Journal of Biological Sciences 7 (6): 981-984, 2007
ISSN 1727-3048

Microbiological and Physicochemical Qualities of Selected Commercial Poultry Feeds in Akure, Nigeria

D.J. Arotupin, R.M.O. Kayode and K.O. Awojobi
Department of Microbiology, Federal University of Technology, P.M.B. 704, Akure, Nigeria

Abstract: Five different commercial poultry feeds namely, broiler finisher, broiler starter, broiler super starter, grower mash and layer top mash obtained from their trade outlets in Akure, Nigeria were examined for their microbiological and physicochemical qualities using standard microbiological and analytical methods. The bacterial count was highest in broiler starter with 2.50×10^4 cfu mL^{-1}, while the least count of 6.60×10^2 cfu mL^{-1} was recorded in layer top mash. Fungal count was highest in layer top mash (7.40×10^2 sfu mL^{-1}) and least in grower mash (1.50×10^2 sfu mL^{-1}). A total of seventeen microorganisms were isolated which include *Aerobacter aerogenes*, *Bacillus cereus*, *Erwinia amylovora*, *Mirococcus luteus*, *Staphylococcus aureus*, *Aspergillus flavus*, *A. fumigatus*, *A. niger*, *Acaulopa macrospore*, *Cladosporium fulvum*, *Dotchiza populae*, *Fusarium* sp., *Geotrichium candidum*, *Pleurophrgmium* sp., *Rhizopus stolonifer*, *Candida albicans* and *Saccharomyces cerevisiae*. Proximate composition revealed the presence of moisture, ash, fat, crude fibre and protein content. The mineral analysis shows that, the poultry feeds contained essential elements, namely K^+, Na^+, Ca^{2+}, Mg^{2+} and P. The presence of some pathogenic microorganisms in the poultry feeds lucidly revealed the level of contamination. Therefore, the commercial poultry feeds should be periodically examined for bio safety, so as to reduce or probably prevent the risk of cross contamination of poultry and poultry products.

Key words: Poultry feed, microbiological quality, contamination, pathogenic microorganisms

INTRODUCTION

Feeds for poultry production are composed largely of grains such as corn, wheat or barley, oil seeds, cake meal (originating mainly from oil producing seeds such as soybeans), sunflower seeds, peanuts, cotton seed and protein products of animal origin such as fish meal, meat and bone meal, slaughter house offal's and feather meals (Bale *et al*., 2002). Since these feeds are expected to be the sole sources of nutrition of the birds, they usually contain essential mineral and vitamin additives (Dhand *et al*., 1998). However, there are variations in nutrient requirements for different farm animals, but the level of dietary energy and associated nutrient should be high enough to allow expression of animal potentials under certain environmental circumstances within the economic limitations (Wilson, 1990). According to Cevger and Yalcin (2003), poultry feeds are essential source of energy needed to generate heat and to support the chemical reactions in which all physiological processes depended. Many of these reactions are catalysed by vitamins or some inorganic elements, hence must be provided in the diet (Uwaezuoke *et al*., 2000). In addition, is water, since virtually all cell mediated reactions take place in an aqueous medium. In most cases, poultry feed ingredients are delivered in bulk and usually in very large quantities conveyed from one storehouse to another.

The poultry industries rely on the supply of ready-to-use feed firm from feed mills for handling, unloading, grinding of grains, mixing and usually pelleting of the mixed ration (Aganaga *et al*., 2000). These packaged feeds from feed mills constitute the main source of feeds for poultry farmers.

