DISCOVERY

Assessment of the nutritional compositions of selected commercial fish feeds in Nigeria

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ABSTRACT

Manufactured feeds are an important part of modern commercial fish farming which provide the balanced nutrition needed by the fish. However, this study assessed the proximate and mineral compositions of three different selected commercial fish feeds (Top, Aqua boom and Sirsigwe feeds). Proximate analysis was carried out using standard analytical procedures. The mineral compositions were determined using Atomic Absorption Spectrophotometer (AAS) and Flame Photometer. Results for the proximate analysis revealed that Aqua boom feed recorded highest percent moisture (9.52%), crude protein (23.78%) and fiber contents (1.076%) among the feed samples while Sirsigwe feed sample was found to be highest in ash (5.67%) and crude fat contents (6.35%). The results for the mineral compositions showed that Sirsigwe feed recorded the highest content of essential minerals such as K (1.62 mg/kg), Mg (1.02 mg/kg) and Ca (5.11 mg/kg) while concentration of Na (1.91 mg/kg) was highest in Aqua boom feed among the feed samples. From the results obtained, the feed samples could as serve good sources of nutrients for fishes and therefore suitable for commercial fish farming.

Keywords: Commercial, fish feeds, fish farming, minerals, proximate

1. INTRODUCTION

Globally, commercial fish farming is on the increase especially in Nigeria. Reasons include federal government policy on economic diversification, high demand for fish from the consumers worldwide, population growth, increasing average incomes and most importantly, the nutritional and health benefits of fish in human diet (Tacon and Metian, 2013). However, scientific studies revealed that fish is a rich source of animal protein, fat, vitamins (A, B and D) and some essential and non-essential minerals such as calcium, phosphorus, magnesium, potassium, iodine, iron, selenium and zinc respectively (Martınez-Valverde et al., 2000; Lu et al., 2007; Chalamaiah et al., 2012). Medically, literatures revealed that consumption of fish lowers the risk associated with fatal and total coronary heart disease (Aadland et al., 2015; Torris et al., 2016). Furthermore, the presence of omega-3 fatty acids in fish reduces inflammation, protect heart and stave off chronic disease. Other health benefits include lowering of blood pressure, reducing risk of cancer, improve vision among others (Torris et al., 2016).

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However, commercial fish feeds are manufactured feeds containing all the required nutrients that provides balanced nutrition needed by the farmed fish. The feeds are prepared in form of pellets or granules, providing the desired nutrients in a stable and concentrated form which enable the fish to feed efficiently and grow to their full potentials (Shearer, 2001). Additionally, research has shown that many of the farmed fish around the world today are carnivorous, examples include Acara, Archerfish, Oscar, Bettas, Hatchet fish among others (Sarvenaz & Sabine, 2017). Survey also revealed that in modern aquaculture, these species normally feed on feeds containing fish meal and oil meal as major ingredients (Byrd et al., 2021). In addition, other ingredients such as cereal grains, vegetable proteins, minerals and vitamins are also included into the feed pellets. For example, Wheat is used extensively in preparing the feeds as it helps in binding the ingredients in the pellets. In addition, other fish species (herbivores) such as Pleco, Cories, Sae, Mollies feed mainly on other forms of feeds made entirely from vegetable materials (Souza et al., 2007).

However, for the improvement of commercial fish farming to achieving maximum yield, it is therefore, necessary to provide artificial feeds of high standards by which fish grows rapidly and attains maximum weight within the shortest possible time. This research work therefore, aimed at assessing the proximate and mineral compositions of selected commercial fish feeds from three different producers in Nigeria.

2. MATERIALS AND METHODS

Sampling and Sample preparation

Samples of three different commercial fish feeds were purchased in Keffi LGA of Nasarawa State, Nigeria. The samples were purchased at weekly interval for a month in order to have better representation (samples) for the analyses. The feed samples include Top feed, Aqua boom and Sirsigwe feed. The samples were ground into 1 mm mesh size using pestle and mortar and carefully stored in polythene bags for further analyses (Chris et al., 2008).

Proximate Analysis

The moisture, ash, crude fat, crude protein contents (N x 6.25), carbohydrate and crude fiber contents were determined using the method described by the Association of Official Analytic Chemists, (2010). All the parameters in the samples were determined in triplicates and were expressed in percentage. The chemicals used were all analytical grade.

Determination of Minerals

The fish sample (2 g) was weighed into a 250 cm^3 conical flask and digested with a mixture of concentrated Hydrochloric acid and Nitric acid in the ratio of 1:3 (5 cm^3:15 cm^3) at the temperature of 200 – 250^oC in a fume cupboard. The samples were filtered after digestion, transferred into 100 cm^3 volumetric flask and made up to mark with distilled water. The digests were analyzed using Atomic Absorption Spectrophotometer (AAS) for Ca, Mg, Fe, Cu, Zn and Pb, while for Na and K, Flame Photometer was used.

