



PROXIMATE COMPOSITION AND MICROBIOLOGICAL QUALITY OF FIVE COMMERCIAL BROILER SUPER STARTER FEEDS SOLD IN JOS NORTH LGA OF PLATEAU STATE

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ABSTRACT

The study was conducted to determine the proximate composition and microbiological quality of five selected broiler super starter feeds in Jos North LGA of Plateau State. Five commercial broiler super starter feeds were purchased and designated as samples A, B, C, D and E. A batch of 300g of each feed sample was aseptically collected in plastic bags and analyzed for the proximate composition at the Chemistry Laboratory, Faculty of Natural Sciences, University of Jos. The feed samples were also assayed for microbial contamination (bacteria and fungi) at the Department of Microbiology, Faculty of Natural Sciences, University of Jos. The result of the analysis revealed that percentage crude protein of feed A was highest at 22.49% while feed D had the least crude protein of 18.13%. The metabolizable energy of feeds A, B, C and E were higher than 3000kcal/kg. Feed D was found to fall within the range of 2860-3000kcal/kg recommended for broiler starter chicks. The total plate count ranged from 0.88 to 1.28×10^5 CFU/g, coliform counts ranged between 1.40 to 3.20×10^4 CFU/g, and fungal counts 0.08 to 2.90×10^5 CFU/g. The high coliform count indicated that more attention is needed to improve feed storage practices, warehouse conditions, handling of products and duration of feed storage. The presence of pathogenic microorganisms in poultry feeds is indicative of the level of contamination which could possibly limit growth performance in chickens. Based on the results of this study, it can be concluded that, advocacy for periodic examination of feed nutritional quality and safety to prevent cross contamination of poultry products should be adhered to for profitable poultry production in and around the study area.

Keywords: Diet, Utilization, Poultry, Coliform, Microorganisms

INTRODUCTION

Quality assurance is a comprehensive programme of control directed at ensuring that feed production meets a predefined standard (Alaoma, 2016). Broiler super starter feeds are well fortified with nutrients, making them highly preferred by poultry farmers. Inadequacies have been reported in the quality of some commercial broiler starter feeds, leading to poor performance in chickens (Doma *et al.*, 2001; Uchegbu *et al.*, 2007). Poultry feeds are contaminated during processing, handling, mixing and exposure to microorganisms. Onyeze *et al.* (2013) asserted that most poultry diseases occur as a result of consumption of contaminated feeds. Diseases such as dysentery, fowl cholera, *salmonellosis*, *staphylococcosis*, *aflatoxicosis* amongst others are associated with ingestion of contaminated feeds (Aliyu *et al.*, 2016). Irrespective of the adequacy of nutrients in formulated rations, microbial contamination can result in competition for ingested nutrients in the GIT, leading to poor performance (Idachaba, 2017).

According to Aliyu *et al.* (2016), microorganisms also degrade nutritional value of feeds resulting in the production of toxins. The nature and presence of microorganisms in animal feeds is a major concern to animal nutritionists and poultry farmers because they cause



economic losses and affect animal health. Several researches have been carried out to determine some pathogenic microbial species contaminating poultry feeds (Sule and Ilori, 2017). Poultry get infected when pathogenic organisms are ingested during feeding as reported by Barnes *et al.* (2003). Thus, it is empirical to ensure that healthy feed ingredients as well as feeds are provided for chickens to improve their productive performance and gut health (Idachaba, 2017). Proximate analysis and determination of microbial contamination in poultry feeds can help to provide relevant information regarding the quality and safety of feeds for chickens. This study evaluated the proximate composition and microbial contamination of five (5) commercial broiler super starter feeds in Jos North LGA of Plateau State, Nigeria.

MATERIALS AND METHODS

Study Area

The study was carried out in Jos North LGA of Plateau State. It is located in the Northern Guinea Savannah between longitude 8° 20'N and latitude 9° 30'E. The average temperature ranges between 21-25°C. The climate of Jos is cool due to its high altitude with average annual rainfall of 1,250 mm (FCF, 2017).

Sample Collection

Five brands of broiler super starter feeds were purchased from retailers in Jos North LGA of Plateau State. Each feed sample was aseptically collected in triplicate in sterile plastic bags and labelled A, B, C, D and E.

