

## Chapter one

### 1.0 Introduction

Feed is the most expensive input in poultry production business, it accounts between 65 – 70 % of the total production cost (Abel Fas et al, 2015 and Maina. et al, 2012). *Banana sepientum L* is widely used all over the world as a fruit or sometimes as an important energy source (Honfo *et al.*, 2011). FAO (1975) reported that an estimated 7 to 10 million tons of the 36 million tons world banana production per year (20 to 30 %) could be recovered as animal feed.

The composition of Fresh bananas is rich in water (70-80%). Bananas have low concentrations of crude protein (5-6% DM), ether extract (1-3% DM) and minerals (2-4% DM). Crude fiber content is also low (3-5% DM). The peels account for 18-23% of the dry matter and contain more crude fiber, so removing them decreases the crude fiber down to 0-3% DM (Ly, 2004). Bananas are poor in lysine and sulphur-containing amino acids (Pérez, 1997). Tannins are the main antinutritional factor of bananas and are mostly contained in the peels. In addition to their antinutritional effects, particularly in monogastrics, banana tannins are responsible for the astringent taste of immature fruits, making them less palatable than mature fruits (Ly, 2004). Feeding bananas to animals has been relatively neglected. This

is largely because bananas are principally a human food, but is also partly attributable to the fact that their value as animal feed has not been adequately studied (Chenost et al, 1969 and FAO 1969). Few studies dealing with banana fruits in poultry feed. Early researches suggests that banana meal can be used in poultry diets but not more than 5 or 10% of the grain content should be replaced by the banana meal, as higher levels are detrimental to growth and feed efficiency (Göhl, 1982).

The total Sudanese consumption of banana is estimated as 36.9 thousand tones; all the quantity produced was consumed locally, although there was a 15% loss during and after harvesting was occurred (Hasusain et al, 2011). Bananas are rejected for being damaged and for being failing to meet quality standards making them potentially available to livestock.

Therefore, the aim of the present work was to study the effect of feeding rejected dried green banana on the performance of broiler chickens during the finishing period.

## Chapter Two

### 2.0 Literature Review

#### 2.1 Banana description and classification

The word “banana” is said to have its roots in the Arabic word “banan” which means “finger” (Wikipedia, 2006). Banana is a general term embracing a number of species or cultivars in the genus *Musa* of the family *Musaceae*. Most edible fruited bananas are usually seedless and belong to the species *Musa acuminata*, *Musa sapientum*, *Musa cavendishi*, *Musa paradisiaca*. Other species include *Musa balbisiana* of southern Asia which bears a seeded fruit. Banana (*Musa sapientum*) is a monocotyledonous plant that originated from the South – East Asian countries with two main species, *Musa acuminata* and *Musa balbisiana* from Malaysia and India respectively (Archibald, 1949 and Sharrock, 1996). Banana is one of the most widely grown tropical fruits, cultivated over 130 countries, along the tropics and sub tropic. Edible bananas are derived from *Australimusa* and *Eumusa* series which have different origins from same genus. Most of the edible bananas are either derived solely from *Musa acuminata* or are hybrid between two

wild diploid species, *M. acuminata* Colla and *M. balbisiana* Colla. Plant has an origin from India and eastern Asian region (Malaysia and Japan) and some varieties are found to be genetically linked with some species from Africa, Other varieties also exist naturally or developed by hybridisation, which have different nomenclatures (Simmond, 1962 and Robinson, 1996 )

## **2.2 Banana production in Sudan**

Bananas are today grown in every humid tropical region it is the world's second largest fruit crop of the world with an estimated gross production exceeding 139 million tons (FAO, 2010). Banana is the second largest produced fruit after citrus contributing about 16% of the world's total fruit production FAO (2009).

India is the largest producer of banana, contributing 27% of world's banana production ([indiastat.com/agriculture](http://indiastat.com/agriculture), 2009). Banana widely cultivated in Africa (Archibald, 1949; Adisa and Okey, 2009 and Anhwange, 2008).

