ABSTRACT
A study was conducted to evaluate the organ weights and biochemical indices of broiler chickens fed diets containing varying levels of Saccharomyces cerevisiae. One hundred and twenty (120) broiler birds were used for the experiment. The birds were weighed and randomly allocated into four treatment groups. Each treatment containing varying levels of Saccharomyces cerevisiae. One hundred and twenty (120) broiler birds were used was replicated three times with 10 birds per replicate. Treatment 1 served as the control and did not contain any S. cerevisiae supplement, while treatments 2, 3 and 4 contained 0.7, 1.2 and 1.7 g/kg of S. cerevisiae supplement, respectively. The experiment lasted for eight weeks. At the end of the feeding trial (day 56), two birds were randomly picked from each replication for carcass evaluation and another two birds were randomly selected from each pen and 5ml blood was collected from the wing vein using sterile disposable syringe for biochemical analysis. The result of this study showed that there were no significant (p > 0.05) differences among treatments in total protein, globulin and high density lipoprotein levels while albumin, total cholesterol, glucose and triglyceride were significantly (p < 0.05) affected. In T3 significant (p > 0.05) differences among treatments existed in the heart, gizzard and liver weights. The study also revealed that there were no differences among treatments in kidney, spleen and pancreas weights while significant (p < 0.05) differences in kidney, spleen and pancreas weights while significant (p < 0.05) differences among treatments existed in the heart, gizzard and liver weights. The study also revealed that there were no significant (p > 0.05) differences among treatments in total protein, globulin and high density lipoprotein levels while albumin, total cholesterol, glucose and triglyceride were significantly (p < 0.05) affected. In T3 highest heart weight (0.33 % of live weight) and lowest blood cholesterol concentration (91.77 mg/dl) were recorded and therefore T3 was recommended. Low blood cholesterol enhances broiler production.

Key words: albumin, cholesterol, kidney, liver, yeast

INTRODUCTION
There is a public and scientific concern about the widespread use of antibiotics and the possibility for transfer of antibiotic resistance to human pathogenic bacteria (Parvez et al., 2006). In addition, the presence of antibiotic residues in the meat may have deleterious effect on human consumers. For these reasons the European Union banned the use of antibiotics for non-therapeutic purposes in January 01, 2006. It is therefore imperative to find safe alternatives to the use of antibiotics. Hence, alternatives like probiotics are being used in poultry feed to improve production performance (Onifade, 1998). Probiotic is defined as a live microbial feed supplement which beneficially affects the host animal by improving its intestinal microbial balance (Fuller, 2001). Yeast has been used as a probiotic in animal feed (Saegusa et al., 2004). Saccharomyces cerevisiae, one of the most widely commercialized type of yeast, has long been fed to poultry. Saccharomyces cerevisiae is a rich source of protein, vitamin B complex, trace minerals and many other beneficial factors (Reed and Nagodawithana, 1991). It can improve body weight gain, feed efficiency, stimulate the immunity system and increase its defensive activity against pathogenic bacteria and also reduces feed cost by shortening the length of feeding (Mohamed et al., 2015; Patane et al., 2017). Lutful Kabir (2009) stated that the yeast acts by (i) maintaining normal intestinal microflora by competitive exclusion and antagonism (ii) altering metabolism by increasing digestive enzyme activity and decreasing bacterial enzyme activity and (iii) stimulating the immune system. The study was designed to evaluate the effects of dietary inclusion of Saccharomyces cerevisiae on organ weights, and biochemical indices of broiler chickens.

MATERIALS AND METHODS
The study was carried out at the Poultry Unit of the Department of Animal Science Teaching and Research Farm, University of Nigeria, Nsukka. The study lasted for eight weeks. The experimental procedures complied with the provisions of the University of Nigeria, Nsukka Ethical Committee on the Use of Animals for Biometric Research.
Experimental Animals and Management

One hundred and twenty commercial broilers of Anak strain were used for the study. The birds were weighed and randomly allocated into four treatment groups having 30 birds per treatment in a completely randomized design. Each treatment was replicated three times with 10 birds per replicate. Treatment 1 served as the control and does not contain Saccharomyces cerevisiae, while treatments 2, 3, and 4, respectively contained 0.7, 1.2, and 1.7 g/kg of S. cerevisiae supplementation. Broiler starter and finisher diets were formulated. The percentage of ingredients composition used in formulating starter and finisher rations are shown in Table 1. Clean water and feed were provided ad libitum. The required drugs and vaccinations were administered appropriately according to the vaccination routine for broilers. Other health precautions and disease control measures were taken throughout the study period. The experimental diets were assayed for proximate composition (Table 2) by the method of the Association of Official Analytical Chemist (AOAC, 1995).

