Quality Control Assessment of Unskinned-dried Tadpole Meal Supplemented Fish Feeds

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Abstract: The hike in the price of fish feed due to that of fish meal called for researches into suitable supplement for this essential animal protein which will be use to produce feeds with high nutrient and preserved quality. Unskinned-dried tadpole meal was used to supplement fish meal at inclusion levels of 0% (control diet) , 25%, 50%, 75% and 100% of Unskinned-dried tadpole meal coded Tdp1 to Tdp5. The feeds were divided into two first parts were preserved in a refrigerator at 8°C while the other at 28-30°C for 70 days. Routine checking was done bimonthly for the physical, biochemical and microbial evaluations for duration of 10 weeks. The results of the experiment showed that the highest Hedonic scale, 7 was Mould appearance of all unskinned-dried tadpole meal diets stored in refrigerator while lowest value, 2 was for colour in 75% and 100% unskinned-dried tadpole meal diets stored in room temperature diets stored in room temperature at 28-30°C. There was significant different ($p<0.05$) between the final lipid stored at the two temperatures. High significant correlations $r=0.885$ and $r=0.990$, $p<0.05$ existed between the final proteins and lipids respectively of the diets stored at the two different temperatures. The microbial evaluation for unskinned-dried tadpole meal ranged from 16.73x107cfu/mol - 41.73x107cfu/mol with highest from 100% unskinned-dried tadpole meal stored at room temperature and lowest from the control diet stored in refrigerator. Based on the results from this study 50% unskinned-dried tadpole meal diet stored in refrigerator at 8°C is recommended as a better way of feed storage for sustainable aquaculture and improving fish food security. [World Rural Observations 2009;1(1):7-16]. ISSN: 1944-6543 (print); ISSN: 1944-6551 (online).

Key words: dried–unskinned tadpole meal; fish meal; preservation quality; temperature

1. Introduction

The future growth of the aquaculture industry in Nigeria and other country's of the world depends upon the availability of suitable and economical feeds. Information on the type, quality, quantity, seasonality and cost of fish feeds is important in determining the appropriate production strategy. Enhancement of aquaculture practice in Nigeria has tendency to proffer solution to problem of malnutrition in providing fish (which is a cheap and reliable animal protein source) on every table at each meal (Adegbola, 1999; Falayi et al., 2003 ; Sogbesan et al., 2006). For aquaculture to supply the population's growing demand of 1.84Million tonnes of fish as food in the 2009 and to fill the gap of 1.22Million tonnes deficiet in declining yield from capture fisheries (Federal Department of Fisheries, 2003); basic but critical information should be available especially as regards feeds that are less competitive and of low cost value. These should have replaceable capacity for fishmeals with the aim of making fish to attain table size at reduced culture time and minimum production cost.

Quality assurance investigates all aspects capable of influencing the end products and it is aimed at ensuring that the initial quality is maintained so as to reduce incidence of quality shortcomings (Eyo, 2001). Fish diet must have the correct appearance (ie. size, shape and colour), texture (ie. hard, soft, moist, dry, rough or smooth), density (buoyancy) and attractiveness (ie. smell or taste) to elicit an optimal feeding response (appetite) by the fish fed (Mackie and Mitchell, 1985). Quality assurance in feeds must have hazard analysis critical control points plan (HACCP) and adhere to it (Tacon, 1994), hence the need for proper processing and preservation methods.

The presences of toxins, inhibitors and anti-growth factors in feeds and feed ingredients have a problem that limits their maximum utilization and inclusion as

supplementary non-conventional ingredients to the conventional ones. In the choice of feed ingredient, the easiness in processing and preservation of ingredients and prepared feeds shelf life remains important factors apart from availability, nutrient composition, easy accessibility and lack of competition with other consumers. Processing methods embarked upon during most feed preparation are aimed at detoxification of toxins in the ingredient either by boiling/cooking, fermenting with/without enzymes/soaking, heating, roasting, blanching, extruding among other methods (Akpodiete and Okagbare, 1999; Isikwenu and Bratte, 1999; Obun et al., 2005).