In Sudan, banana is produced commercially in small and medium-scattered along the River Nile and its tributaries banks and in large

plantations at Kassala. The water resources are the Blue Nile River and in an aquifer system in the alluvial deposits of the Gash River. The cultivar “Dwarf Cavendish” covers most 95% of the plantation. Total Sudanese consumption of banana is estimated as 36.9 thousand tones; all the quantity produced was consumed locally, although there was a 15% loss during and after harvesting was occurred (Hussain, 2011).

### **2.3 Chemical composition of banana**

The composition of all banana varieties is determined chiefly by the degree of ripeness. Bananas have high water content (78 to 80 %). In the green state, in which they are generally picked and packed, the dry matter consists mainly of starch (72 %), which on ripening changes into simple sugars (saccharose, glucose and fructose). The cellulose content is low (3 to 4 %) and most of it is found in the skin. The inorganic fraction is poor, with low levels of Ca and P, but it is rich in K. Whether green or ripe, the banana has low protein content and is deficient in lysine and in the sulphur-containing amino acids (2.3– 2.9 g/16 g N) (Le Dividich et al 1976). However, during

ripening process, starch is converted into sugar, through enzymatic breakdown process (Yang and Hoffman,1984) .Starch content declines from 20-30% to 1-2%, but starch amount could be as high as 11% depending on variety. Sugar content of fully mature banana is quite high (Cheirsilp and Umsakul, 2008). Carbohydrate type in banana is resistant starch and non-starch polysaccharides, which have low digestibility (Lehmann and Robin, 2007),this property makes it an excellent ingredient for different functional and convenience foods (Aparicio et al., 2007).

Fat content in pulp remains almost constant (1%) during ripening process. Peel contains lipid (2.2-10.9 %) and is rich in poly unsaturated fatty acids, particularly linoleic acid and  $\alpha$ -linolenic acid (Emaga, et al., 2008).Ripe pulp contains pectin (0.7-1.2%) (Smith et al.,1989 and Emaga et al., 2008). Bananas are rich in phenolic compounds and flavanoids, which have antioxidant properties, Astringent taste of unripe banana is due to phenolic compounds. Bananas are also rich in dopamine, an antioxidant (Kanazawa and Sakakibara, 2000 and Alothman, et al., 2009). Rather than carotenoid synthesis pulp is rich in vitamin A, B-vitamins (thiamine, Riboflavin,

Niacin, Pantothenic acid, Pyridoxine, Folic acid and ascorbic acid,(Aurore et al.,2009).Bananas are rich in potassium and calcium and low in sodium content (Wall, 2006).Potassium is most abundant mineral present inedible portion of banana, followed by magnesium ,calcium, and phosphorus, the mount of iron is high, where as copper is found in very small quantity (Ruales et al., 1990). Bananas fruit contain 1.00 -2.5 grams of protein depending on variety ,altitude and climate, 28 grams carbohydrates, 2.8 grams fiber, 0.6 grams fat, 467 mg sodium, 1.00 mg potassium, 9.2 mg calcium, 44.1 mg of magnesium, 5.1% vitamin A, 20% vitamin C, vitamin B, 2.6% thiamine, 5.3% riboflavin, niacin 4% (Margen, 2002).While the waste like banana peel contain nutrients and minerals that are not much different from the banana fruit (Someya et al., 2002 and Hernawati, 2007).Chemical composition of banana peel was 10.09%, 18.01% crude fibber, fat, 5:17%, dry matter 55.59%, calcium 0.36%, Phosphor 0.10% and gross energy 3727 kcal/kg. Banana peel also contains vitamin C, E, and B6. (Faigin, 2001 and Adlin, 2008). Protein and mineral content of banana peel that is high enough to replace the lack of nutrients and minerals but has the high

crude fiber content and the presence of tannins in the banana peel that makes it difficult to digest. Banana peel is a major by product in pulp industry and its contains various bioactive compound like poly phenols cartenioids and others compound that are important in human and animal metabolism (Sundaram et al., 2011 and Mohapatra et al., 2010).Some amount of  $\beta$  –carotene found in pulp and peel of fruit (Englberger, et a al.,2003 and Wainwright and Hughes, 1989).Banana peel is a rich source of starch (3%), crude protein (6-9%), crude fat (3.8-11%) (Emaga et al., 2008) . total dietary fibre (43.2-49.7%), and polyunsaturated fatty acids, particularly linoleic acid and  $\alpha$ -linolenic acid, pectin, essential amino acids (leucine, valine, phenylalanine and threonine), and micronutrients (K, P, Ca, Mg). Banana peels are also a good source of lignin (6-12%), pectin (10-21%), cellulose (7.6-9.6%), hemicelluloses (6.4-9.4%) and galactouroninc acid. Pectin extracted from banana peel also contains glucose ,galactose, arabinose, rhamnose, and xylose (Emaga et al., 2008). Micronutrients (Fe and Zn) were found in higher concentration in peels compared to pulps (Davey et al.,2009).Emaga et al., (2007) reported that banana peels are rich in total dietary fiber



