Effects of dietary lead exposure and graded levels of ascorbic acid supplementation on performance and haematology of broiler chickens

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Abstract
The effects of dietary lead acetate (LA) exposure on growth performance and haematological characteristics of broiler chickens and possible ameliorative effect of ascorbic acid (AA) were investigated. One hundred and twenty day-old broiler chicks were randomly divided into six treatment groups of 20 birds with two replicates. Six isonitrogenous and isocalories experimental diets were compounded and fed to birds for seven weeks: T1 (control) received diet I (0mg of LA and AA/kg feed), T2 received diet II (200mg LA/kg feed), T3 received diet III (200mg LA and 50mg AA/kg feed), T4 received diet IV (200mg LA and 100mg AA/kg feed), T5 received diet V (200mg LA and 150mg AA/kg feed) and T6 received diet VI (200mg LA and 200mg AA/kg feed). Finally, two birds per replicate were randomly selected, weighed and slaughtered. For haematology, blood samples were collected into labelled EDTA-bottles. PCV, RBC, WBC and Hb concentration were determined using Auto Haem analyzer. T2 showed significantly (P<0.05) decreased body weight and dressed weight than the control. Although depressive effects of LA on body weight gain, feed intake and feed conversion ratio were significant. Birds in other treatments compared favourably with the control. Dietary lead significantly (P<0.05) reduced WBC in T2, while it significantly (P<0.05) and non-significant (P>0.05) lowered haemoglobin and RBC in T2 and T6 respectively. The PCV was numerically lowered in T2 and T6. However, haematology of AA treated groups, especially those of T3 and T4 compares favourably with the control. In conclusion, dietary lead exposure negatively affects growth performance and haematology of broilers, which was ameliorated by as low as 50mg AA/kg diet supplementation.

Keywords: ascorbic acid, broiler, growth performance, haematology, lead acetate.

Introduction
Lead is a common cause of poisoning in domestic animals throughout the world. Cattle are the most susceptible livestock (Khan et al., 2008). However, lead poisoning can occur in all domestic animals including horses, poultry and dogs (Khan et al., 2008). Animals become intoxicated when they consume lead from contaminated feed and water. The main sources of contamination of feed by lead are soil, industrial pollution and agricultural technology as well as feed processing. A good source of lead contamination of poultry feed is bone and blood meals, majority of which comes from cattle. However, in cattle, highest lead accumulation has been reported to occur in bones (Heaney, 2000). Vegetables constitute essential components of the diet by contributing protein, vitamins, iron, calcium and other nutrients, which are usually in short supply (Suruchi & Pankaj Khanna, 2011). However, vegetables take up metals by absorbing them from contaminated soils, as well as from deposits on different parts of the vegetables exposed to the air from polluted environment (Zurera-Cosano et al., 1989). It was reported that nearly half of the average ingested lead, cadmium and mercury in food is due to plant origin (fruit, vegetables and cereals). Other sources of lead contamination are leaded gasoline fumes (Genevieve & Greg, 1994); paints used in poultry equipment such as drinkers and feeders to prevent rusting, with either lead based paint or lead-free paint with leaded drying agent. Also, majority of litter material that comes from woods...
previously painted with lead base paints (North & Bell, 1990), constitute another source of lead poisoning to birds. It is common to observe indiscriminate disposal of used batteries and its contents, grease and automobile oil filters in and around poultry houses in the study area. Ingested lead has resulted in poisoning, poor performance and death in animals (McDowell, 1992; Gurer & Ercal, 2000). Stone & Soares Jr., (1976); Vodela et al. (1997), reported that, dietary lead poisoning in broiler chickens significantly reduced body weight and body weight gain. Erdogan et al. (2005) showed that 200 mg lead/kg diet reduced growth in term of body weight and body weight gain. Bakalli et al. (1995), also reported that feed conversion ratio was significantly poor at a level of 10 mg lead/kg feed. Lead accumulation in kidney and liver of broiler was reported by Erdogan et al. (2005), as well as by Khan et al. (1993), who stated that toxic doses of lead administered orally accumulate in the liver and this could be the source of lead poisoning to humans. In some cases, haematological parameters may provide an indication of lead intoxication. Among the major effects of lead poisoning is anemia, which results from inhibition of the heme synthesizing enzymes with concurrent elevation of protoporphyrin (Lee, 1981). This assertion was further buttressed by Osweiler (1996) who reported that lead slows down haemoglobin synthesis through inhibition of enzymes. A hyperchromic, regenerative anaemia was reported to occur in some affected birds poisoned with lead (McDonald, 1988). According to studies (Stohs & Bagchi, 1995; Mateo et al., 2003), lead has a potential to induce oxidative stress and acts as a catalyst in the oxidative reactions of biological macromolecules. Hence, the toxicities associated with lead might be due to oxidative tissue damage (Gurer & Ercal, 2000; Ercal et al., 2001). To prevent peroxidative tissue damage, there are protective mechanisms in vivo, such as an enzymatic defense system (antioxidant enzymes) and free radical scavengers (antioxidants).