Poultry feed component of plants and animal origin are commonly contaminated with microorganisms, mostly bacteria and fungi and/or insects. However, the number and types of microorganisms and insects vary depending on the function of materials, location of its origin, climatic conditions encountered, harvesting, processing, storage transport technologies employed and packaging materials (D'Mello, 2006). He further reported the impart of the general environmental and handing circumstances including the nature and extent of quality control measures on the level of microbial contamination. Some beneficial poultry feed contaminants such as lactic acid bacteria have been reported (Dhand *et al*., 1998; D'Mello, 2006). The importance of LAB in poultry feeds and growth performance in farm animals have equally

Corresponding Author: D.J. Arotupin, Department of Microbiology, Federal University of Technology, P.M.B. 704, Akure, Nigeria

been documented (D'Mello, 2000). Other microorganisms that have been implicated as contaminants of poultry feeds include *Escherichia coli*, *Erwinia herbicola*, *Salmonella* spp. *Listeria* sp., *Enterococcus faecalis*, *Aspergillus flavus*, *A. parasiticus*. *Penicillium* spp. and *Fusarium* spp. (WHO, 1992; Klinger and Lapidot, 1993; Dhand *et al*., 1998; Hancock *et al*., 1998; Jeffrey *et al*., 1998; D'Mello, 2006).

The microbiology of animal feeds became imperative in view of the recent birds infections and diseases outbreak in Nigeria. The out break resulted in massive destruction of birds championed by the Federal Government of Nigeria. In addition, many poultry farmers have not recovered from the shock and huge financial losses created by the scenario. Therefore, this study focus on the microbiological and physicochemical qualities of selected commercial poultry feeds sold in Akure, Nigeria, with the aim of ascertaining the safe quality of the feeds.

MATERIALS AND METHODS

Sample collection: Bulk samples were obtained from selected five commercial poultry feed brands sold in Akure, Ondo State, Nigeria. The feeds sampled include Broiler Finisher (BF), Broiler Starter (BS), Broiler Super Starter (BSS), Grower Mash (GM) and Layer Top Mash (LTP). A standard commercial feed bag in the weights of 25 kg were sampled according to Solanitro *et al.* (1986). The samples were transported to the laboratory for analysis within 1 h.

Isolation and enumeration of associated microorganisms: The method used was that of Obuekwe and Ogbimi (1998). One gram of each of the sample was first measured and dissolved in 10 mL of sterile distilled water prior to serial dilution. One milliliter aliquot was diluted with 9 mL of sterile water in different test tubes to give 1:9 dilution. From this, ten-fold serial dilutions were made up to 10^{-4}. One milliliter of the sample was plated on nutrient agar for bacteria, EMB for coliform organisms and MSA for *Staphylococcus aureus*. Dilution of 10^{-2} was plated on SDA for fungi count. All the plates in triplicates were incubated at 37°C for 24 h for bacteria, while the plates for fungi were incubated at 30°C for 24-72 h.

Enumeration and identification of associated microorganisms: Colonies of microorganisms that developed on the plates after incubation were counted, recorded and expressed as standard numbers of colony forming unit per milliliter (cfu mL^{-1}) for bacteria and spore forming unit per milliliter (sfu mL^{-1}) for fungi. The discrete colonies that grew were subculture on fresh media to obtain pure cultures. The pure cultures were maintained at 4°C as stock culture for further tests. The bacterial isolates were characterized and identified using the methods of Holt *et al.* (1994) and Cowan and Steel (1990), while the fungal isolates were identified with the features described by Barnett and Hunter (1972).

Proximate analysis of the feed samples: The proximate analysis of each of the commercial feed samples was carried out according to the procedures of AOAC (1990) for ash, moisture, crude fibre, fat and protein content using nitrogen to protein conversion factor of 6.25. Carbohydrate was determined by difference.

Mineral analysis: The mineral content such as Na, K, Ca, Mg and P were determined for each of the CFS from ashing solution described by AOAC (1990) with Atomic Absorption Spectrophotometer (AAS).

RESULTS AND DISCUSSION

The total bacterial count was highest in BS with 2.50×10^4 cfu mL^{-1}, while the least bacterial count was recorded in LTM with 6.60×10^2 cfu mL^{-1} (Table 1). Also, LTM had the highest fungal count of 7.40×10^2 sfu mL^{-1} and the lowest count of 1.50×10^2 sfu mL^{-1} in GM (Table 1).

The occurrence of the microbial isolates in different Poultry Feeds (PF) consists of five bacteria, ten fungi and two yeasts (Table 2).