2. Materials and methods

2.1 Formulation of experimental diets

Ingredients used in compounding the diets such as fish (clupeid) meal, yellow maize, groundnut cake, soybean, blood meal, cassava starch and bone meal were purchased from Monday Market in New-Bussa while vitamin/mineral premix was purchased from Hope Farms Ltd, Ibadan. Tadpole meal was from the cultured and processed tadpole (Sogbesan et al., 2007 and 2008). Soybean was dehulled and toasted before use while cow blood collected from abbatoir was boiled and congealed. The congealed blood was sun-dried and ground into powder. Cassava starch was used as a binder at a rate of 1%.

A completely randomized design was used in the designing the diets which were formulated using Algebraic Method along with Least Cost Formulae (LCF). Unskinned –dried tadpole meal was used to replace fishmeal as animal protein source at 0% (control), 25%, 50%, 75% and 100%. All diets were isonitrogenous at 42.5% crude protein, isocaloric at calculated 1900kJ/100g with the same protein to gross energy ratio (P: GE) of 44.7mgprotein/kJ/100g. The percentage composition of the ingredients in the experimental diet is shown in Table 1.

Table 1. Percentage composition of ingredients (g/100g diets) in unskinned-dried tadpole meal diets for the feeding trial

Ingredients	Tpd1 (control)	Tpd2	Tpd3	Tpd4	Tpd5
Fishmeal	30.0	22.5	15.0	7.5	0.0
Unskinned-dried tadpole meal	0.0	7.5	15.0	22.5	30.0
Yellow maize	28.7	21.1	15.2	8.9	1.3
Groundnut cake	11.7	17.3	20.9	24.6	25.0
Soy bean meal	12.6	14.6	16.9	19.5	25.2
Blood meal	10.0	10.0	10.0	10.0	10.0
Chromic oxide	0.5	0.5	0.5	0.5	0.5
Vitamin/minerals premix	2.0	2.0	2.0	2.0	2.0
Palm oil	2.0	2.0	2.0	2.0	2.0
Common salt	0.5	0.5	0.5	0.5	0.5
Bone	1.0	1.0	1.0	1.0	1.0
Cassava starch (binder)	1.0	1.0	1.0	1.0	1.0
Total	100.0	100.0	100.0	100.0	100.0
Calculated crude protein (%)	42.5	42.5	42.5	42.5	42.5
Calculated gross energy kJ/100g	1900	1900	1900	1900	1900

P :GE mg of protein/kJ/100g	44.7	44.7	44.7	44.7	44.7
Inclusion of unskinned-dried tadpole meal %	0.0	25.0	50.0	75.0	100.0

Tpd= Unskinned-dried tadpole meal
P = crude protein content
GE= gross energy value

2.2 Preparation of experimental diets

After formulation, the ingredients were measured using electric sensitive weighing balance (OHAUS- LS 2000 Model), milled into fine particles (commonly practised for fish feed preparation) (Falayi, 2003) using a combined grinder and mixer (ASEFAC Prototype 1989). The dry ingredients were thoroughly mixed for 30 minutes to ensure homogeneity of the ingredients. Starch was prepared with hot water and added after thorough mixing of all the other ingredients. The dough was pelleted wet using hand pelleting machine (Kitchen Hand Cranker Pelletizer). The pelleted dough was collected in flat trays and sun-dried to constant weight after which the feeds were crushed into crumbs with pestle and mortar (for easy ingestion by the fish). They were packed in plastic bowls with covers labelled and stored at room temperature in the laboratory.

2.3 Determination of shelf life of the experimental diets

5g of each of the experimental diet was put in corked bottle labelled according to each of the diet code. One set was stored in a refrigerator at 8^0C and coded A while the other set was stored under ambient room temperature of 28-31^{0}C in the laboratory and coded B. Routine checking was done bimonthly for the physical, biochemical and microbial evaluations for a duration of 10 weeks. The duration choice was based on 1-2 months recommendation by DeSilva and Anderson (1995) for storing fish feed in the tropical region.