Ascorbic acid (AA) is a well-known antioxidant vitamin involved in several biochemical processes in biological systems. This vitamin breaks the chain of lipid peroxidation in cell membranes and scavenges free radicals such as reactive oxygen species (Carr & Frei, 1999; Kucuk et al., 2003). The antioxidant function of these macronutrients could enhance immunity by preserving the functional and structural integrity of important immune cells, it lower concentration of lead in the blood and restored the levels of iron, calcium and zinc in the blood as well as the lipid balance. AA supplementation offered protection to the cell from expansion or abnormalities in their structural features. Erdogan et al. (2005) reported that the addition of 100mg AA/kg diet tend to reduce the inhibitory effect of lead on growth in broilers. This study was conducted to evaluate the effect of various doses of AA, an antioxidant in ameliorating the inhibitory effects of dietary lead acetate on the haematology and growth performance of broiler chickens.

Materials and methods
Experimental Diets
Six isonitrogenous and isocalories experimental diets were formulated as shown in Tables 1 and 2. Tablets of vitamin C (Vitamin C, 100mg tabs, Michelle Laboratories Limited, Enugu, Nigeria) and lead in the form lead acetate salt (Lab Tech Chemicals, India) were crushed into powder. During feed composition, the smallest feed component by volume were weighed out and spread on a clean cement floor in the feed compounding vat. The next was salt and for those diets that contain lead acetate and or ascorbic acid, these were weighed using top loading balance and mixed with vitamin premix and minerals thoroughly, until a uniform ingredient was obtained. Other feed ingredients were individually weighed using a 20kg kitchen weighing scale and were spread on the clean floor in the feed compounding vat and were thoroughly mixed together manually. Each experimental diet was separately prepared in batches of 100% each and was packed into labelled bags and properly kept until required for use. The control diet I contained neither lead acetate nor ascorbic acid (0mg lead acetate/kg feed and 0mg ascorbic acid/kg feed), while diets II, III, IV, V and VI contained lead acetate at a fixed level of 200mg lead acetate/kg feed. Also diets II contained no ascorbic acid or 0mg ascorbic acid/kg feed. Other diets, i.e. diets III, IV, V and VI contained: 50; 100; 150 and 200mg ascorbic acid/kg feed respectively. These inclusions were done for both starter and finisher rations.

Experimental design
A Completely Randomised Design (CRD) was used. A total of 120 day-old broiler chicks were used. The birds were weighed and randomly distributed into six treatment groups of 20 birds per treatment; i.e. treatments I, II, III, IV, V and VI (i.e.T1, T2, T3, T4, T5 and T6). Each treatment group was replicated twice with 10 birds per replicate; the birds were raised using deep litter system and the experimental diets I, II, III, IV, V and VI were respectively fed to each treatment. Starter diets were fed from day-old to fourth week of age and finisher diets from fifth week of age until the end of the experiment. They were allowed ad libitum access to feed and water for a
period of seven weeks.

**Data collection**

*Performance Parameters:* The body weight gain and feed consumption were determined weekly throughout the duration of the study. All the birds in a replicate pen were weighed collectively and divided by the total number of birds in that replicate pen, to determine the average weight per bird for the week. Similarly, the feed consumed by birds in each replicate of the treatment groups was also recorded on a weekly basis, by subtracting the leftover at the end of the week from the quantity supplied for the week. The average feed consumed per bird was calculated by dividing the total feed consumed by the number of birds in that replicate pen. The average increase in weight gain per bird in a week was then calculated. This was carried out by subtracting the new week average weight per bird from the previous week. Feed conversion ratio was calculated by dividing the feed consumed per bird per week with average increase in weight gain per bird week. This was done for each treatment group as described by Oluyemi & Roberts (2000).