The moisture content ranged from 8.19 to 9.87%, ash 7.87 to 13.61%, fat 1.19 to 3.43%, crude fibre 2.60 to 10.30% and protein 12.03 to 22.03% (Table 3).

The observed high microbial counts in broiler starter, broiler finisher and broiler super starter (Table 1) agrees with the findings of Salanitro *et al.* (2006) and probably reflects the contamination picture of ingredients used in producing the feeds. The higher performance needed in broiler and egg production requires inclusion of animal proteins in these mashes, usually to elicit the animal protein factor effect in the birds (Aganga *et al*., 2000). Also, the use of animal protein ingredients especially cheap locally processed fish wastes has been reported to be an important vehicle for bacterial contamination of poultry feed ingredients (Jeffery *et al*., 1998).

Table 1: Microbial counts of the poultry feed samples

	Microbial count	
Feed sample	Bacteria (cfu mL^{-1})	Fungi (sfu mL^{-1})
Broiler finisher	1.46×10^4	2.30×10^2
Broiler starter	2.50×10^4	3.60×10^2
Broiler super starter	1.80×10^4	1.80×10^2
Grower mash	1.65×10^4	1.50×10^2
Layer top mash	6.60×10^2	7.40×10^2

Table 2: Occurrence of microbial isolates from the poultry feed samples

	Poultry feeds				
Microbial isolates	BF	BS	BSS	GM	LTM
Bacteria					
Aerobacter aerogenes	-	+	-	+	+
Bacillus cereus	+	+	+	-	-
Erwinia amylovora	+	-	-	+	-
Micrcoccus luteus	-	+	+	-	-
Staphylococcus aureus	+	+	+	+	+
Fungi					
Aspergillus flavus	+	+	+	+	+
A. fumigatus	+	-	-	-	+
A. niger	+	+	-	+	+
Acaulopa macrospore	+	+	-	-	-
Claudosporium fulvum	+	-	-	-	+
Doctchiza populae	-	-	-	-	+
Fusarium poae	-	+	-	+	+
Geotricum candidum	-	-	+	-	+
Pleurophrgmium sp.	-	-	-	-	+
Rhizopus stolonifer	-	+	-	+	-
Candida albicans	-	-	+	-	+
Saccharomyces cerevisiae	-	+	+	-	-

BF = Broiler Finisher, BS = Broiler Starter, BSS = Broiler Super Starter, GM = Grower Mash, LTM = Layer Top Mash, + = Present, - = Absent

Table 3: Proximate composition of the poultry feed samples

	Proximate composition (%)				
Feed sample	MC	AC	FC	CF	PC
Broiler finisher	8.87	12.24	3.43	5.34	12.03
Broiler starter	8.51	13.61	3.18	5.49	14.02
Broiler super starter	9.90	6.58	1.19	4.10	22.03
Grower mash	8.19	10.57	2.54	10.30	14.37
Layer top mash	9.87	7.87	1.03	2.60	13. 04

MC = Moisture Content, AC = Ash Content, FC = Fat Content, CF = Crude Fibre, PC = Protein Content

Table 4: Mineral composition of the poultry feed samples

	Minerals (ppm)				
Feed sample	K^+	Na^+	Ca^{2+}	Mg^{2+}	P
Broiler finisher	74590.16	41530.06	1748.63	603.28	3249.17
Broiler starter	77974.28	42068.60	1972.13	565.92	3204.59
Broiler super starter	54228.53	29757.24	830.77	244.32	2675.34
Grower mash	58823.53	32398.90	1654.41	375.00	3206.06
Layer top mash	88971.58	51759.13	2110.96	649.53	2651.52