(40-50%) protein and a minor acids (8-11%) ,lipids and fatty acids (2.2% to 10.9%). Negesse et al., (2009) stated that banana peels contains (55g/kg DM) crude protein ,(163 g/kg DM) ash, (48/Kg DM) ether extract, (9.3 MJ/Kg) metabolizable energy and its dry matter was (124g/Kg).

## **2.4 Medicinal uses of banana**

Sharrock (1996) reported that banana is highly nutritious and easily digestible than many other fruits. The ripe fruit is laxative when eaten early in the morning , An excellent food for those anemic persons , having general weakness, jaundice, nervous breakdown, obesity, weak digestion and vitamin deficiency, also unripe fruit is good for diarrhea (Sampath et al., 2012). Banana is High in iron, so it can stimulate the production of hemoglobin in the blood and so helps in cases of anemia, vitamin B6 regulates blood glucose levels, banana is unique tropical fruit which is extremely high in potassium low in salt, making it perfect to beat blood pressure. Banana is high in fiber; including bananas in the diet can help restore normal bowel action, helping to overcome the problem without resorting to

laxatives. Bananas have a natural anti acid effect; banana can treat depression this is because bananas contain tryptophan, a type of protein that the body converts into serotonin which acts as anti-depressant, Bananas are a good source of vitamin C which helps to rebuild the immune system. Vitamin C also increases the absorption of iron and increases the formation of blood, also can act as an antioxidant (Faigin, 2001 and Adlin, 2008). Bananas are high in B vitamins that help calm the nervous system, potassium is a vital mineral, which helps normalize the heartbeat. Ethanol-based extracts of banana flowers inhibit the growth of pathogenic bacteria such as *Bacillus subtilis*, *Bacillus cereus*, and *Escherichia coli* and may help heal wounds and prevent infections (Sampath et al., 2012).

### **2.5 Utilization of banana fruit in poultry feeding.**

In spite of their high availability and good nutritive value, a few studies were performed on the inclusion of banana peels in broilers diet. The inclusion levels of banana peels in diets are somewhat limited because of the presence of tannins in the banana peel that makes it difficult to digest (Widjastuti and Hernawan, 2012).

Maximum inclusion rates of 7.5% and 10% dried banana peels have been suggested for broiler diets. Dried peelings replacing maize grain resulted in a significant decrease of the weekly weight gains when included at more than 7.5 % in the diet (Tewe, 1983). Oppositely, in another trial, live weight gain and feed conversion efficiency were significantly higher in chickens fed up to 10% banana peel meal in the diet. Feed intake increased linearly as the level of peels increase to 10%, after which growth decreased (Sabutan, 1996). Omole et al. (2008) reported no significant difference in the weight gain of weaned rabbit fed 15% peels in place of maize.

Abel fas et al (2015) stated that, the treated banana peel meal can be included in the broiler finisher feed up to 10% without any adverse effect on the growth performance of the broiler birds , it also positively leads to cost reduction in feed purchase thus a lowered cost of production and a better feed conversion ratio . they substitute the maize by banana peel meal at inclusion rate of 10 , 20 and 30% of the total diets , their results showed that , the final live weight and daily weight gain were reduced with increased rate of banana peel meal, their result also showed that feed intake was increased with increased