*Haematological Parameters:* At the end of the feeding trials, the birds were starved overnight to stabilize them. Two birds were randomly sampled from each replicate, weighed and slaughtered using Halal/Kosher method of slaughtering. For haematology, blood samples were collected from severed jugular vein into labelled sterilized bottles containing Ethylene Diamine-Tetra-acetic Acid (EDTA). The packed cell volume (PCV), red blood cell (RBC), white blood cell (WBC) and its differentials as well as haemoglobin (Hb) concentrations were determined using Auto Haem Analyzer (Via Guido Borghi 43, 21025 Comerio-Varese – Italy) as described by the manufacturer.

**Statistical Analysis**

Data obtained were subjected to one–way ANOVA and significant means were compared with post hoc test, using GraphPad InStat 3 software. Results were considered to be statistically significant when P values are less than 0.05 (P<0.05).

**Results**

The effects of lead and ascorbic acid on body weight, body weight gain, feed intake and feed conversion ratio are presented in Table 3. Supplemental dietary lead significantly reduced body weight (P<0.05), but its effects on body weight gain, feed intake and feed conversion ratio were not significant (P>0.05) between treatment means. No clinical signs of lead toxicity were observed in the broilers administered lead. However, the body weight, body weight gain, feed intake and feed conversion ratio of ascorbic acid treated groups were statistically similar to that of control.

As shown in Table 4, the dietary treatment with lead significantly (P<0.05) lowered WBC in T3 (66.88×10³/mm³) and haemoglobin which was significantly (P<0.05) reduced both in T3 (9.85g/dl) when compared with the control and other treatments. T2 and T6 produced numerical anaemia as their RBCs were below normal ranges. The PCV was numerically lowered in T2 and T6. Numerically and statistically, all the haematological parameters of ascorbic acid treated groups, particularly those of T3 and T4 compares favourably with those obtained for the control group (T1).

**Table 1: Composition of Experimental Diet; Broiler Starter**

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Percentage composition (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Diet I</td>
</tr>
<tr>
<td>Maize</td>
<td>55.00</td>
</tr>
<tr>
<td>Groundnut Cake</td>
<td>30.00</td>
</tr>
<tr>
<td>Fish Meal</td>
<td>3.00</td>
</tr>
<tr>
<td>Blood Meal</td>
<td>3.00</td>
</tr>
<tr>
<td>Wheat Offal</td>
<td>5.00</td>
</tr>
<tr>
<td>Bone Meal</td>
<td>0.80</td>
</tr>
<tr>
<td>Limestone</td>
<td>2.50</td>
</tr>
<tr>
<td>Salt</td>
<td>0.25</td>
</tr>
<tr>
<td>Vitamin Premix</td>
<td>0.25</td>
</tr>
<tr>
<td>Lysine</td>
<td>0.10</td>
</tr>
<tr>
<td>Methionine</td>
<td>0.10</td>
</tr>
<tr>
<td>Total (kg)</td>
<td>100</td>
</tr>
<tr>
<td>Lead Acetate (mg/kg)</td>
<td></td>
</tr>
<tr>
<td>Ascorbic Acid (mg/kg)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Calculated values</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Metabolizable Energy (kcal/kg)</td>
<td>2881.21</td>
<td>2881.21</td>
<td>2881.21</td>
<td>2881.21</td>
<td>2881.21</td>
<td>2881.21</td>
</tr>
</tbody>
</table>
Dietary treatment with lead acetate in this study significantly (P>0.05) decreased body weight in the experimental broilers, which is in agreement with previous findings by Morgan et al. (1975), and Erdogan et al. (2005). The reduction of body weight might be due to the interruption in absorption and metabolism of feed nutrients essential for health (Marchlewicz et al., 2007). Also, ingestion of lead acetate at 200mg/kg feed did not result in significant (P>0.05) decrease in the body weight gain of broiler chickens. This corroborate the result of Damron et al. (1969), who observed that broilers (4 weeks-old) were relatively resistant to lead poisoning at levels up to 2,000 mg Pb/kg body weight. However, this result contradicts that of Morgan et al. (1975) and Erdogan et al. (2005) who reported that body weight gain was statistically lowered in the lead-treated group than that in the control and ascorbic acid-treated groups. This contradiction could be attributed to environmental factors such as temperature difference, differences in strain of birds used or the variation in dietary composition.