3. RESULTS AND DISCUSSION

Proximate Compositions

The proximate and mineral compositions of the selected fish feed samples were presented in Tables 1 and 2 respectively. The moisture contents of the feed samples fell within the range of 7.17 to 9.52% in which AFF had the highest percent (9.52%) while SFF had the lowest percent (7.17%). High moisture contents in feed, especially commercial feeds are disadvantageous as they can easily get spoiled within a short period which could lead to financial loss by the producers or sellers (Chris et al., 2008). The outcome for the moisture contents implies that SFF will have the longest shelf life among the analyzed feed samples as moisture content varies inversely with shelf-life (Sampels, 2015; Jibrin et al., 2020). Furthermore, the values for the moisture contents in all the feed samples were found within the value of ≤ 12% recommended for shelf stability of feed for long time storage (Aremu et al., 2012). This suggests that the feed samples could be stored for a long period. The value of crude protein was found to be highest in AFF (23.78%) and lowest in TFF (20.86%). The highest percent crude protein observed in AFF could be attributed to the feed ingredients fortified in the feed. Solomon et al., (2016) reported that fish production increases through the utilization of high amount of protein i.e 20% and above in their diet and phase feeding may be more profitable. However, the values obtained for the crude protein in all the feed samples suggests that the feeds are rich sources of protein when compared with the recommended value of 18% (NRC, 2000).

The result for ash contents of the feed samples fell within the range of 4.25-5.67% (Table 1). High ash content is an indication of high mineral contents in feed (Okonkwo and Ozoude, 2015). This suggests that SFF contains highest minerals among the feed samples since is having highest percent ash content (5.67%). The analyzed crude fat contents of the fish feed samples varied slightly

among the feeds. The mean crude lipid was recorded 6.10% in AFF, 6.25% in TFF and 6.35% in SFF. Their slight differences in fat contents could be attributed to the use of similar sources of fat as ingredients in preparing the feeds. Lipids are primarily included in formulated diet to maximize their protein sparing effect by being sources of energy (Steffens and Wirth, 2007). The observed lipid values were in line with that of Leaver et al., (2008) who reported that in general, 2-10% of lipid in most freshwater fish diets gives optimal growth rates without producing an excessively fatty carcass. The result of percentage crude fiber fell within the range of 1. 045 to 1.076%. Fiber provides physical bulk to the feeds. A certain amount of fiber in feed permits better binding and moderates the passage of feed through the alimentary canal.

However, Molnar et al., (2012) reported that it was not desirable to have a fiber content above 8-12% in fish diet, as increase in fiber content can result to the decrease in the quality of an unusable nutrient in the diet. When the fiber content is excessive, it results to lower digestibility of nutrients (Naylor et al., 2009). The crude fiber contents in all the feed samples under study were within the safe dietary limit for fish (FAO & WHO, 2011). The carbohydrate contents in the feed samples fell within the range of 55.27 to 59.31%. Carbohydrates provides energy and also contribute to the sweetness, appearance and textural characteristics of the feeds. The result also agrees with the one reported by Etonihu et al., 2008 on selected commercial broiler feeds which include Top feed, Vital feed and Ecwa feed.

Table 1 Mean proximate composition of analyzed feeds

Parameters (%)	SFF	TFF	AFF
Moisture	7.17 ± 0.36	8.06 ± 0.30	9.52 ± 0.28
Ash	5.67 ± 0.76	4.47 ± 0.26	4.25 ± 0.78
Protein	21.65 ± 0.48	20.86 ± 0.73	23.78 ± 1.01
Crude Fat	6.35 ± 0.50	6.25 ± 0.50	6.10 ± 0.70
Crude fiber	1.07 ± 0.38	1.05 ± 0.30	1.08 ± 0.38
Carbohydrate	58.10 ± 0.18	59.31 ± 0.13	55.27 ± 0.03

Each value represents the mean ± standard deviation of three determinations

Mineral Compositions

The mineral compositions revealed that concentrations of Iron fell within the range of 5.38 to 7.4 mg/kg. SFF was found to be the highest among the samples. This implies that SFF is better source of iron compared to TFF and AFF samples. Iron is an essential component of hemoglobin, an erythrocyte protein that oxygen from the lungs to the tissues. As a component of myoglobin, a protein that provides oxygen to muscles, iron supports metabolism (Umar et al., 2005). Zinc is a vital mineral that human body uses in countless ways. In fact, zinc is the second-most-abundant trace mineral in your body-after iron and is present in every cell (Wong and Ho, 2012). However, from Table 2, the concentrations of Zinc fell within the range of 0.09 to 0.27. This is considered very low and therefore, the feeds need to be fortified with rich source zinc if necessary. mg/kg SFF contains also found to contain highest concentration of copper (0.04 mg/kg) while TFF contains the lowest concentration (0.32 mg/kg). This is considered high when compared with 0.001 mg/kg recommended value for Copper (FAO, 2002). It has been reported that continues ingestion of copper leads to accumulation of the element in the body tissues especially in the liver (Vatta et al., 2012). The magnesium contents of the feed samples ranged from 1.025 mg/kg in SFF to 0.412 mg/kg in AFF. However, these values appear to be significantly different when compared with the standard value of 0.15 mg/kg recommended by FAO, (2002). It has been reported that magnesium is essential for efficient metabolism of carbohydrate and lipid (Ali, 2009). It could be inferred that all the feeds samples are good sources of magnesium when consumed by the fish in the diets.