Sample Analysis

The feed samples were analyzed for their proximate composition at the Chemistry Laboratory, Faculty of Natural Sciences, University of Jos. The analysis was carried out according to the procedures described by AOAC (2010). The feed samples were also cultured and isolated for selected microbial contamination at the Microbiology Laboratory, Department of Microbiology, Faculty of Natural Science, University of Jos. The determinations for bacterial and fungal counts were carried out according to procedures described by Quinn *et al.* (1992), Al-Natour and Alshwabkeh (2005) and Ochei and kolhatkar (2007). The number of bacteria in colony forming unit CFU per gram of sample was obtained by multiplying the number of colonies by the dilution factor. The colony count obtained in CFU was expressed in logarithmic transformations and analyzed statistically.

Data Analysis

Data obtained from microbial colony count was subjected to analysis of variance (ANOVA) using the General Linear Model (GLM) procedure of SAS (2001) software. Duncan's multiple range test (Duncan, 1955) was used to determine differences between means.

RESULTS

Proximate Composition of Five Commercial Broiler Super Starter Feeds

Table 1 shows the result of the proximate composition of five (5) commercial broiler super starter feeds. The result showed that feed A had a moisture content of 9.58% which is higher than other feed samples. Feed B had the lowest moisture content of 9.08%, while feed C, D and E showed moisture contents of 9.26, 9.63 and 9.38 respectively. Feed B showed the highest ash content of 9.5%, followed by feed E and D showing 8.8 and 7.9% respectively. Feed A showed ash content of 6.0%, while feed C showed the least ash content of 5.9%. Feed A showed the highest crude protein value of 22.49%, followed by feed E and D showing 22.25 and 20.37% crude protein levels respectively. Feed C showed a crude protein value of 19.44%, while feed B showed the lowest crude protein value of 19.13%.



The result further revealed that feed E had the highest Ether extract value of 6.3%, followed by feed B and A showing 4.8 and 4.4% ether extract respectively. Feed D showed ether extract value of 3.7, while feed C showed the lowest value of 3.6%. Feed B showed the highest crude fibre value of 4.70%, followed by feed E and D showing 4.30 and 3.90% crude fibre respectively. Feed A showed crude fibre value of 3.01%, while feed C showed the lowest crude fibre value of 3.00%. Feed C showed the highest Nitrogen free Extract value of 69.06%, followed by feed A and B showing 64.11% and 62.07% Nitrogen free Extract value respectively. Feed D showed Nitrogen free Extract value of 3.7%, while feed C showed the lowest value of 3.6%.

Table 1: Proximate Composition of Five (5) Commercial Broiler Super Starter Feeds

Parameters (%)	Feeds				
	A	B	C	D	E
Moisture content	9.58	9.08	9.26	9.63	9.38
Ash	6.00	9.50	5.90	7.90	8.80
Crude protein	22.49	19.13	19.44	20.37	22.25
Ether extract	4.40	4.80	3.60	3.70	6.30
Crude fibre	3.01	4.70	3.00	3.90	4.30
Nitrogen free extract	64.11	62.87	69.06	56.23	58.38

Metabolizable Energy (ME) Values of Feeds

Table 2 shows the result of the calculated metabolizable energy (ME) values of five (5) commercial broiler super starter feeds. The result shows that feed A has the highest metabolizable energy value of 3405.05kcal/kg, followed by feed C having a metabolizable energy value of 3368.50kcal/kg. Feed E and B had ME values of 3357.60 and 3245.00kcal/kg respectively, while feed D showed the least value of 2995.50kcal/kg.

Table 2: Calculated Metabolizable Energy (ME) Values of Five (5) Broiler Super Starter Feeds

FEEDS	Calculated ME values (Kcal/kg)
A	3405.05
B	3245.00
C	3368.50
D	2995.50
E	3357.60

Microbial Colony Count of Five (5) Commercial Broiler Super Starter Feeds

Table 3 presents the result of the microbial colony count of five (5) commercial broiler super starter feeds. Feed A showed significantly ($P \leq 0.05$) lower total plate count (0.88) compared to other feed samples. There was a significant ($P \leq 0.05$) difference in total plate count among other feed samples with feed D showing lower counts compared to feed B, C and E. No significant ($P \geq 0.05$) difference was observed in total plate count between feed samples C and E while the highest value was observed in feed sample B.

Feed C showed significantly ($P \leq 0.05$) lower coliform count (1.40) compared to other feed samples. There was a significant ($P \leq 0.05$) difference observed among other feed samples, with feed B showing the highest value. Feed A showed significantly ($P \leq 0.05$) lower fungal count (0.08) compared to other feed samples, and this was followed by feed D which showed significantly ($P \leq 0.05$) lower fungal count compared to feed B, C and E. No significant ($P \geq 0.05$)

difference was observed in fungal count between feed samples B and E, while the highest value was observed in feed sample C.