On the contrary, birds fed lead plus ascorbic acid produced similar body weight and body weight gain like those of the control. Thus ascorbic acid addition to diet tend to reverse the growth depressive effect of lead in broiler chickens. This might be due to the ability of ascorbic acid to offer protection to the cell

### Table 2: Composition of Experimental Diet; Broiler Finisher

<table>
<thead>
<tr>
<th>Ingredients</th>
<th>Diet I</th>
<th>Diet II</th>
<th>Diet III</th>
<th>Diet IV</th>
<th>Diet V</th>
<th>Diet VI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>62.00</td>
<td>62.00</td>
<td>62.00</td>
<td>62.00</td>
<td>62.00</td>
<td>62.00</td>
</tr>
<tr>
<td>Groundnut Cake</td>
<td>30.00</td>
<td>30.00</td>
<td>30.00</td>
<td>30.00</td>
<td>30.00</td>
<td>30.00</td>
</tr>
<tr>
<td>Fish Meal</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Blood Meal</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Wheat Offal</td>
<td>3.00</td>
<td>3.00</td>
<td>3.00</td>
<td>3.00</td>
<td>3.00</td>
<td>3.00</td>
</tr>
<tr>
<td>Bone Meal</td>
<td>0.80</td>
<td>0.80</td>
<td>0.80</td>
<td>0.80</td>
<td>0.80</td>
<td>0.80</td>
</tr>
<tr>
<td>Limestone</td>
<td>1.50</td>
<td>1.50</td>
<td>1.50</td>
<td>1.50</td>
<td>1.50</td>
<td>1.50</td>
</tr>
<tr>
<td>Salt</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
</tr>
<tr>
<td>Vitamin Premix</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
</tr>
<tr>
<td>Lysine</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td>Methionine</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td>Total (Kg)</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Lead Acetate (mg/kg)</td>
<td>-</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>Ascorbic Acid (mg/kg)</td>
<td>-</td>
<td>50</td>
<td>100</td>
<td>150</td>
<td>200</td>
<td></td>
</tr>
</tbody>
</table>

**Calculated values**

| Crude Protein (%) | 20.89 | 20.89 | 20.89 | 20.89 | 20.89 | 20.89 |
| Metabolizable Energy (kcal/kg) | 2981.79 | 2981.79 | 2981.79 | 2981.79 | 2981.79 | 2981.79 |

### Table 3: The effects of lead (200mg/kg) and graded levels of ascorbic acid on performance of broilers

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Dietary treatments</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
<th>T5</th>
<th>T6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial body weight/bird (kg)</td>
<td></td>
<td>0.098</td>
<td>0.088</td>
<td>0.093</td>
<td>0.093</td>
<td>0.080</td>
<td>0.095</td>
</tr>
<tr>
<td>Final live weight/bird (kg)</td>
<td></td>
<td>2.05a</td>
<td>1.58a</td>
<td>1.95a</td>
<td>1.76a</td>
<td>1.81a</td>
<td>1.73a</td>
</tr>
<tr>
<td>Body weight gain/bird (kg)</td>
<td></td>
<td>1.952</td>
<td>1.492</td>
<td>1.857</td>
<td>1.667</td>
<td>1.730</td>
<td>1.635</td>
</tr>
<tr>
<td>Feed intake/bird/wk (kg)</td>
<td></td>
<td>0.488</td>
<td>0.444</td>
<td>0.489</td>
<td>0.471</td>
<td>0.468</td>
<td>0.463</td>
</tr>
<tr>
<td>Feed conversion ratio</td>
<td></td>
<td>2.046</td>
<td>2.367</td>
<td>2.230</td>
<td>2.389</td>
<td>2.264</td>
<td>2.135</td>
</tr>
</tbody>
</table>

*ab: Means on the same row with different superscripts are significantly different (P < 0.05).*

### Table 4: Haematological Parameters of Experimental Birds.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Dietary treatments</th>
<th>T1</th>
<th>T2</th>
<th>T3</th>
<th>T4</th>
<th>T5</th>
<th>T6</th>
</tr>
</thead>
<tbody>
<tr>
<td>WBC (&gt;10³/mm³)</td>
<td></td>
<td>79.75a</td>
<td>66.88a</td>
<td>72.88a</td>
<td>90.75a</td>
<td>79.95a</td>
<td>84.35a</td>
</tr>
<tr>
<td>RBC (&gt;10⁶/mm³)</td>
<td></td>
<td>2.38</td>
<td>1.93</td>
<td>2.21</td>
<td>2.67</td>
<td>2.10</td>
<td>1.95</td>
</tr>
<tr>
<td>PCV (%)</td>
<td></td>
<td>33.25</td>
<td>28.75</td>
<td>32.25</td>
<td>35.75</td>
<td>29.75</td>
<td>27.25</td>
</tr>
<tr>
<td>Haemoglobin (g/dl)</td>
<td></td>
<td>13.05a</td>
<td>9.85a</td>
<td>12.20a</td>
<td>13.65a</td>
<td>11.75a</td>
<td>10.30a</td>
</tr>
</tbody>
</table>