The values for lead concentrations in the feed samples ranged between 0.01 – 0.11 mg/kg. The values were low when compared with acceptable limit of 0.30 mg/kg (WHO, 2010). However, lead was not detected in sample AFF. Thus, the presence of lead in the two samples could be either it entered through the feed ingredients used in the formulation or during the formulation or even at the market. Nnorom et al., (2013) reported that lead poisoning causes physiological and neurological disorder such as abdominal pains and death in aquatic animal (including fish) consequently, the levels are monitored to know how much could be toxic in fish. Calcium contents in SFF, TFF and AFF ranged from 5.11-1.2 mg/kg. The recommended value for calcium in fish feed is 0.80 mg/kg (NRC, 2000). Thus, when compared with the result obtained, the values seem to be significantly higher than the recommended value. This also suggests that the feed samples are rich sources of calcium. Sodium and Potassium contents in the feed samples ranged from 1.91-1.59 mg/kg and 1.60-1.62 mg/kg respectively. It was observed that there was little or no significant difference in the concentrations of Potassium present in the feed samples.

The values were also found to be higher than those reported on selected poultry feeds which include Top feed (0.02 mg/kg), Vital feed (0.038 mg/kg) and 0.41 for Ecwa feed (Etonihu et al., 2008). The higher concentrations of potassium obtained in the feed samples could attributed the feed ingredients used in the preparation of the feeds. The concentrations of sodium in the feed samples were found to be lower than the recommended values of 2.5 mg/kg (FAO, 2002). Sodium plays an important role in nerve conductivity and muscle contraction, it also regulates acid-base balance and body fluids (Umar et al., 2005). On the hand, deficiency of sodium could lead to distortion of acid-base balance and seizure of nerve conductivity. However, this suggests for the supplementation of this mineral in the various feed types during their formulation since its deficiency could lead to abnormalities. Table 2 also shows that the concentrations of iron in the feed samples ranged from 7.40 to 5.38 mg/kg. The values are high when compared with 1.8 mg/kg recommended requirement (NRC, 2000). This is also suggested that the feed samples under investigation are rich sources of iron.

Table 2 Mineral compositions of the feed samples

Parameters (mg/kg)	SFF	TFF	AFF
Fe	7.4 ± 0.84	6.15 ± 0.46	5.38 ± 0.50
Mg	1.02 ± 0.19	0.55 ± 0.01	0.41 ± 0.18
Zn	0.09 ± 0.02	0.10 ± 0.02	0.27 ± 0.11
K	1.62 ± 021	1.60 ± 0.21	1.60 ± 0.22
Pb	0.01 ± 0.13	0.11 ± 0.01	ND
Na	1.78 ± 0.12	1.59 ± 0.19	1.91 ± 0.14
Ca	5.11 ± 1.02	1.24 ± 0.26	4.74 ± 0.00
Cu	0.04 ± 0.14	0.03 ± 0.01	0.04 ± 0.30

Note: Each value represents the mean ± standard deviation of three determinations
SFF = Sirsgwe fish feed, TFF= Top fish feed and AFF= Aquaboom fish feed. ND = not detected

4. CONCLUSION

The study revealed the levels of nutritional compositions in the selected commercial fish feeds. Aqua boom feed recorded highest percent moisture, crude protein and fiber while Sirsigwe feed sample was highest in ash and crude fat contents among the feed samples. The results for the mineral compositions showed that Sirsigwe feed recorded highest concentrations of essential minerals which include K, Mg and Ca while concentration of Na was highest in Aqua boom among the feed samples. But concentrations of non-essential minerals which include Fe, Zn and Cu fell within the range of 0.03 to 7.4 mg/kg. From the results obtained, it could be inferred that the feed samples are good sources of nutrients when compared with the recommended standards and therefore suitable for commercial fish farming.

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Author's contribution

Jibrin Mohammed, prepared and drafted the manuscript. Adamu Usman, did surveyed of the literature. Jibrin Isah, designed and supervised the experiment. Kabiru S Madaki, performed the experiment and recorded the experimental data. All authors read and edited the manuscript and finally approved the version for your consideration.

Informed consent

Not applicable.

Ethical approval

No Animals utilized in the work. Ethical guidelines are not applicable.

Conflicts of interests

The authors declare that there are no conflicts of interests.

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Data and materials availability

All data associated with this study are present in the paper.

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