(1) Physical and sensory evaluation

A 10-member evaluation panel comprising of experienced and qualified fish nutritionist from NIFFR, Federal College of Freshwater Fisheries Technology, and Federal College of Forestry and Wildlife all in New-Bussa were constituted. The quality attributes assessed included colour, mould appearance, odour/ flavour (rancidity) and texture (Eyo, 2001). A 7-point Hedonic Scale of Tiamiyu et al. (2004) adopted for the evaluation were 7=excellent, 6=very good, 5= good, 4= fairly good, 3=fair, 2=poor and 1=very poor). Each member of the panel evaluated each quality attribute.

(2) Chemical evaluation

Each of the experimental diet was analysed for proximate composition in triplicate on bi-monthly bases and the mean was recorded. The parameters considered were crude protein, crude lipid and crude fibre according to (AOAC, 2000) Methods.

(3) Microbial evaluation

The microbial analysis of the stored feeds was carried out in triplicate in the Biological Laboratory of NIFFR following Tiamiyu et al. (2004) Methods.

(4) Colony forming unit (cfu)

The colony forming unit (cfu) was determine by serial dilution of the preserved experimental feeds using 1.0g of feed to prepare 10 fold serial dilution with sterile distilled water.

(5) Agar preparation

Potato dextrose agar (PDA) (Oxoid Industry, England) was prepared according to the manufacturer's instruction and autoclaved at 120^{0}C for 15 minutes. This was allowed to cool to 37^{0}C before 1% streptomycin was added to prevent bacteria contamination of the agar (Adriau and Dehant, 1979). All glasswares used for the experiment were sterilized in the oven at 105^{0}C for 2 hours.

(6) Inoculation with experimental diets

1ml of each fold dilution was incorporated into 16ml of sterilized molten potato dextrose agar, mixed clockwise and anticlockwise for 1 minute, and incubated at 27^{0}C for 24hours in an incubator.

(7) Fungal counts

This was done quantitatively using colony count on pour plate technique according to the method of Adriau and Dehant (1979). 24hours old culture was used for

this determination.

3. Results

The lowest crude protein, 43.39% was in 100% unskinned-dried tadpole meal diet while the highest value, 43.53% was in the control diet (Table 2). Crude protein content in all the diets were not significantly different ($p>0.05$). The lipid content increased as tadpole meal inclusion increased with the values ranging from 10.63% to 16.07% which were significantly different ($p<0.05$) except between 50% and 75% inclusion levels. There was no significant difference ($p>0.05$) in the gross energy content in all the diets. Highest potassium, 0.78g/100g was in 100% diet while lowest 0.72g/100g was in control and the values were not significantly different ($p>0.05$) between all the diets.

Table 2. Proximate and energy composition (% dry matter) of the unskinned dried tadpole meal diets

Composition	Experimental diets				
	Tpd1 (control)	**Tpd2**	**Tpd3**	**Tpd4**	**Tpd5**
Inclusion levels of unskinned-dried tadpole meal (%)	0	25	50	75	100
Crude protein %	43.53	43.51	43.48	43.46	43.39
Crude lipid %	10.63^{e}	11.62^{d}	13.10^{c}	14.66^{b}	16.07^{a}
Crude fibre %	3.36	3.58	3.74	3.92	3.99
Ash %	8.41	9.98	11.44	12.62	13.77
Nitrogen free extract %	18.33^{a}	15.92^{b}	13.11^{c}	10.51^{d}	6.87^{e}
Dry matter %	84.28	84.61	84.87	85.16	84.09
Sodium (g/100g)	0.53	0.52	0.48	0.45	0.43
Calcium (g/100g)	1.47^{a}	1.23^{b}	1.14^{b}	1.10^{bc}	1.04^{bc}
Potassium (g/100g)	0.72	0.73	0.77	0.74	0.78
Phosphorus (g/100g)	0.95^{a}	0.89^{a}	0.77^{ab}	0.65^{bc}	0.55^{c}
Magnesium (g/100g)	0.10	0.11	0.21	0.26	0.32
Gross energy kJ/100g	1776	1766	1777	1788	1777
Metabolizable energy kJ/100g	1332	1324	1333	1341	1332
Digestible energy kJ/100g	1439.2	1451.3	1476.5	1499.4	1509.7

All values on the same row with the different superscripts are significantly different ($p<0.05$).
Data without superscript are insignificantly different ($p>0.05$)
Tpd: Unskinned-dried tadpole meal

Lowest hedonic scale, 2 was for color in 75% and 100% unskinned-dried tadpole meal diets stored in room temperature (Figure 1). There was mould appearance in all unskinned-dried tadpole meal diets stored in refrigerator with hedonic scale, 7. There was significant difference ($p<0.05$) between colour, odour and texture of unskinned–dried tadpole meal diets stored at the two temperatures.