*ab: Means on the same row with different superscripts are significantly different (P<0.05)*
from expansion or induction of abnormalities in their structural features. Alternatively, it may be as a result of its protection and therapeutic role against lead toxicity (Bhattacharjee et al., 2003). This could therefore imply that, in contrast to the result of Erdogan et al. (2005), the adverse effects of dietary lead exposure on body weight gain though not significant, at 200mg lead/kg feed, could be ameliorated with even as low as 50mg ascorbic acid/kg supplementation in the diet. However, the ameliorative effects of ascorbic acid may not be dose dependent.

In agreement with the report by Erdogan et al. (2005), the effects of lead and ascorbic acid on feed intake and feed conversion ratio recorded in the present study were not significant. The findings of Bakalli et al. (1995), in terms of feed conversion ratio contradict the result of this study. This might be due to: different form of lead used, the present study used lead acetate while Bakalli et al. (1995), used lead sulphate and period of exposure, as Bakalli et al. (1995), exposed the birds for 42 days whereas this study exposed the birds for 49 days. However, birds treated with only lead without ascorbic acid revealed decrease feed intake, thus indicating toxic effect of lead and/or alteration in feed palatability resulting into lower average body weights in this group at the end of seventh week, whereas groups exposed to lead as well as varying levels of ascorbic acid revealed increased feed intake per kg gain with decrease in ascorbic acid supplementation. This indicated that an ameliorative effect of ascorbic acid on decreased feed intake due to lead, however, feed intake was best at 50mg ascorbic acid/kg supplementation.

According to the result of this study, the leukopenia observed in T2 could have been due to aplastic anaemia as a result of overwhelming blood poisoning from lead as well as infiltration of bone marrow by lead. Also, significant haemoglobin reduction of birds in T2 with consequent, non-significant lowered PCV and RBC clearly indicated retardation and/or inhibiting effect of lead acetate on haeme synthesizing enzymes (Lee, 1981; Osweiler, 1996). In accordance with the present findings, Khan et al. (2008) observed that following lead acetate administration, there was moderate decrease in haemoglobin and PCV. Similarly, Szymezak et al. (1983) observed that haemoglobin level was reduced after intoxication with lead acetate at the dose of 400mg/kg of the fodder. Also, Kamruzzaman (2006) observed that following lead acetate administration, there was significant decrease of RBC, WBC and haemoglobin content in rats. The WBC, RBC, PCV and haemoglobin of the ascorbic acid treated groups, especially those of 50mg ascorbic acid/kg feed were within the normal range and this illustrated the ameliorative effects of ascorbic acid on dietary lead exposure as it affects haematology.

In conclusion, the results obtained from the present study showed that, supplementation with ascorbic acid, even as low as 50mg/kg feed may be of immense prophylactic and therapeutic values in exposed broiler chickens. Ascorbic acid caused significant ameliorative effect on lead acetate-induced toxicity by improving the reduced growth performance and haematological values back to normal.

References


Kamruzzaman (2006). *Effects of ascorbic acid (vitamin C) and α-tocopherol (vitamin E) in lead induced toxicities in rats*. MSc thesis, department of pharmacology, BAU, Mymensingh.


Pelvimetry of kuri and bunaji cows in Maiduguri metropolitan slaughterhouse, northern Nigeria