Table 3: Microbial Colony Count in Five (5) Commercial Broiler Super Starter Feeds

Microbial count (CFU/g)	FEEDS					SEM
	A	B	C	D	E	
Total plate count (10^5)	0.88 ^a	1.28 ^d	1.11 ^c	1.05 ^b	1.12 ^c	0.01
Coliform count (10^4)	2.60 ^d	3.20 ^e	1.40 ^a	1.60 ^b	1.90 ^c	0.06
Fungal count (10^5)	0.08 ^a	1.21 ^c	2.90 ^d	1.00 ^b	1.16 ^c	0.03

a, b, c, d, e = means with different superscript on the same row differs significantly, SEM- standard error of means, CFU/g- coliform forming unit per gram

Culture Media and Biochemical Tests for Isolated Bacteria Species in Selected Poultry Feeds

Table 4 shows the results of the culture media and biochemical tests for isolated bacteria species in selected poultry feeds. All feed samples were found to be contaminated with various bacteria species. Feed C had the least presence of bacteria species showing; *Staphylococcus aureus* and *Proteus spp.* This was followed by feed D and E showing contamination by three (3) bacteria species; *Staphylococcus aureus*, *Proteus spp.*, *Pseudomonas aeruginosa* and *Staphylococcus aureus*, *Proteus spp.*, *Salmonella typhi* respectively. Feed A had four (4) bacteria species which are; *Staphylococcus aureus*, *Proteus spp.*, *Pseudomonas aeruginosa*, and *Salmonella typhi*. Feed B had the highest number of bacteria species contamination; *Streptococcus faecalis*, *Proteus spp.*, *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *Salmonella para typhi* A.

Table 4: Culture Media and Biochemical Tests for Isolated Bacteria Species in Poultry Feeds

Feeds	Catalase	Coagulase	Urease	Indole	Oxidase	Motility	Slope	Butt	H ₂ S	Gas	Bacteria species present
A	+	+	+	-	+	+	Red	Yellow	+	+	<i>Staphylococcus aureus</i> , <i>Proteus spp.</i> , <i>Pseudomonas aeruginosa</i> , <i>Salmonella typhi</i> .
B	+	-	+	-	-	+	Red	Yellow	+	+	<i>Streptococcus faecalis</i> , <i>Proteus spp.</i> , <i>Staphylococcus aureus</i> , <i>Pseudomonas aeruginosa</i> , <i>Salmonella paratyphi</i> A.
C	+	+	+	-	-	+	Red	Yellow	-	+	<i>Staphylococcus aureus</i> , <i>Proteus spp.</i>
D	+	+	+	-	+	+	Red	Yellow	-	-	<i>Staphylococcus aureus</i> , <i>Proteus spp.</i> , <i>Pseudomonas aeruginosa</i> .
E	+	+	+	-	-	+	Red	Yellow	+	+	<i>Staphylococcus aureus</i> , <i>Proteus spp.</i> , <i>Salmonella typhi</i> .

KEY: Catalase + and Coagulase + = *Staphylococcus aureus*, Indole + = *Escherichia coli*, Urease + = *Proteus spp.*, Oxidase + = *Pseudomonas aeruginosa*, Triple sugar ion = Black = H₂S production = *Salmonella typhi*, Catalase + Coagulase - = *Streptococcus faecalis*

Fungi Species Isolated from Five (5) Commercial Broiler Super Starter Feeds

Table 5 shows the fungi species isolated from five (5) commercial broiler super starter feeds. Feed A, B, C and D had one fungal specie isolated, while E had two fungi isolates. The fungal isolates of feed A, B, C and D are; *Saccharomyces cerevisia*, *Trichoderma harzianum rifai*, *Rhizopus oryzae went*, and *Mucor ehrenb* respectively. The fungi species present in feed E are; *Penicillium spp*, and *Mucor ehrenb*.

