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Effect of storage and anti-nutritional components in stored pelleted fish feed

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Abstract: The effect of storage on the nutritional composition of pelleted fish feed as well as the anti-nutritional components was studied using two commercially formulated feeds: Coppens (exotic) and vital (local) feeds. Feed samples were purchased and monitored in storage at ambient temperature forth nightly for 6 weeks using standard procedures. Result obtained showed reduction in feed quality as the storage period increased with significant difference ($P > 0.05$) in all nutrient components studied (moisture, protein, lipid, ash, crude fibre and nitrogen free extract).There was however no significant difference ($P>0.05$) between the nutritional components of feed samples during the storage period. Anti-nutritional components detected in feed samples were oxalate, phytate and tannins with phytate having the highest values in both feed samples.

Keywords: Fish Feed, Pellets, Storage, Nutrients, Temperature

1. Introduction

Prepared feeds for fish are perishable (Abowei and Tawari, 2011). They are also relatively fragile depending on the type of feed. The activities of insects, microorganisms and animals as well as improper handling, plus physical and chemical changes due to change in temperature and humidity pose serious problem of deterioration in stored fish feeds. Although, these causes are inter-related, the effect of microbial activity in stored feeds reduces nutritional value owing to the loss of dietary lipids, amino acids and vitamins by enzymatic digestion (Jones, 1987; Lim *et al*., 2008). It may also assist in the development of lipid ketonic rancidity and non-ketonic browning (Cockerel *et al*., 1971). In addition, Chow (1980) reported that mold infestation also produce poorer flavor and appearance making feeds lump and less palatable.

Feed processors attempt to formulate and manufacture aquaculture feeds to extend their shelf life and improve durability. However the degree to which aqua culturists can reduce wasted feed and realize its full purchase value is alternately dependent on how well the basic principles of storage and handling are understood and applied.

Microorganisms invade feeds and feed stuffs during storage causing deterioration, these include bacteria and fungi. Fungi contamination of fish feed have been reported to result in aflatoxicosis. Aflatoxins are chemicals produced by fungi like *Aspergillus flavus* and *A. parasiticus* (Russo and Yonong, 2006). Mold infested fish feed have been reported to impact negatively on the growth of *Heterobranchus bidorsalis* fish (Effiong and Alatise, 2009).

Aflatoxins present in fish have been known to be capable of having carcinogenic effects on human consumers of contaminated fish (Brown, 2007). The occurrence of these microbial strains in fish feeds have been reported to depend on the storage condition of the feed, particularly temperature (Nwabueze and Nwabueze, 2011).Poor storage conditions of feed will enhance microbial activity. Studies conducted to determine the effect of storage on the nutritional composition of pelleted fish feed are limited. Coppens and Vital feeds used in this experiment are exotic and local feeds respectively used commonly by farmers in aquaculture systems in Nigeria. Coppens feed is manufactured by Coppens International, Belgium, Netherland while Vital feed is manufactured by Grand Cereals Ltd., Jos, Nigeria.

This experiment was therefore conducted to determine the effect of storage on nutrient quality of feeds at ambient temperature; determine quality changes in different feed samples stored under the same conditions; and determine the anti- nutritional components in the pelleted fish feed samples in storage.

2. Materials and Methods

One kg each of exotic (Coppens) and locally manufactured (Vital) feeds were purchased from a retail outlet in Ilorin, Nigeria with manufacturing and expiring dates noted in both feeds. The feed samples were 5 and 3 weeks old respectively from the day of manufacture at the time of purchase. They were packaged in air tight containers and sent for proximate and anti-nutritional analysis at the Agricultural Technology Research Laboratory, Federal University of Technology, Akure (FUTA) Nigeria. Analysis was conducted forth nightly for 6 weeks. The methods for analyses were the standard procedures of AOAC (1990). Moisture content was determined by oven- drying (at 105^0C) samples for 24 hours, ash by incineration of 2g of each samples in a muffle furnace (Lenton Furnaces, England) at 600^0C for 2 hours; protein was estimated as nitrogen content (Nx6.25) by the micro-kjeldahl method; crude fibre by acid-base digestion using 1.25% H_2SO_4 (W/V) and 1.25% NaOH (W/V) solution, available nitrogen free extract was calculated by difference.

All proximate components were analyzed in triplicate and reported as means on percentage dry weight basis. Tannins, oxalate and phytate were determined as the anti-nutritional feed components using the method of Friedman and Shibko (1972).

For microbiological analysis, 1.0 g of feed sample was ground forth-nightly using pestle and mortar to prepare a 10-fold serial dilution. Agar used for the culture and isolation of microorganisms was Potato Dextrose Agar. This was prepared using sterilized glassware according to manufacturer's instruction and autoclaved at 121^{o}C for 15 minutes. It was allowed to cool to about 37^{o}C before 1% streptomycin was added to prevent bacterial contamination (Nwachukwu, 1988).

A 48-hour- old culture of the isolates was subcultured and incubated at room temperature to produce pure cultures from which stock was prepared and stored. Mold isolates were characterized during sporulation on the basis of cultural and morphological characteristics as well as direct microscopic examination (Oloke *et al*., 1988).

Three replications were used to obtain average values and standard deviations while T- Test was used to compare the effect of storage on the nutrient contents in both samples of the experimental feed.