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Abstract

The study was conducted on 58 indigenous cattle consisting of 33 Kuri and 25 Bunaji cows slaughtered at the Maiduguri Metropolitan Slaughter House. The internal and external pelvic dimensions in the two breeds were obtained immediately post-slaughter before the animals were dressed. The Mean ± SEM for pelvic area were found to be 120.83 cm ± 3.6 and 110.1 cm ± 3.4 for Kuri (K) and Bunaji (WF) respectively. The mean ± SEM for various body measurements were 80.98 cm ± 0.5 and 74.0 cm ± 0.8 for heart girth; 149.9 cm ± 1.1 and 138 cm ± 0.7 for height at withers; 129.3 cm ± 1.04 and 117.96 ± 1.4 for height at pin bone; 141.3 cm ± 0.54 and 131.7 cm ± 1.05 for height at hook bone; 46.2 cm ± 0.42 and 42.3 cm ± 0.51 for rump length; 43.6 cm ± 0.45 and 40.8 cm ± 0.74 for rump width; 10.7 cm ± 0.2 and 9.5 cm ± 0.16 bisilliac distance and 11.85 cm ± 0.02 and 11.12 cm ± 0.18 sacropubis distance for Kuri and Bunaji respectively. There was a significant correlation (P<0.05) between pelvic area and sacropubis, bisilliac, height at pin bone and height at withers in both breeds. The pelvic area was significantly (P<0.05) correlated with height at hook bone in Kuri cows but, there was no correlation with heart girth. The Bunaji showed a significant correlation of the pelvic area with the heart girth while, there was no correlation with the height at hook bone. A significant difference (P<0.05) was observed in the dimensions of the traits between the breeds except in the heart girth and rump width. The study indicated that the parameters measured above may be used as good indicators of cows with large pelvic area in both breeds.

Keywords: bunaji, cows, kuri, maiduguri, pelvimetry

Introduction

Dystocia defined as delayed or difficult parturition has been reported to be the most common cause of perinatal calf loss (Bellows and Short, 1994; Noakes et al., 2001). The best method of dealing with calving problems is to avoid them. Calving ease, bulls and pelvimetry are some of the more recent tools to consider in a breeding program. Research has shown that the internal pelvic area is one of the best predictions of dystocia in heifers (Bellows, 1992). Recently, interest in pelvic measurements has increased considerably by beef producers, veterinarians and researchers (Deutscher, 1995). Studies have shown that causes of dystocia can be divided into two (2) components; those attributed to calf and those attributed to dam (Cook et al., 1993). The size of the pelvic area was among the most important factors attributed to the dam. The pelvic area was reported to be the most important cow variable influencing calving difficulty (Johnson et al., 1988). Pelvic measurements can be successfully used to identify abnormally small or abnormally shaped pelvises (Deutscher, 1995). Dams with larger pelvic area experience less calving difficulty. The difficulty involved in the direct measurement of the internal pelvic dimension in live animals implies the need for information on the association existing among internal pelvic dimensions and external body measurements that might be of value in determining dams with larger pelvic area and guide in crossbreeding. Studies on pelvimetry have been conducted in exotic cows (Rice & Wiltbank, 1970; Schwabe & Hall, 1989). There is, however a paucity of information on indigenous breeds of cattle in Nigeria. The Kuri cattle also referred to as Buduma, inhabit the Lake Chad basin and are characterized by huge, porous, bulbous horns, light colored with an average mature weight of 450 – 500 kg (Blench, 1999). They are principally used as milkers. The Bunaji cattle also called Yakanji are predominantly found in the northern part of Nigeria. They vary from 250 – 500 kg live weight and are grey-white in color with black extremities. They may have black or reddish markingsand are multipurpose breeds (Blench, 1999). The objective of this study, therefore, was to determine the relationship among intrapelvic dimensions and external body measurements in Kuri and Bunaji cows; and to investigate differences in terms of these body measurements between the two breeds.
Materials and methods
The study was conducted on 58 indigenous cattle consisting of 33 Kuri cows and 25 Bunaji cows, during the months of January and March (2008). The cows were obtained from Maiduguri metropolitan slaughterhouse. The study area is located 11°5" north and longitude 13°5" east at an altitude of 354m above sea levels, falls within the Sahel savanna zone. The climate is characterized by two distinct seasons, yearly with a unimodal rainfall pattern, a long dry seasons of about 8-9 months. The dry seasons start from November to April while the rainy season is from May to October. The climate is generally hot with mean annual rainfall of between 200-250mm. The hottest months in the study area are March and April with a mean temperature of 37°C to 43°C (Carter, 1994). The animals were apparently healthy and sexually mature with ages varying between 4 to 6 years. The management record and breeding history of the animals prior to slaughter were not known.