Table 5: Fungi Species Isolated from Five (5) Commercial Broiler Super Starter Feeds

FEEDS	Fungi isolates
A	<i>Saccharomyces cerevisia</i>
B	<i>Trichoderma harzianum rifai</i>
C	<i>Rhizopus oryzae went</i>
D	<i>Mucor ehrenb</i>
E	<i>Penicillium spp</i> , and <i>Mucor ehrenb</i>

DISCUSSION

Proximate Analysis of Five (5) Commercial Broiler Super Starter Feeds

Moisture content (MC) of feeds determine the amount of water in the feed samples. It is an indicator of quality and a key to safe storage. High moisture content of feeds, high temperatures and poor aeration predisposes feeds to mycotoxins and spoilage (Prabakaran and Dhanapal, 2009). This could pose health problems to birds when such feeds are consumed (Ofori *et al.*, 2019). It was found that the highest and lowest moisture contents were 9.58 and 9.08% which were within the range of values obtained by Ofori *et al.* (2019) who reported moisture contents between 7.84 and 11.8% in commercial broiler feeds. The values obtained in this study were lower than 12% reported by Ghana Standard Authority (2007), thus indicating better keeping quality of the feeds as moisture contents above 12% could result to mycotoxin contamination. The crude protein content of feeds B, C and D (18.13, 18.44 and 20.37%) respectively were lower than 23% CP recommendation of NRC (1994). This was further stressed by Oladokun and Johnson (2012) who recommended that a dietary crude protein of 23% was ideal for broiler starter chicks.

The ash content of the feeds ranged from 6.0 to 9.5%. This is in agreement with the results obtained by Ofori *et al.* (2019) who reported ash content which ranges between 7.64 and 9.55% for broiler starter feeds. Ether extract ranged from 3.6 to 6.3%. This also agrees with the results obtained by Ofori *et al.* (2019) who reported fat content which ranged between 3.05 and 4.60% for broiler starter feeds. According to Marcus and Dan (2001), fat inclusion in poultry diets should range between 2-5%, but Oladokun and Johnson (2012) recommended a standard not above 4.0% for broiler starter feeds.

Crude fibre ranged from 3.00 to 4.70% which fell within the recommended level of 3-5% crude fibre content in broiler starter feeds. The results obtained in crude fibre content of the feeds did not agree with Alaoma (2016) who reported crude fibre value of 6.43% for commercial broiler starter feeds. It has been shown that inclusion of moderate quantity of fiber in diets for broilers may have positive effects on gizzard activity, leading to improved mixing of digesta and motility of gastro intestinal tract (Alaoma, 2016). Carré (2004) indicated that fibrous components of feeds had negative effects on growth performance in broiler chicks. Nitrogen-free extract ranged from 56.23 to 69.06%. These were lower than 78.90% reported by Bukar and Saeed (2015) for some commercial broiler starter feeds.



Metabolizable Energy (ME) Values of Five Commercial Broiler Super Starter Feeds

Feeds A (3405 kcal/kg), B (3245 kcal/kg), C (3368 kcal/kg), and E (3357 kcal/kg) showed high metabolizable energy values above the recommendation of 3000 kcal/kg by NRC (1994). High energy value of feeds particularly for chickens may affect feed intake and other performance indices as birds eat to first meet their energy requirements after which they withdraw from feed consumption (Idachaba *et al.*, 2019). Thus very high caloric yields in feeds may limit the ability of chickens to meet the requirements for other nutrients once that of energy has been met. These results were in agreement with the observations of Ofori *et al.* (2019) and Alaoma (2016), who reported ME values of 3419.98 kcal/kg and 3582.44kcal/kg respectively in some commercial broiler starter feeds.

Microbiological Contamination of Five Commercial Broiler Super Starter Feeds

Results of this study revealed a high microbial count and the presence of pathogenic microorganisms in the feed samples investigated. This could be attributed to poor handling and storage of the feeds either by producers or retailers. Coliforms are a group of *Enterobacteriaceae* that are able to ferment lactose rapidly (within 24 – 48 hours) producing acid and gas (FsanZ, 2018). Coliforms are able to survive and grow in feed processing environments where other pathogens (*Enterobacteriaceae*) may not. As such, their presence in feeds does not necessarily indicate faecal contamination. Their presence at high levels provides a warning that unhygienic feed handling may have occurred or processing was not effective according to the Food Standards Australia New Zealand (FSANZ, 2018). According to FSANZ (2018), ready to eat foods that have coliform count greater than 1×10^4 CFU/g is unsatisfactory, while counts between 10^2 to 10^4 is marginal, and counts less than 10^2 is satisfactory.