level of banana peel meal. Farman et al., ( 2016 ) studied the effect of feeding orange and banana peel on the growth performance of broiler, they concluded that ,the incorporation of banana peel into the broiler ration as a up to level of 3% is the most economical and has positive effect on growth performance, this result agreed with that obtained by Abel fas et al (2015) who stated that banana peel have no significant effect on feed conversion ratio but feed intake , carcass weight and dressing %, live body weight were significantly increased compared to the control group. Blandon et al,( 2015) substitute the yellow corn with banana peel at inclusion rate of 15 , 30 and 45% in broiler diets , they concluded that, the inclusion of banana peel level in the diets was not detrimental to growth performance carcass characteristics and hematological parameters. Feed intake and feed conversion ratio is also an advantage and should result in reduced feed cost , they concluded that the banana peel have promising application in broiler chickens feed, this result was disagreed with that stated by (Farman et al., 2016 and Abel fas et al., 2015). Their result also showed that there were no significant different on feed intake. Feed conversion ratio was reduced with increased inclusion % this

results were inconsistent with that obtained by (Farman et al., 2016) , their results also showed that , there were no significant different in liver , gizzard , heart and abdominal fat weight between the experimental groups, on the other hand, a significant differences in dressing % were observed, the control had the highest dressing percent compared to the treated . Adisa and Okey ( 2009) reported that inclusion of banana pulp meal in broiler diets at the levels of 7.5 , 15 and 22% led to improved growth performance, the best result was obtained when banana pulp was included in the ration at 22%. This result agreed with that obtained by Farman et al( 2016 ) and Abel fas et al (2015) who observed a significant improvement in total weight gain the same result disagreed with Blandon et al ( 2015) who noticed insignificant effect of feeding banana pulp on feed conversion ratio and dressing % .Tuti and Elvia (2012) study the utilization of banana peel in the ration and its influence on final body weight percentage of carcass and abdominal fat of broiler, the results showed that the use of a banana peel in the ration up to the level of 20 percent had no effect on final body weight percentage of carcass and abdominal fat percentage percent, but the use of 30 percent of banana

peel significantly decreased the final body weight, percentage of carcass and abdominal fat percentage. The meal from whole banana fruit contains less anti-nutritional factors (Onibon et al 2007) and it would appear that a much higher level might be included in the diet of chickens. However, there was a negative effect on growth of feeding the diet of banana fruit meal with duck. Göhl (1981) stated that high levels of banana fruit meal tended to depress growth rate and reduce feed efficiency, and so it is recommended that not more than 10% of the grain portion of the poultry diet should be replaced by banana fruit meal. Sharrock (1996) also reported that banana fruit meal has been used in poultry diets, but high levels in the diet also tend to depress growth and reduce feed efficiency.

## **Chapter Three**

### **3.0 Materials and Methods**

#### **3.1 Experimental Site and Duration**

The Experiment was conducted at the Animal Production Research Center, Poultry Department (Hillat Kuku, Khartoum North). Temperature ranged between 23.4°C - 26.7°C and relative Humidity was 66% The experimental was extended from 21 to 42 days of age.

#### **3.2 Experimental house.**

The experiment was conducted in a semi closed system of housing .The house was constructed of iron posts with two sides iron sheet slatted roof with concrete floor and 5 meter height, the house is about 45 meter in length covered with wire netting which is covered by plastic curtain along the two long axis of the house. The other two axes' (width) were completely closed with iron sheet. Four fans for ventilation and cooling pads for the incoming air were installed. The house was partitioned into 20 equal pens ( 4.5\*3.5 m ),Two pens were selected and cleaned, disinfected and partitioned into 12 experimental units of equal sizes (1\*1m) before the arrival of the

experimental birds , fresh wood shaving 5cm depth was spread as litter, one tubular feeder and 5 nipple drinker were provided in each replicate.

### **3.3 Experimental birds and management**

One hundred twenty 21 days old commercial broiler chickens ( Arbor Acres ) were randomly selected and weighed from 3000 birds. All birds were vaccinated against Infectious Bursal Disease (IBD ) (Gumboro) at 14 and 21 days old , Newcastle and Infectious Bronchitis (IB ) were administered at 6 and repeated at 26 days old .The experimental selected birds were randomly divided into four treatment groups (30 birds/each) in a completely randomized design, each treatment was further subdivided into 3 replicates (10 birds/each).The mean initial weight of the birds were nearly similar ( $782\pm 5$  g).Continues light was provided, experimental diets and water were provided for adlibitum consumption.