The external body size dimensions and the internal pelvic measurements were taken immediately after slaughter, before the animals were dressed. They were placed on lateral recumbency with the limbs fully extended. The external body measurements were obtained using Freeman’s measuring tape (Tailor’s tape). These included, height at hook bone being the linear distance from the rear hoof to the highest point of the tuber coxae; height at withers, the linear distance from the fore hoof to the highest point of the withers; rump length, the linear distance between the anterior surface of the wing of the ilium and posterior surface of the ischium; rump width, the linear distance between the two dorsolateral ischial tuberosities; and the heart girth being the smallest circumference behind the shoulder.

The internal pelvic dimensions were obtained by the use of a modified pelvimeter (Rice & Wiltbank, 1972). The pelvimeter (Plate 1) was inserted per rectum, through which the internal pelvic measurements were read on a scale. Pelvic height was the vertical distance between the sacral vertebrae and pubic symphysis; and pelvic width was the horizontal distance between the shaft of the ilium at the widest part (Coburn et al., 1997). The internal dimensions taken were sacropubis (pelvic height) and bisilliac (pelvic width). The pelvic area was calculated as the product of the vertical diameter and the transverse diameter of pelvis as described by Rice & Wiltbank (1972).

The pelvic and the body measurements were subjected to Analysis of variance (ANOVA), (Steel & Terrie, 1960). And simple correlation was done using a GraphPad Instat statistical computer package (GraphPad software, 2000).

Results
The mean ± SEM of the pelvic area and various body measurements in Kuri and Bunaji and their comparism (using ANOVA) are presented in Table 1. The correlation co-efficient (r) of pelvic area and the various body measurements in the two breeds of cows is shown in Table 2.

A high correlation was obtained between pelvic area and sacropubis and bisilliac, height at pin bone and height at withers in both Kuri and Bunaji cows. There was a significant correlation P<0.05) between pelvic area and heart girth in the Bunaji cows. However, pelvic area and heart girth were not significantly correlated (P>0.05) in Kuri cows. Similarly, there was a significant correlation (P<0.05) of pelvic area and height at hook bone in Kuri cows, while, the pelvic area and height at hook bone were not significantly correlated (P>0.05) in the Bunaji cows.

There was a significant difference (P<0.05) in the mean dimensions of pelvic area, height at withers, height at pin bone, bisilliac and sacropubis between the two breeds of cows. However, there was no significant difference (P>0.05) between Kuri and Bunaji cows in the mean dimensions of heart girth and rump width.

Plate 1: Modified Pelvimeter
Table 1: Mean ± SEM and comparisons of various pelvic and body measurements for Kuri (n = 33) and Bunaji (n = 25) cows.

<table>
<thead>
<tr>
<th>Traits</th>
<th>Kuri</th>
<th>Bunaji</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pelvic area (cm²)</td>
<td>120.8 ± 3.0</td>
<td>110.1 ± 2.4 *</td>
</tr>
<tr>
<td>Heart girth (cm)</td>
<td>80.98 ± 0.5</td>
<td>74.0 ± 0.8</td>
</tr>
<tr>
<td>Height at withers (cm)</td>
<td>149.9 ± 1.1</td>
<td>138.8 ± 0.7 *</td>
</tr>
<tr>
<td>Height at pin bone (cm)</td>
<td>129.3 ± 1.04</td>
<td>117.96 ± 1.4 *</td>
</tr>
<tr>
<td>Height at hook bone (cm)</td>
<td>141.3 ± 0.54</td>
<td>131.7 ± 1.05 *</td>
</tr>
<tr>
<td>Rump length (cm)</td>
<td>46.2 ± 0.42</td>
<td>42.3 ± 0.54 *</td>
</tr>
<tr>
<td>Rump width (cm)</td>
<td>43.6 ± 0.45</td>
<td>41.8 ± 0.74</td>
</tr>
<tr>
<td>Bisilliac (cm)</td>
<td>10.7 ± 0.2</td>
<td>9.5 ± 0.16 *</td>
</tr>
<tr>
<td>Sacropubis (cm)</td>
<td>11.85 ± 0.2</td>
<td>11.12 ± 0.18 *</td>
</tr>
</tbody>
</table>

*Statistically significant (P<0.05)

Table 2: Correlation coefficient of the pelvic area with various body measurements for kuri (n – 33) and Bunaji (n – 25) cows