ppm = Part per million

All the poultry feed samples examined showed the presence of microorganisms which include *Aerobacter aerogenes*, *Bacillus cereus*, *Erwinia amylovora*, *Micrococcus luteus*, *Staphylococcus aureus*, *Aspergillus flavus*, *A. fumigatus*, *A. niger*, *Acaulopa macrospore*, *Cladosporium fulvum*, *Dotchiza populae*, *Fusarium poae*, *Geotricum candidum Pleurophrgmium* sp., *Rhizopus stolonifer*, *Candida albican* and *Saccharomyces cerevisiae* (Table 2). The presence of these microorganisms in the poultry feeds, suggest that the feeds contain sufficient nutrients for the growth of these organisms. The activities of these microorganisms on the feeds under study may cause degradation, thereby reducing the nutrients that would have been wholly available for the livestock to feed on. This is in consonance with the report of Aganaga *et al.* (2000) on poultry feeds and the sensitivity pattern of the associated microorganisms. These microorganisms may probably have originated from the raw materials from which the feeds are being produced. In addition, most of the isolated microorganisms owned their origin from air and soils (Arotupin and Akinyosoye, 2001). D'Mello (2006) reported microbial contamination of poultry feeds of plant and animal origin to be due climatic conditions encountered, harvesting, processing, storage and transport technologies employed. However, package and packaging materials, environment and handling circumstances, including the nature and extent of the quality control measures greatly influenced the source and degree of contamination (Dessie, 1996; Hancock *et al*., 1998).

Most of the bacterial isolates are highly pathogenic in poultry industry. Dhand *et al.* (1998) and Hancock *et al.* (1998) separately implicated *Aerobacter aerogenes*, *Bacillus cereus*, *Erwinia amylovora*, *Micrococcus luteus* and *Staphylococcus aureus* in the microbial infection outbreak of poultry farming. The presence of *S. aureus*, a normal floral of the skin and nose portend an improper handling practices (Hancock *et al*., 1998) and component of soil particles (Eleke and Obidiugwu, 2001). The prevalence of toxigenic lipolytic moulds such as *A. flavus*, *A. fumigatus. A. niger*, *Fusarium poae* and *Rhizopus stolonifer* should be viewed with serious concern. More often than not, these organisms have been documented to be the most dominant of all the fungi in respect of mycotoxins production in poultry feeds (Henzler and Opitz, 1992; Dhand *et al*., 1998).

However, fungal isolates are more than bacterial isolates (Table 2) which may probably be as a result of the relatively low moisture content of the feeds (Table 3). Miosture content and ambient temperatures are key factors affecting fungal colonization of poultry feeds and the mycotoxins production in concentrates and compounded feeds (Hancock *et al*., 1998). The ability of the fungal isolates to transform into spores that can remain dormant for very long time may be accounted for their ecological success in poultry feeds.

The nutritional requirements of the poultry animals are essential for good performance. However, the qualities and proportion differ depending on the nature, purpose and age of the birds. The considerable percentage of ash, fat, crude fibre and protein content (Table 3) justify the feed types. These nutrients may as a matter of fact form nutrients for utilization by the contaminating microorganisms. Also, the feeds are high in mineral elements (Table 4). These elements play an important role in the development of the poultry animals including birds.

Aletor and Daramola (1989) reported the success of poultry production to depend largely on the quality of feeds, based on their nutrient formulation. Calcium, Zn, Mg and P are responsible for healthy bones, skin, feather development as well as strong egg shells and good hatching rate (Aganga *et al*., 2000; Cever and Yalcin, 2003).

This study revealed high microbial counts and the presence of pathogenic microorganisms in the different poultry feeds investigated. This tends to reflect the level of bio security and hygienic practices in the production, handling and storing of the feeds. Incorporation of feed additives into poultry feeds that would prevent microbial contamination should be encouraged. These findings emphasize the need for constant quality assessment of these commercial feeds on sale in order to maintain the production of microbiologically stable poultry feeds and poultry products for human consumption.

REFERENCES

Aganaga, A.A., U.G. Omphile, P. Malope, C.H. Motsamai, and L.G. Mostsumi, 2000. Traditional poultry production and commercial broiler alternative for small-holder farmers in Botswana. Livestock Res. Rural Dev., 12: 1-8.

Aletor, V.A. and A.C. Daramola, 1989. Government policies and feed mill industry in Nigeria. Food Policy, pp: 298.