### **3.4 Experimental diets**

#### **3.4.1 Processing of rejected green banana**

Rejected green banana was collected from the central market of Shambat in plastic container, then washed and chopped into small circular slices then subjected to sun light for five days to dry. Appendixes (1, 2, 3 and 4). The dried green banana slices were ground into a powdery form using a hummer mill then chemically analyzed according to the AOAC (1970) methods (Table 1)

#### **3.4.2 Diets formulation**

Four experimental broiler finisher diets were formulated, Diet (A) serve as control diet which does not contained rejected dried green banana. Diets (B, C and D) contained rejected dried green banana with inclusion rate of 10% ,15 and 20 % respectively . The diets were formulated to meet the nutrient requirements for broiler finisher chickens as outlined by the National Research Council (NRC) (1994). Table (2) shows the composition and calculated analysis of the experimental diets.

### **3.5 Performance data collection.**

Performance data which include feed intake, body weight, and body weight gain and feed conversion ratio were recorded on weekly basis during the experimental period.

#### **3.5.1 Body weight (BW).**

Body weight was measured at the beginning of the experiment and repeated weekly at the beginning of each week at the same time.

#### **3.5.2 Body weight gain (WG)**

Weight gain was calculated by subtracting the body weight at the beginning of the week from the body weight of the next week.

#### **3.5.3 Feed intake (FI).**

Feed intake is the amount of feed consumed every week; it was calculated at the end of the week, the residual amount of feed was weighed and subtracted from the known weight of the feed given at the beginning of the week, the product was divided by the total number of the birds.

### **3.5.4 Feed conversion ratio (FCR)**

Feed conversion ratio (FCR) was calculated by dividing the amount of feed consumed over body weight gain.

Feed conversion ratio = Feed consumed (g) /weight gain (g)

### **3.5.5 Mortality.**

Mortality was recorded when occurred

### **3.5.6 Internal organs weight.**

At the end of the experiment and before slaughtering the birds were fasted for 12 hours two birds ( one male and one female) were randomly selected from each replicate and weighed , labeled and then slaughtered eviscerated. Heart , Spleen ,Liver, gizzard and abdominal fat weights were recorded. Dressing percent was calculated by dividing carcass weight over live body weight multiply by 100.

## **3.6 Statistical analysis**

The experiment was carried out in a complete randomize design (CRD).Collected data were subjected to analysis of variance (ANOVA ) according to general linear model procedure of SPSS soft

ware (SPSS,2001).Least significance difference (LSD ) test was used to assess the significance between means.

**Table (1) Chemical composition of rejected dried green banana**

Component (%)	(%)
Dry mater	95.1
*ME ( MJ / Kg)	13.96
Crude protein (CP)	7.5
Fat	4
Crude fiber (CF)	4
Ash	7.4
Calcium	1.2
Phosphorus	0.1

\*ME: was calculated according to the equation of Lodhi, et al (1976).

$$\text{ME ( Mj /Kg )} = ( 1.549 + 0.102\text{CP}+0.275\text{Oil}+0.148\text{NFE} ) - 0.034 \text{ C}$$

**Table ( 2) Composition of the Experimental Broiler Finisher Diets**

treatments Ingredients	Rejected green banana inclusion (%)			
	0	10	15	20
Sorghum	69.3	59.5	54.0	48.63
Ground nut cake	21	21.6	22.7	23.8
Wheat bran	2.2	1.7	1.2	0.5
*Broiler Concentrate	5	5	5	5
Rejected dried green banana	0	10	15	20
Lime stone	1.7	1.4	1.3	1.25
Lysine	0.2	0.2	0.2	0.21
Methionine	0.1	0.1	0.1	0.11
Na C l	0.3	0.3	0.3	0.3
Antitoxin	0.2	0.2	0.2	0.2
Total	100	100	100	100

\*Broiler concentrate Kafi chemical contained :Crude protein 35% ,  
 Crude fiber 6.0% , Crude fat 2.5% , Calcium 5.0% , Av .phosphorus  
 4.4% , Lysine 10.0% , Methionine 3.0% , Meth + Cyst 3.41% and  
 Metabolizable energy 2000 Kcal / kg .