Relative Organs Weights

At the end of the feeding trial (on 56 day of age), two birds were randomly picked from each replication for carcass evaluation. The birds were slaughtered after being starved for about 12 hours and weighed. These birds were de-feathered completely and eviscerated. The kidney, pancreas, heart, liver, gizzard and spleen were collected, weighed and their percentages were determined in relation to live weight.

Blood Collection

Six birds were randomly selected from each treatment at the end of the experiment and 5ml blood was collected from each bird, from the wing vein using sterile disposable syringe and emptied into sample bottles for biochemical analysis. The total protein concentration was determined using the Tietz (1995) method while the serum albumin concentration was determined using the method of Grant et al. (1987). The determination of the plasma globulin level was by the following formula:

\[
\text{Plasma globulin} = \text{Total protein} - \text{Plasma albumin}
\]

The total plasma cholesterol, high density lipoprotein, glucose and triglycerides were determined by adopting the protocol outlined in the manufacturer’s assay kit from M/s Randox Laboratories Ltd, Ardmore, Co. Antrim, UK.

Statistical Analysis

Data collected were subjected to one-way model of analysis of variance in a completely randomized design as described by Steel and Torrie (1980) using Statistical Package for the Social Sciences (2003). Significant differences between treatment means were separated using Duncan’s New Multiple Range Test (Duncan, 1955). The treatment effects were considered significant at \( p < 0.05 \).

RESULTS

Organ Weights

The results of the effects of Saccharomyces cerevisiae supplementation on internal organs of broilers are shown in Table 3. There were significant \( (p < 0.05) \) differences among the treatments in heart, liver and gizzard weights while no significant \( (p > 0.05) \) difference existed in kidney, pancreas and spleen weights. The relative heart weight value of birds on T3 diet was the highest while the least value was recorded on T1. The liver weights values of birds on T3 and T4 diets were similar but were significantly \( (p < 0.05) \) higher than those of birds on T1 and T2 diets. The gizzard weight of birds on T1 (control) diet was lower than those of birds on other treatment groups.

Biochemical Indices.

The effects of S. cerevisiae supplementation on biochemical indices of broilers are shown in Table 4. There were significant \( (p < 0.05) \) differences among the treatments in total cholesterol, albumin, glucose and triglycerides while no significant \( (p > 0.05) \) differences existed among treatments in total protein, globulin and high density lipoprotein. Birds fed diets without S. cerevisiae supplementation had the highest \( (p < 0.05) \) cholesterol, albumin, glucose and triglycerides concentrations.

Table 1: Percentages of ingredients used in starter and finisher rations formulation

| Ingredients         | Starter (%) | Finisher (%) |
|---------------------|-------------|--------------|
| Maize               | 30.00       | 28.62        |
| Wheat offal         | 12.00       | 28.62        |
| Palm Kernel Cake    | 20.00       | 18.13        |
| Soyabean meal       | 29.50       | 18.13        |
| Fish meal           | 4.00        | 2.00         |
| Lysine              | 0.25        | 0.25         |
| Methionine          | 0.25        | 0.25         |
| Premix              | 0.50        | 0.50         |
| Salt                | 0.50        | 0.50         |
| Oyster shell        | 3.00        | 3.00         |
| Total               | 100.00      | 100.00       |
| Calculate Crude protein | 23.30   | 19.50        |
| Metabolizable energy (kCal/kg) | 2880.00 | 3008.00 |

Table 2: Proximate composition of the experimental diets

|                | Starter (%) | Finisher (%) |
|----------------|-------------|--------------|
| Crude protein  | 23.42       | 20.85        |
| Ash            | 5.33        | 6.13         |
| Ether extract  | 4.39        | 5.74         |
| Crude fibre    | 2.10        | 2.62         |
| Moisture       | 8.72        | 7.90         |
| Nitrogen free extract | 56.04 | 56.76        |
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Table 3: Organs weights of broiler chickens fed diets supplemented with Saccharomyces cerevisiae

| Parameters                  | T1 (control) | T2 (0.7 g/kg SC) | T3 (1.2 g/kg SC) | T4 (1.7 g/kg SC) | SEM |
|-----------------------------|--------------|------------------|------------------|------------------|-----|
| Internal organs (% of live weight) |              |                  |                  |                  |     |
| Heart                       | 0.19         | 0.28             | 0.33             | 0.27             | 0.06|
| Liver                       | 0.61         | 0.60             | 0.79             | 0.78             | 0.12|
| Kidney                      | 0.18         | 0.17             | 0.21             | 0.19             | 0.08|
| Pancreas                    | 0.15         | 0.16             | 0.18             | 0.17             | 0.07|
| Gizzard                     | 1.38         | 1.63             | 1.65             | 1.68             | 0.04|
| Spleen                      | 0.12         | 0.10             | 0.16             | 0.18             | 0.02|