AOAC, 1990. Official Method of Analysis. 15th Edn., Association of Official Analytical Chemists. Washington DC., USA.

Arotupin, D.J. and F.A. Akinyosoye, 2001. Evaluation of microbial isolates from sawdust for cellulose hydrolysis. Nig. J. Microbiol., 15: 97-102.

Bale, O.O., A.A. Sekoni and C.N. Kwanashie, 2002. A case study of possible health hazard associated with poultry house. Nig. J. Anim. Prod., 29: 1022-1111.

Barnet, H.L. and B.B. Hunter, 1972. Illustrated Genera of Imperfect Fungi. 3rd Edn., Burges Publishing Company Minneapolis, pp: 331.

Cevger, Y. and C. Yalcin, 2003. A qualitative model to determine factors affecting profits of broiler enterprises. Turk. J. Vet. Anim. Sci., 27: 1201-1205.

Cowan, S.T. and K.J. Steel, 1990. Manual for the Identification of Medical Bacteria. 4th Edn., Cambridge University Press, pp: 22-29.

Dessie, T., 1996. Study on village poultry production systems in the Central Highland of Ehtiopia. M.Sc. Thesis, Swedish Universitybof Agricultural Science, Uppsala Sweeden.

Dhand, N.K., D.V. Joshi and S.K. Jand, 1998. Contamination of dairy feeds and their toxigenicity. Indian J. Anim. Sci., 68: 1095-1096.

D'Mello, J.P.F., 2000. Anti-Nutritional Foods and Mycotixins. In: Farm Animal Metabolism and Nutrition. D'Mello, J.P.F. (Ed.), CABI Publishing, Wallingford, pp: 383-403.

D'Mello, J.P.F., 2006. Microbiology of animal feeds. Microbiology of Ensilage http:/www.fao.org/DOCREP/ARTICLE/AGRIPPA/556-EN.HTM.

Eleke, F.N. and C.C. Obidiugwu, 2001. Microbial contamination of some Nigerian herbal drugs sold in buses and market places in South Eastern Nigeria. Nig. J. Microbiol., 15: 1-5.

Hancock, D.D., T.E. Besser, D.H. Rice, E.D. Ebel, D.E. Herriott and L.V. Carpenter, 1998. Multiple sources of *Escherichia coli* 0157 in feed lots and dairy farms in the Northern USA. Preventive Vet. Med., 35: 11-19.

Henzler, D.J. and H.M. Opitz, 1992. The role of mice in the epizootiology of *Salmonella enteritidis* infections on chicken layer farmer. Avian Dis., 36: 625-631.

Holt, J.G., N.R. Kneg, P.H. Sneath, J.J. Stanly and S.T. Williams, 1994. Bergey's Manual of Determinative Bacteriology. Wilkins Publishers, Baltimore, pp: 783.

Jeffrey, J.S., J.H. Kirk, E.R. Atwill and J.S. Cullor, 1998. Prevalence of selected microbial pathogens in processed poultry waste used as dairy cattle feed. Poult. Sci., 77: 808-811.

Klinger, I. and M. Lapidot, 1993. Irradiation of poultry meat and its products IEA A-TEC DOC-688, Vienna.

Obuekwe, I.F. and A.O. Ogbimi, 1998. Contamination of drugs by microorganisms. Nig. J. Microbiol., 12: 13-17.

Solanitro, J.P., I.G. Fairchilds and Y.D. Zgornicki, 1986. Isolation, culture characteristic and identification of anaerobic bacteria from cicken ceacum. Toxicology Programme, Alabama USA., pp: 1-40.

Uwaezuoke, J.C., J.N. Ogbbulie and J.N. Njoku, 2000. Antibiotic sensitivity pattern of bacterial isolates from poultry feed. Int. J. Environ. Health Hum. Dev., 1: 23-38.

WHO, 1992. Report of WHO Consultation on National and Local Schemes of *Salmonella* Control in Poultry. WHO/CDS/VPH/92.110.

Wilson, J.E., 1990. Raw materials-Animal protein. Process. Soc. Feed Technol., 2: 26-31.