**Table (3): Calculate Analysis of the Experimental Broiler Finisher Diets.**

Nutrients	Rejected green banana inclusion (%)			
	0	10	15	20
ME( MJ/kg)	13.51	13.48	13.47	13.47
Crude protein ( % )	21.44	21.00	21.02	21.02
Lysine ( % )	1.17	1.16	1.16	1.17
Methionine ( % )	0.48	0.46	0.46	0.46
Crude fiber ( % )	4.77	4.87	4.96	5.02
Calcium ( % )	1.06	1.07	1.09	1.14
A v. phosphorus ( % )	0.59	0.57	0.57	0.54

## **Chapter Four**

### **4.0 Results**

#### **4.1 Chemical composition of rejected dried green banana.**

The proximate chemical composition of rejected dried green banana used in the present work is reported in Table 1. Rejected dried green banana was found to contain 95.1 % DM, 13.96 MJ/Kg ME, 7.5 % CP, 4% fat , 4% CF, 7.4% Ash 1.2 % Ca and 0.1% P.

#### **4.2 Effect of feeding rejected dried green banana on weekly feed intake (g/ bird).**

The results of mean weekly feed intake are presented in Table (4), weekly feed intake of birds fed on tested levels (10, 15 and 20 %) was significantly higher compared to the control group in the 6<sup>th</sup> week .However, no significant effect were observed in the 4<sup>th</sup> and 5<sup>th</sup> weeks between all treatments.

#### **4.3 Effect of feeding rejected dried green banana on weekly weight gain (g/bird).**

As presented in Table (5), the weekly weight gain of the control group and the birds fed diet containing 10 and 15 % rejected dried green banana were significantly (  $P < 0.05$  ) higher than the birds fed



20% during the 4<sup>th</sup> week. The result also revealed that weight gain was significantly decreased when the level of rejected dried green banana was increased during the 5<sup>th</sup> week in comparison with those fed the control diet, in contrast during the 6<sup>th</sup> week weight gain was significantly improved when the level of feeding rejected dried green banana reached increased.

#### **4.4 Effect of feeding rejected dried green banana on weekly feed conversion ratio (g feed / g gain).**

The results of the mean weekly feed conversion ratio are presented in Table (6). Highly significant differences ( $P < 0.05$ ) were noted between the tested and the control treatments during the 4<sup>th</sup> and 5<sup>th</sup> week, in that FCR was positively increased when the rate of inclusion of rejected dried green banana was increased, but no significant differences were observed during the 6<sup>th</sup> week.

#### **4.5 Effect of feeding rejected dried green banana on weekly body weight (g/bird).**

The results of the mean weekly body weight are presented in Table (7). During the 4<sup>th</sup> and 5<sup>th</sup> week a highly significant differences ( $P < 0.05$ ) were observed between the birds fed 0.0, 10 and 15 rejected dried green banana and those fed 20% in that body weight was

significantly decreased when the level of rejected dried green banana increased. On the other hand, no differences were noticed during the 6<sup>th</sup> week between all treatments.

#### **4.6 Effect of feeding rejected dried green banana on the overall performance of broiler finisher chicks.**

The overall performance results revealed that feeding rejected dried green banana had no significant effect on feed intake and weight gain but a highly significant effects on body weight and feed conversion ratio were observed (Table 8).

#### **4.7 Effect of feeding rejected dried green banana on some internal organs and abdominal fat weight and dressing percent.**

The results of the effect of feeding rejected dried green banana on gizzard, liver, spleen, heart, abdominal fat weight and dressing percent are presented in Table (9). The results indicated that feeding 20% rejected dried green banana significantly increase gizzard weight, but no differences were recorded in Liver, spleen, Heart, and abdominal fat weight between the birds fed the control diet and those fed different levels (10, 15 and 20%) rejected dried green banana.

Feeding rejected dried green banana resulted in highly significant differences in dressing percent between the birds fed (0.0 and 15%) and those fed diets contained (10 % and 20%) rejected dried green banana.

**Table (4) Effect of feeding rejected dried green banana on weekly feed intake (g/bird)**

Treatments Weeks	Rejected dried green banana inclusion (%)				Level of sig.
	0.0	10	15	20	
Wk4	821±0.05	824±0.01	832±0.02	816±0. .03	NS
WK5	1041±0.04	1081±0.42	1108±0.03	1034±0.05	NS
Wk6	1119 <sup>c</sup> ±0.06	1214 <sup>b</sup> ±0.03	1224 <sup>b</sup> ±0.18	1273 <sup>a</sup> ±0.02	**

Values are means of 30 birds / treatment

Means within the same rows followed by different litters are significantly different.