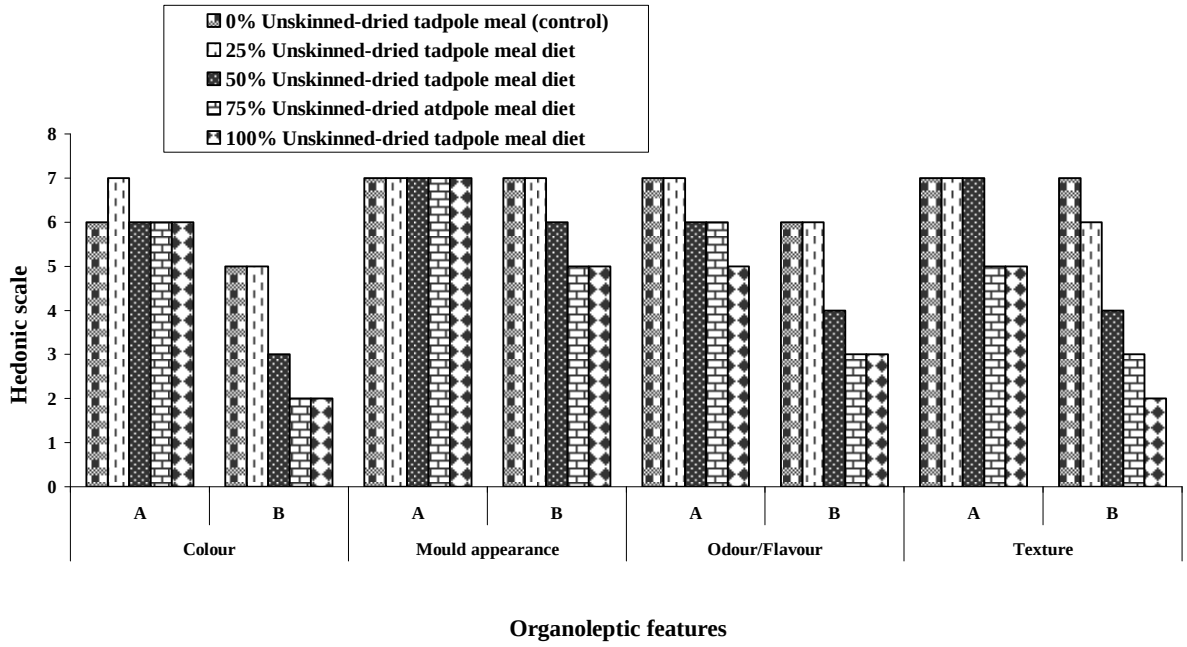
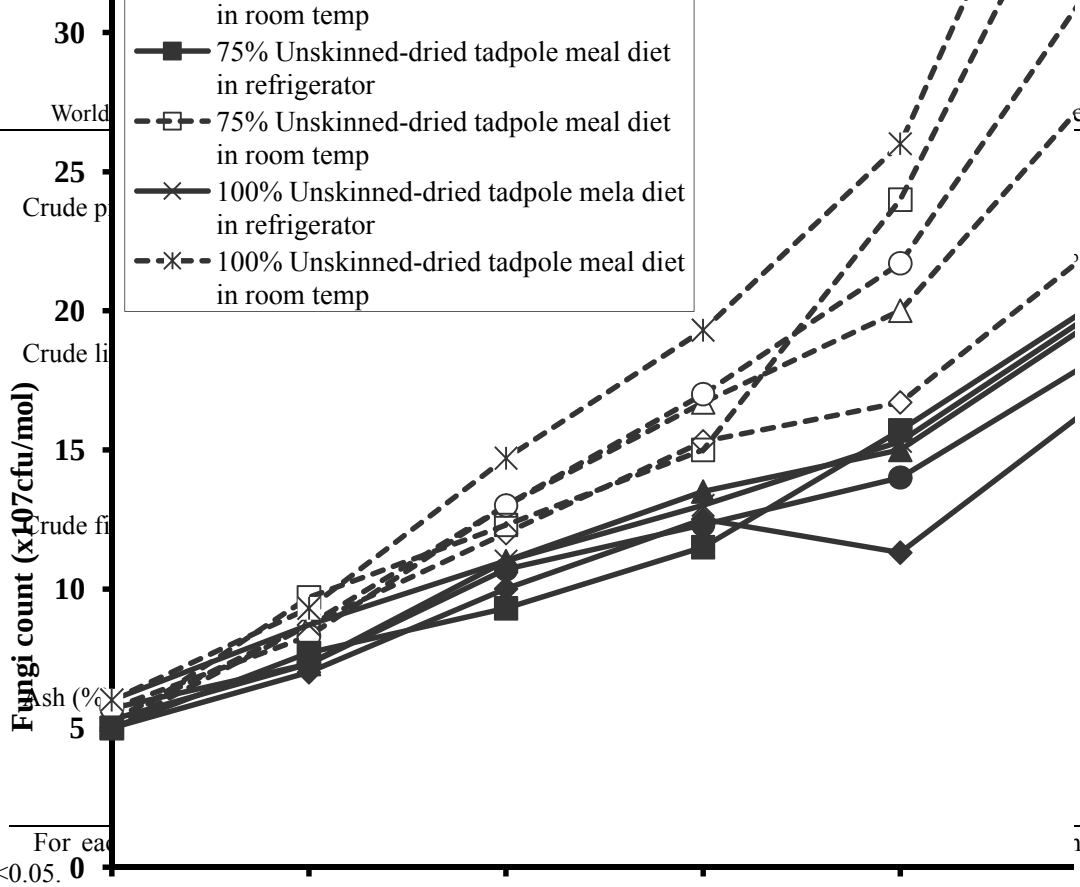