3. Results and Discussion

The result of the proximate composition of both feeds samples (Coppens) and (Vital) feeds stored for 6 weeks and monitored forth nightly is shown in Tables 1 and 2. Moisture was higher in Vital feeds (locally manufactured) than Coppens (exotic) and was significantly different ($P<0.05$). Most nutrients were also significantly different including protein and lipid over the storage period in both feed samples.

A decreasing trend in the nutritional content of the feed samples was observed generally in both feeds from week zero (initial) to week six. Bautisa *et al*; (1992) and Ramezanzadeh *et al.*; (1999) both reported that high temperature resulted in increase in both oxidative and hydrolytic rancidities with possible loss in quality in stored fish feeds. Studies by Hamilton (1989); Sandars (1989), Van den Berghe *et al*; (1990) and Ruiz *et al;* (2000) indicated that fats are intrinsically unstable when under temperature of about 30^0C. FAO (1987) reported that environmental factors such as moisture, relative humidity, temperature, light and oxygen cause deteriorative changes and losses in stored feed and feed stuff. High moisture levels in stored feed result in loss of quality due to growth of micro- organisms. The quality of fish feeds and the hygienic levels of the technological process employed during feed formulation determine the level of risk of microbial contamination aided by temperature (Nwabueze and Nwabueze, 2011).

The anti- nutritional components found in the feed samples over the period of six weeks are shown in Table 3. Francis *et al*; 2001 reported the presence of a wide range of anti-nutritional components in plants- derived fish feed components including phytate, oxalate and tannins stating that their presence is unlikely to affect fish growth performance especially if proper heat treatment is carried out during feed formulation process. Makkar, and Becker (1999a and 1999b) reported similar findings. Phytate content in both feeds were higher than those of oxalate and tannins and their concentrations increased with increase in the storage period. Their levels from the findings of this experiment were however within safe limit (FAO/IAEA, 2000).

Molds isolates identified from the experimental feed samples were *Fusarium oxysporium, Penicillium digitatum, Aspergillus niger, A.fumigatus, A. flavus, Rhizopus stolonifer and R.oryzae.* Effiong and Sanni (2010) reported similar findings.

Table 1. *Proximate chemical analysis of Coppens feed stored for 6 weeks (% based on dry matter basis.).*

Parameters	Initial (WK zero)	Wk 2	Wk 4	Wk 6
Moisture	6.86 ± 0.12^d	8.16 ± 0.03^c	15.42 ± 0.02^b	18.42 ± 0.02^a
Ash	7.69 ± 0.01^a	6.93 ± 0.01^b	6.00 ± 0.02^c	5.94 ± 0.02^d
Lipid	15.21 ± 0.01^b	16.01 ± 0.02^a	12.00 ± 0.02^a	12.86 ± 0.02^c
Protein	46.65 ± 0.02^a	44.02 ± 0.02^c	35.08 ± 0.02^d	36.18 ± 0.02^d
Crude fibre	3.20 ± 0.01^b	2.86 ± 0.02^c	3.68 ± 0.03^a	2.43 ± 0.02^d
NFE*	21.15 ± 0.02^d	22.03 ± 0.02^c	27.83 ± 0.02^a	24.18 ± 0.02^b

*Nitrogen Free Extract. Data are expressed as mean of three replications. Means followed by the same letter within a column indicate no significant ($P> 0.05$) difference.

Table 2. *Proximate chemical analysis of Vital feed stored for 6 weeks (% based on dry matter basis).*

Parameters	Initial (WK zero)	Wk 2	Wk 4	Wk 6
Moisture	11.57±0.02^{d}	12.76±0.02^{b}	17.46±0.02^{b}	20.46±0.02^{a}
Ash	10.33±0.02^{b}	10.70±0.02^{b}	9.93±0.02^{c}	8.90±0.02^{d}
Lipid	12.65±0.02^{a}	10.92±0.02^{b}	9.65±0.02^{c}	8.98±0.02^{d}
Protein	45.95±0.02^{a}	40.73±0.02^{b}	35.27±0.02^{d}	38.27±0.02^{d}
Crude fibre	2.27±0.02^{c}	2.88±0.02^{b}	2.94±0.02^{a}	2.61±0.02^{d}
NFE*	20.78±0.01^{d}	22.03±0.02^{b}	24.75±0.02^{a}	20.78±0.02^{c}

*Nitrogen Free Extract. Data are expressed as means of three replicates. Means followed by the same letter within a column indicate no significant (P > 0.05) difference.

Table 3. *Anti-nutritional components in feed samples stored for 6 weeks at ambient temperature (mg/g).*

Anti-nutritional components	Coppens feeds				Vital feeds			
	Time(Weeks)				Time(weeks)			
	0	2	4	6	0	2	4	6
Oxalate	0.72	0.81	0.90	1.08	0.63	1.08	1.08	1.17
Phytate	7.41	8.24	9.89	11.54	7.41	9.06	12.36	13.18
Tannins	0.78	0.79	0.79	1.15	0.62	1.06	1.14	1.213

4. Conclusion

The findings of this experiment in line with those of the authors cited (Jones, 1987; Lim *et al*., 2008) indicate increase deterioration of feed quality with increase in storage period of feeds at ambient temperature. Therefore long storage of feeds should be discouraged to prevent quality loss. However additional research work involving environmental factors is recommended to further ascertain this assertion.

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