NS: Not significant.

\*\* Highly significant ( $P < 0.05$ )

**Table ( 5 ) Effect of feeding rejected dried green banana on weekly weight gain (g/bird)**

Treatment Weeks	Rejected dried green banana inclusion (%)				Level of sig.
	0.0	10	15	20	
WK4	484 <sup>a</sup> ±0.02	453 <sup>a</sup> ±0.01	460 <sup>a</sup> ±0.01	410 <sup>b</sup> ±0.02	**
WK5	667 <sup>a</sup> ±.06 0	581 <sup>b</sup> ±.010	524 <sup>b</sup> ±.02 0	430 <sup>c</sup> ±0.04	**
WK6	531 <sup>d</sup> ±.09 0	567 <sup>c</sup> ±0.02	625 <sup>b</sup> ±.06 0	745 <sup>a</sup> ±0.07	*

Values are means of 30 birds / treatment

Means within the same rows followed by different letters are significantly different.

\*\* Highly significant( P < 0.05)

\* Significant( P < 0.05 )

**Table ( 6 ) Effect of feeding rejected dried green banana on weekly feed conversion ratio (g feed/g gain)**

Treatments weeks	Rejected dried green banana inclusion (%)				Level of sig.
	0.0	10	15	20	
WK4	1.70 <sup>c</sup> ± .00	1.82 <sup>b</sup> ±.04	1.81 <sup>b</sup> ±.03	1.99 <sup>a</sup> ±.09	**
WK5	1.57 <sup>b</sup> ±.16	1.86 <sup>b</sup> ±.10	2.11 <sup>a</sup> ±.06	2.42 <sup>a</sup> ±.26	**
WK6	2.14 ±.26	2.14 ±.05	1.97 ±.16	1.72±.17	NS

Values are means of 30 birds / treatment

Means within the same rows followed by different litters are significantly different.

NS: Not significant.

\*\*Highly significant (P < 0.05).

**Table ( 7 ) Effect of feeding rejected dried green banana on weekly body weight (g/ bird)**

Treatment Weeks	Rejected dried green banana inclusion (%)				
	0.0	10	15	20	Level of sig.
WK4	1268 <sup>a</sup> ±.02	1239 <sup>a</sup> ±.01	1240 <sup>a</sup> ±.0		**
WK5	1935 <sup>a</sup> ±.04	1820 <sup>b</sup> ±.01	1764 <sup>b</sup> ±.0		**
WK6	2466±.06	2387±.02		2365 ±.06	NS

Values are means of 30 birds / treatment

Means within the same rows followed by different letters are significantly different.

NS: No significant difference.

\*\*Highly significant different (P < 0.05).

**Table (8) Effect of feeding rejected dried green banana on the overall performance of broiler finisher chicks**

Treatment parameters	Rejected green banana inclusion (%)				
	0.0	10	15	20	Level of sig.
Feed intake (g/ bird )	993±0.04	1038±0.01	1.058±0.03	1040±0.02	NS
Weight gain (g/bird )	560±0.02	538±0.01	540±0.02	527±0.03	NS
Body weight(g/bird )	1890 <sup>a</sup> ±0.02	1817 <sup>b</sup> ±0.01	1800 <sup>b</sup> ±0.03	1723 <sup>c</sup> ±0.03	**
Feed conversion ratio(g feed/g gain)	1.77 <sup>b</sup> ±0.03	1.93 <sup>a</sup> ±0.04	1.96 <sup>a</sup> ±0.04	1.97 <sup>a</sup> ±0.10	**

Values are means of 30 birds / treatment

Means within the same rows followed by different litters are significantly different.

NS: Not significant.