Figure 1. Physical evaluation of unskinned-dried tadpole meal diets preserved in refrigerator, 8°C (A) and under room temperature, 28-30°C (B) for 84 days

Final crude protein ranged from 41.93% to 43.21% in stored unskinned-dried tadpole meal with highest from 25% diet stored at 8°C while lowest from 100% diet stored at room temperature (Table 3). Lowest lipid, 10.55% was in the control stored at room temperature while highest, 15.88% was from 100% unskinned-dried tadpole meal diet stored at 8°C. There was significant different ($p<0.05$) between the final lipid stored at the two temperatures. High significant correlations $r=0.885$ and $r=0.990$, $p<0.05$ existed between the final proteins and lipids respectively of the diets stored at the two different temperatures.

Table 3. Proximate composition of the unskinned-dried tadpole meal diets before and after storage at the two different storage temperatures (8°C and room temperature 28-30°C)

Nutrient	Storage temperatures	Experimental diets				
		Tpd1 (control)	Tpd2	Tpd3	Tpd4	Tpd5
Inclusion levels of unskinned-dried tadpole meal		0%	25%	50%	75%	100%
	Initial	43.53	43.51	43.48	43.46	43.39



Crude p... 42.60[b]
Crude li... 41.93[c]
Crude fi... 16.07[d]
Ash (%... 15.88[d]
15.69[d]
3.99[c]
3.90[b]
3.83[b]
13.27[e]
13.10[d]
12.68[e]

For ea... ...ntly difference p<0.05.

For each nutrient data without superscript are insignificantly different (p>0.05)
Tpd= Unskinned–dried tadpole meal

Figure 2. Weekly fungi growth in unskinned-dried tadpole meal diets stored under different temperature for 70 days

The microbial evaluation for unskinned-dried tadpole meal ranged from 16.73x107cfu/mol – 41.73x107cfu/mol with highest from 100% unskinned-dried tadpole meal stored at room temperature and lowest from the control diet stored in refrigerator as shown in Figure 2.