Means on the same row with different superscript are significantly different (p < 0.05);
SEM: standard error of the mean
SC: Saccharomyces cerevisiae

Table 4: Biochemical indices of broiler chickens fed diets supplemented with Saccharomyces cerevisiae

| Parameters       | T1 (control) | T2 (0.7 g/kg SC) | T3 (1.2 g/kg SC) | T4 (1.7 g/kg SC) | SEM |
|------------------|--------------|------------------|------------------|------------------|-----|
| Total protein    | 3.07         | 2.87             | 3.19             | 2.99             | 0.43|
| Albumin (g/dl)   | 1.53         | 1.23             | 1.02             | 1.26             | 0.20|
| Total cholesterol (mg/dl) | 137.07 | 108.77 | 91.77 | 110.57 | 6.80|
| HDL (mg/dl)      | 86.83        | 97.73            | 85.63            | 95.23            | 5.10|
| Glucose (mg/dl)  | 215.5        | 175.6            | 143.7            | 137.4            | 6.40|
| Globulin (g/dl)  | 1.54         | 1.64             | 2.17             | 1.73             | 0.29|
| Triglyceride (mg/dl) | 65.13     | 55.22            | 45.25            | 44.33            | 4.21|

Means on the same row with different superscript are significantly different (p < 0.05);
SEM: Standard error of the mean
SC: Saccharomyces cerevisiae

**DISCUSSION**

**Organ Weights**

The present results agree with that of Dimcho et al. (2005) and Onwurah and Okejim (2014) who reported improvements in liver, gizzard and heart of broilers, mules and ducklings by supplementing diets with probiotics. The increase in the gizzard and liver weights may suggest increased digestibility and metabolism and hence a higher efficiency of feed and nutrients utilization. The present results are in accordance with the findings of Mandal et al. (1996), who stated that there was no effect on kidney and pancreas weights when broilers were fed diets supplemented with probiotics.

However, the result of this study is in contrast with the findings by Hussein and Selim (2018) who reported that dietary probiotic supplementation did not increase the liver weights of broiler chickens. The observed inconsistency might be attributed to the strains of probiotic, technique of preparation, administration dosage, diet composition and hygienic status (Zhang et al., 2012).

**Biochemical Indices**

The results of present study are consistent with Paryad and Mahmoudi (2008) and Gudev et al. (2008) who found that broiler chicks fed ration containing S. cerevisiae had significantly lower plasma cholesterol, albumin and triglycerides. Probiotics could contribute to the regulation of serum cholesterol concentrations by deconjugation of bile acids (Paryad and Mahmoudi, 2008). Since the excretion of deconjugated bile acids is enhanced and cholesterol is its precursor, more molecules are spent for the recycling of bile acids (De Smet et al., 1994). As a result of increased synthesis of this acid, it is expected that the level of serum cholesterol to be reduced. Klaver and Van Der Meer (1993) suggested that co-precipitation with bile acids might be of importance for decreasing the levels of cholesterol in the blood of broiler chickens by affecting their absorption and metabolism (Klaver and Van Der Meer, 1993). Besides, it might have helped in binding the cholesterol to the cellular surface and incorporated in the cellular membrane during growth (Chiang et al., 2008).

The results of the present study are also in line with Konca et al. (2009) who reported that inclusion of yeast into diets of turkey toms does not affect serum levels of total protein and globulin. In contrast to our result, Konca et al. (2009) and Yalcin et al. (2013) reported that inclusion of yeast into diets of turkey toms does not affect serum levels of triglycerides. The result of the present study also disagrees with Babu et al. (2016) who reported that yeast supplementation in the diet of broilers significantly increased glucose, cholesterol and triglyceride levels. Our result supports the findings of Gudev et al. (2008) and Onifade et al. (1999) who reported a decrease in blood glucose for chicks fed diets containing yeast. This reduced blood glucose level may be due to the suppressive effect of S. cerevisiae on glucagon, which otherwise increases blood glucose in chickens, thereby maintaining blood glucose homeostasis.
CONCLUSION
In T3 (1.2 g/kg Saccharomyces cerevisiae) higher heart weight (0.33% of live weight) and lower blood cholesterol concentration (91.77 mg/dl) were recorded and therefore T3 was recommended. Lower blood cholesterol enhances broiler production.

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