\*\* Highly significant (P<0.05)



**Table (9) Effect of feeding rejected dried green banana on some internal organs, abdominal fat weight and dressing percent**

Parameters	Rejected dried green banana inclusion (%)				
	0.0	10	15	20	Level of sig.
Gizzard(g)	42.12 <sup>b</sup> ±2.1	45.15 <sup>b</sup> ±2.	42.79 <sup>b</sup> ±4.	52.39 <sup>a</sup> ±4	*
Liver(g)	46.66±7.42	40.12±2.2	39.36±1.5	43.88±6.	NS
Spleen(g)	2.42±.64	1.94±.41	2.27±.28	2.15±.28	NS
Heart(g)	11.68±1.10	9.64±.96	11.21±1.1	12.02±1.	NS
Abdominal fat (g)	35.10±1.20	31.52±5.8	36.91±6.5	33.40±9.	NS
Dressing (%)	71.30 <sup>a</sup> ±.26	69.68 <sup>b</sup> ±.6	71.14 <sup>a</sup> ±.6	68.52 <sup>b</sup> ±.	**

Values are means of 30 birds / treatment

Means within the same row followed by different letters are significantly different.

NS: Not significant.

\*\*Highly significant (P< 0.05)

\*Significant (P < 0.05)

## **Chapter Five**

### **Discussion**

Very few studies were conducted for the inclusion of banana meal in broiler diets, but according to Onu et al (2011), the nutritive value of feed ingredients used in feeding poultry should be determined in term of nutrient content and availability. The results obtained for the dried green banana analysis showed that the crude protein (7.5%) and crude fiber 4% were higher than (1.0-2.5CP %) and (2.8% CF) reported by Margen (2002). This could be due to the differences in banana varieties and/or climate.

The results of the broiler performance showed that there were no significant differences ( $P < 0.05$ ) in feed intake and body weight gain values between the groups fed rejected dried green banana compared to their relative control groups. This result disagree with that reported by Abel fas et al (2015) who found that body weight gain was decreased and feed intake increased with increasing inclusion rate of banana peel meal. Farman et al (2016) also stated the same result. Similarly Adisa and Okey (2009) found that feed intake was increased as the level of banana pulp increased. The present study result in line

with the result of Blandon, et al ( 2015) who reported that banana meal have no significant effect for feed intake and body weight gain. The groups fed diets containing 10, 15 and 20% rejected dried green banana recorded the significantly ( $P<0.05$ ) highest feed conversion values meaning worst conversion ratios as compared to the control group this may be due to the high crude fiber content of banana and the presence of tannins in the banana peel that makes it difficult to digest (Sundaram, et al, 2011).Furthermore, Göhl (1981) stated that high levels of banana fruit meal tended to depress growth rate and reduce feed efficiency, and so it is recommended that not more than 10% of the grain portion of the poultry diet should be replaced by banana fruit meal. Sharrock (1996) also reported that banana fruit meal has been used in poultry diets, but high levels in the diet also tend to depress growth and reduce feed efficiency.

Regarding the carcass traits results there were no significant differences ( $P<0.05$ ) in liver, spleen, heart weights and abdominal fat between all of the experimental groups. On the other hand, gizzard weight was significantly increased with the increasing rate of rejected dried green banana. The dressed weight of broiler fed 15% rejected

dried green banana did not differ significantly ( $P < 0.05$ ) with respect to control. Whereas increasing the level of rejected dried green banana to 20% resulted in a highly significant ( $P < 0.05$ ) reduction in dressed weight, body weight and increased feed conversion ratio, similar result was noticed by Sharrock (1996) who reported that banana fruit meal has been used in poultry diets but high levels in the diet tend to depress growth and reduce feed efficiency. Moreover, tannins in banana are only slightly polymerized in the green fruit and therefore inhibit the action of enzymes (Dividich, et al., 1976). In contrast no significant differences in final body weight was reported by Farman, et al ( 2016 ) and Blandon, et al ( 2015).

## **Chapter Six**

### **6.0 Conclusion and Recommendation**

#### **6.1 Conclusion**

Based on the results of the this study rejected dried green banana can be incorporated in broiler finisher diet up to 15% without adverse effect on feed intake, weight gain, liver, spleen, heart and abdominal fat weight

#### **6.2 Recommendation**

Further research will be required on feeding rejected dried green banana with enzymes on performance and cost effectiveness of broiler production.

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pendix (1)





Appendix (2)



Appendix (3)



Appendix (4)

