Feeds in Nigeria. *Fish Nutr. And Fish Techn. NIONIR, Lagos,* 2001; 3(9):58-71.
7. Fagbenro OA, Smith MAK, Amoo AI. Acha (Digitaria exilisstapf) Meal Compared with Maize and Sorghum Meals as Dietary Carbohydrate Source for Nile Tilapia (*O. niloticus*). *Isreal J of Aqua.* 2000; 2(52):3-10.
8. Fasakin EA, Bulogun AM, Fagbenro OA. Evaluation of Sun-Dried Water fern, Azolla Africana and Duckweed, Spirodelapolyrhiza, in Practical Diets for Nile Tilapia, *Oreochromis niloticus* (L) Fingerlings, *J of Applied Aqua.* 2001; 11(2):83-92.
9. Gabriel UU, Akinrotimi OA, Bekibele DO, Onunkwo DN, Anyanwu PE. Locally Produced Fish Feed, Potentials for Aquaculture Development in Sub-Saharan Africa. *Afri. J. of Agric. Research.* 2007; 2(7):287-295.
10. Heuze V, Tran G, Kaushik S. Fish Meal, Feedipedia. orig. A Programme by INRA, CIRAD, AFZ and FAO. <http://www.feedipedia.org/node1208>. last update February 5, 2015; (208):11-14.
11. Keremah RI, Esquire J. Compatative Assessment of Growth Performance and Economics of Production of *Clarias gariepinus* Fingerlings in Ponds and Tanks, *Greener J of Agric Sci.* 2014; 4(2):34-38.
12. Konyeme JE, Sogbesam AO, Ugwumba AAA. Nutritive Value and Utilization of Water Hyacinth (*Erichornia crassipes*), Meal as Plant Protein Supplement in the Diet of *Clarias gariepinus* (Burchell, 1822) *J Sci Research.* 2006; 4:36-41.
13. Madu CT, Ufodike EBC. Growth and Survival of Catfish (*Clarias anquilaris*) Juvenile Fed Live Tilapia and Maggot Unconventional Diets, *J of Aquatic Sci.* 2003; 4(3):808-812.
14. Ogunji JO, Wirth M. Alternative Protein Sources as Substitutes for Fish Meal in the Diet of Young Tilapia, *Oreochromis niloticus* (Linn). *Israeli J of Aqua.* 2001; 53(1):34-43.
15. Ovie SO, Eze SS. Utilization of Dry Yeast in the Replacement of Fish Meal in *Clarias gariepinus* Diet. *Biol. and Environ. Sci. J for the Tropics (BEST).* 2013; 10(2):15-20.
16. Royes JB, Chapman FA. Preparing Your Own Fish Feeds, Document Circular 97, Department of Fisheries and Aquatic Science, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, 2003; 6(2):1-9.
17. Spinelli J. Aquaculture Development and Coordination Programme, Fish Feed Technology, FAO Corporate Document Reposikory, Produced by Fisheries and Aquaculture Department. National Marine Fisheries Services Seattle, Washington, 2014; 4:541-546.
18. Udo IU, Umoren UE. Nutritional Evaluation of Some Locally Available Ingredients Use for Least-Cost Ration Formulation for African Catfish (*Clarias gariepinus*) in Nigeria, *Asian J of Agric Research.* 2011; 5:164-175.
19. Yilmaz E, Akyurt I, Gunal G. Use of Duckweed, Lemna minor, as a Protein Feedstuff in Practical Diets for Common Carp, *Cyprinus carpio*fry, Turkey *J of Fisheries and Aquatic Science.* 2004; 4:105-109.