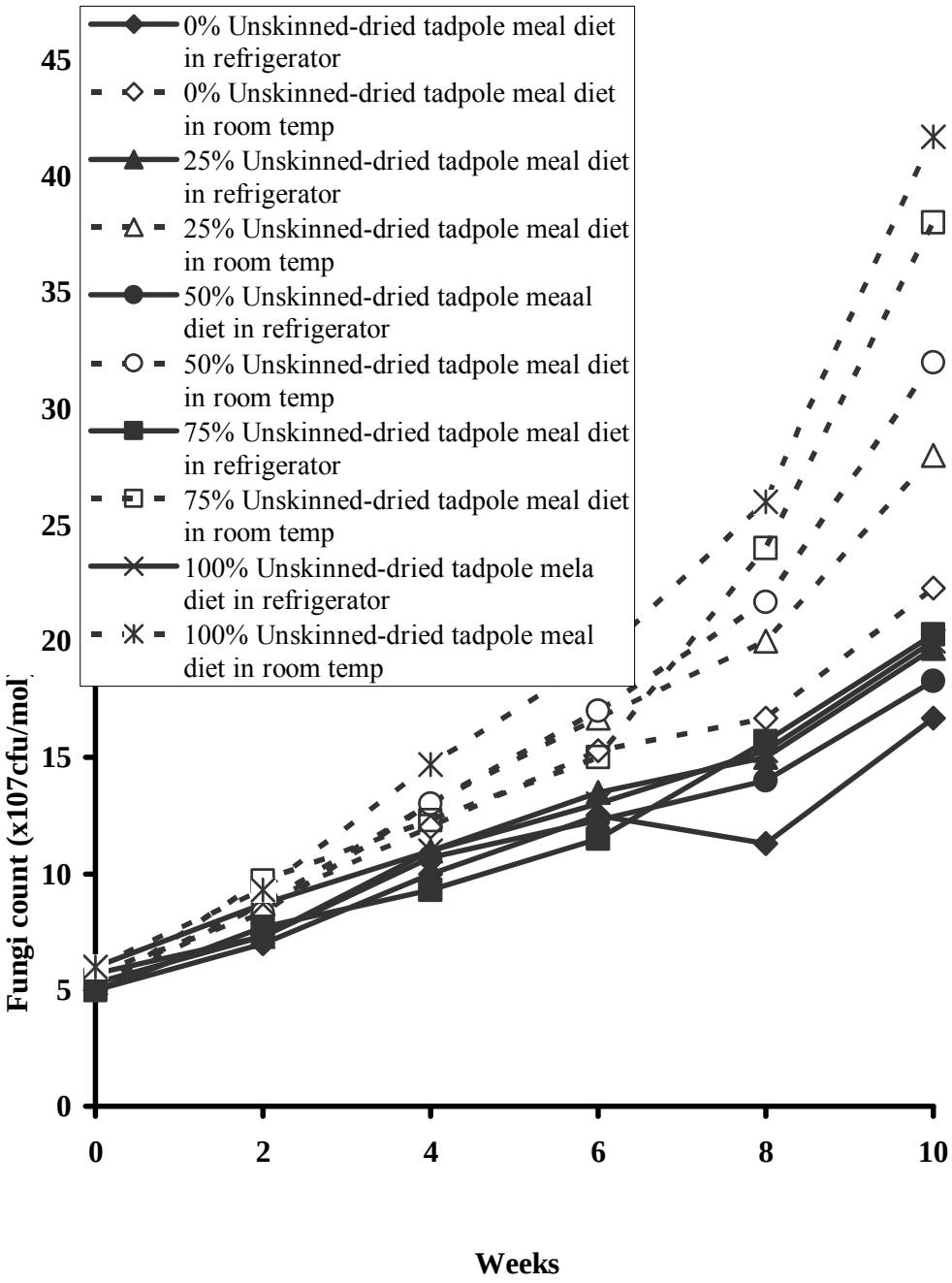


Figure 2. Weekly fungi growth in unskinned-dried tadpole meal diets stored under different temperature for 70 days