The result from this study showed a high coliform count ranging from 1.40×10^4 to 3.60×10^4 which is greater than the 1×10^4 CFU/g recommended by FSANZ (2018) and therefore unsatisfactory. The high coliform and bacteria counts observed in this study are also in agreement with the report of Sule and Ilori (2017) who assessed the microbiological contamination of some commercial poultry feeds. Their report showed a high microbial count ranging from 5.0×10^3 to 1.76×10^6 CFU/g. The likely cause of high coliform counts could be due to cross contamination from raw products or food handlers, inadequate processing, or poor storage conditions (FsanZ, 2018). The high coliform counts in this study indicated that more attention is needed in the storage strategies employed by poultry feed manufacturers, warehouses where ingredients are sourced and duration of feed storage. Okogun *et al.* (2016) reported that broiler starter and chick mash feeds are easily contaminated by microorganisms. This according to the authors is due to their high protein contents which serve as growth factors for contaminating organisms. Irrespective of the adequacy of nutrients in formulated rations, microbial contamination can result in competition for ingested nutrients in the GIT, leading to poor performance (Idachaba, 2017).

Uwaezuoke and Ogbulie (2008) reported that bacteria and fungi contamination of poultry feeds can result from exposure to microorganisms on field, in feed mills, during storage or poor sanitary practices in pens. Bacteria isolates of *Proteus sp.* was found in all feed samples and *Pseudomonas sp.* in feed samples A, B and D. This agrees with reports of Veldman *et al.* (1995) who stated that enterobacteriaceae are common contaminants of poultry feeds. All feed samples were contaminated by *Staphylococcus aureus* while feed samples A, B and E were contaminated by *Salmonella sp.* Idachaba (2017) reported that *Staphylococcus aureus* and *Salmonella sp.* can cause acute or chronic infections in poultry and other animals. The author further stressed that microorganisms from poultry feeds can attach to intestinal epithelium, thus competing with the host animal for ingested nutrients. *Staphylococcus aureus* is a leading cause of cutaneous bacterial infection (Ahmad *et al.*, 2018). Fowl Typhoid has been reported as one



of the most important diseases in commercial chicken industry, and it is caused by *Salmonella*. In poultry, *Salmonella* causes a variety of acute and chronic diseases including paratyphoid, pullorum, fowl typhoid, avian arizonosis, enterotoxigenic diarrhea, plague, shigellosis and many more (Mdemu *et al.*, 2016). *Proteus* is a sporadic bacterium that occasionally causes embryonic death, yolk sac infections, and mortality in young chickens, turkeys, and ducks (Saif, 2008), while *Pseudomonas aeruginosa* in chickens is associated with respiratory disorders, diarrhea and septicemia (Shukla, 2015).

The fungal species isolated in this study were; *Penicillium spp.*, *Trichoderma harzianum rifai*, *Rhizopus oryzae went*, *Mucor ehrenb* and *Saccharomyces cerevisia*. Diseases caused by *penicillium* infection are generally referred to as *penicillosis* (Egbuta *et al.*, 2017). The target site of *Penicillium* species are; eyes, respiratory tract, blood and skin, causing keratitis, asthma, pneumonia, skin lesions and anaemia (Egbuta *et al.*, 2017). *R. oryzae* commonly causes a disease known as mucormycosis characterized by growing hyphae within and surrounding blood vessels. If the conidia of *Trichoderma* molds are inhaled, they can interact with the airway epithelium of birds, and symptoms that follow includes sneezing, asthmatic attacks, prolonged coughing and infections of the lungs.

The bacterial and fungal species isolated from the feed samples in this study were found to be pathogenic and harmful. Only the fungal specie *Saccharomyces cerevisiae* have been stated to have no harmful effect and considered beneficial. Live *Saccharomyces cerevisiae* cultures have been identified as potentially conferring health advantages on the host when administered in adequate quantities. *S. cerevisiae* has long been exploited as a functional food and dietary supplement. According to Farid *et al.* (2019), *Saccharomyces cerevisiae* in the diet of broiler chicks increases both meat production and quality. This is an indication that the presence of *Saccharomyces cerevisiae* in feed sample A may be as a result of the willful introduction into the feed during processing by the manufacturer.

CONCLUSION AND RECOMMENDATION

The study observed that the proximate composition of the selected feed brands within Jos North LGA ranged from ideal to sub-optimal or above the recommended levels. It was also observed that all feed samples investigated were contaminated by microorganisms (bacteria and fungi). This may be due to poor handling and storage practices of the feeds from field to the retail shops. Ingestion of such contaminated feeds can affect productive performance in chickens with residual effects affecting humans where meat is improperly cooked. Based on the result of this study, there is a need to establish better quality control strategies for proper handling of feeds at retail shops and on-farm. Periodic examination of feeds for biosafety can reduce or prevent cross contamination of poultry products.

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