4. Discussion

The basic nutrient that cannot be compromised in the choice of ingredients for feed formulation and preparation is protein (Zeitler et al., 1984) and since each of the experimental diet supplied the optimum required amount they were adequately utilization by the fish. The lipid content of each experimental diet increased with increase in the proportion of their tested animal protein supplements (See Table 2). This lipid increase may have had a sparing effect on the dietary protein and complement its utilization (Okoye et al., 2001). This observation corroborate with that of NRC (1993), that practical diets should be formulated not only to meet the optimum ratio of protein to energy but also the adequate amount of lipid needed by the fish. Dietary lipids also provide essential polyunsaturated fatty acid for normal growth and development of cells and tissues (Sargent et al., 1995) .

Among the experimental diets studied, unskinned-dried tadpole meal diets were rancid ealier and more microbial growths at both 8^{o}C and room temperature (28-30^{o}C) storage temperatures than the other diets. The reason for this would have been their high lipid concents compared to the other diets. This agrees with the report of Tacon (1987) that the major problem faced by animal feed compounders is the susceptibility of individual ingredients and formulated diets having high lipid and moisture to oxidative damage or oxidative rancidity and microbial attack. Despite the fact that the studied diets were dried which eliminate high moisture; deterioration were recorded from physical, chemical and microbial studies which showed that moisture was not a major factor in feed spoilage (DeSilva and Anderson, 1995; Effiong and Eyo, 2003 and Tiamiyu et al., 2004).

The reduction in lipid and protein composition from all the experimental diets at the end of the experimetal period corroborate the reports of DeSilva and Anderson (1995) and Hodari-Okae et al. (1998) that within a period of 2-4months feeds are prone to reduction in their major nutrient composition. Reduction of nutrient content from each diet at the end of the experiment could have been as a result of increase in activity and microbial population, solubilization of minerals into weak acids, other oxides, temperature and humidity fluctuation as also reported by (Eyo, 2001).

The result of the microbiological analysis showed that the method of storage had effect on microbial growth though lower microbial load were recorded from 8^{o}C compared to those preserved at room temperature. Wilson (1991) and Tiamiyu et al (2004) documented that cold storage is the most effective way of preserving raw and processed offal meal. The microbes recorded from the lower temperature could have resulted from water crystals in feed, which could lead to rapid microbial spoilage and destruction of moisture-sensitive vitamins like vitamin C (FAO, 1983 and Wilson, 1991) due to of moisture and low temperature and high humidity. Decrease in Vitamin E, which could result from high rancidity of feed, has been associated with mould appearance in meals because of fungal destruction of α – tocopherols (Aletor, 1990 and Hodari-Okae et al., 1998). Some of the inconsistent trends in microbial growth and nutrient depression in feed can possibly be due to the interactions taking place between chemicals present in the feed, processing methods, preservation technique and resistance of the organisms as reported by Aletor (1990).

The fact that microbial growth was reported all diets studied despite their compositions and place of storage corroborate with the report of Osho et al. (2007) that no feed was completely free of fungi contamination.

The occurrence of Aspergillus is significant in public health. A niger and A. flavus had been reported (Osho et al., 2007) as the common agents of food spoilage most especially in the tropics where their spores are widely distributed. Some species of are known to secrete toxins known as aflatoxin which cause food poisoning and are carcinogenic to man; when ingested affect the liver and no effective therapeutic treatment has yet been known. Aspergillus spp caused “Aspergillosis” (a disease of the lungs) (Okaeme, 1999). Many human and animal diseases such as mycotic abortion, aflatoxin poisoning, allergic reaction, systemic infections are attributed to mould and fungi ingestion (Okaeme, 1999). Penicillum spp and Fusarium spp are also capable of secreting toxins like ichra toxins and penicillic acid that are dangerous to human health. Various lung diseases in farmers are associated with mould and grain dust. Aflatoxins, even at diminutive dietary levels have been established to decrease growth rate and feed conversion efficiency (Aletor, 1990) in animals fed such feed.

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