<table>
<thead>
<tr>
<th>Traits (cm)</th>
<th>Kuri</th>
<th>Bunaji</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sacropubis</td>
<td>0.95*</td>
<td>0.75*</td>
</tr>
<tr>
<td>Bisilliac</td>
<td>0.94*</td>
<td>0.72*</td>
</tr>
<tr>
<td>Height at withers</td>
<td>0.56*</td>
<td>0.58*</td>
</tr>
<tr>
<td>Height at pin bone</td>
<td>0.38*</td>
<td>0.43</td>
</tr>
<tr>
<td>Height at hook bone</td>
<td>0.43*</td>
<td>0.35</td>
</tr>
<tr>
<td>Rump length</td>
<td>0.34</td>
<td>0.04</td>
</tr>
<tr>
<td>Rump width</td>
<td>0.32</td>
<td>0.04</td>
</tr>
<tr>
<td>Heart girth</td>
<td>2.35</td>
<td>0.45*</td>
</tr>
</tbody>
</table>

*Statistically significant (P<0.05)

Discussion
In exotic breeds of cows, the pelvic area was reported to be the most important variable influencing calving difficult and can be successfully used to identify abnormally small or abnormally shaped pelvises (Johnson et al., 1988; Deutscher 2011). To the best of our knowledge this is the first comparative account of the pelvic dimensions in relation to external body measurements of Kuri and Bunaji breeds of cattle and the differences among the two breeds in Nigeria. However, similar observation has been reported in some breeds of sheep (Rabalosilva & Noakes, 1984) and in exotic cattle (Schwabe & Hall, 1989). The values obtained in this study were lower than those reported by Bellows et al., (1971); Rice and Wilbank (1972); Johnson et al., (1988) and Oliveira et al., (2003) for the exotic breeds of cattle. This may be attributed to breed variation and the fact that measurements in the present study were taken post-slaughter.

The high positive correlation observed between the pelvic area and the sacropubis, bisilliac measures and the height at withers is similar to the earlier reports of Johnson et al., (1988). Deutscher (2011) and Bellows et al., (1994). In this study, the pelvic area was significantly (P<0.05) correlated to the height at pin bone and height at hook bone for Kuri cows and the heart girth for the Bunaji cows and these peculiar variations may be attributed to breed differences (Schwabe & Hall, 1989). The Kuri cows were taller and have larger pelvic area than the Bunaji cows. This observation is not in agreement with Neville et al., (1978) who reported that taller breeds of cattle have smaller pelvic area. According to Boyles, (2000) pelvic height is more heritable than pelvic width. The Kuri may, therefore be more suitable for crossbreeding with larger (exotic) breeds.

The sacropubis and bisilliac dimensions possessed the highest correlation with the pelvic area in both breeds which disagrees with Bello (1987) who observed hip width and height at pin bone as having the highest significant association with the pelvic area of unspecified breed of Nigerian cows.

In conclusion, it was evident that the measurements (sacropubis, bisilliac, height at pin bone and height at withers) may be used as good indicators of cows with large pelvic area in both breeds. Further work on the relationship of the pelvic area and incidence of dystocia in these two breeds is highly desired.

References

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Efficacy of *Terminalia avicennoides* and its combination with diminazene aceturate (Berenil®) in rats experimentally infected with *Trypanosoma brucei brucei*

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Abstract
A comparative study was carried out to investigate the efficacy of the aquous extract of *Terminalia avicennoides* alone and its combination with diminazene aceturate. Thirty Wister albino rats of both sexes weighing between 250-260gms were distributed into six groups (A-F) of five rats each. All the rats in groups A-E were infected with 0.5ml of blood containing 1x10⁶ *Trypanosoma brucei brucei*. Rats in group F were uninfected and untreated (control). Rats in groups A-D were treated 5 days post-inoculation orally, with 3.5mg/kg Berenil® alone, 80mg/kg plant extract alone, 80mg/kg extract plus 1.75 mg/kg Berenil® and 1.75 mg/kg Berenil® respectively were infected Group E, not treated. Treatment with extract alone resulted in reduction in parasitaemia, but not curative. However, Berenil® treatment alone and its combination with the extract resulted in the clearance of the parasite. The result obtained suggests that *T. avicennoides* alone and its combination with Berenil® offer great potentials as alternative products for the treatment of trypanosomiasis.

Keywords: diminazene aceturate, efficacy, rats, *Terminalia avicennoides*, trypanosomiasis

Introduction
Trypanosomosis is a potentially fatal disease of humans and domestic animals in tropical Africa and South America (Smith et al., 1998). This disease has undergone a dramatic and devastating resurgence in recent years (Welburn et al., 2001).

In Nigeria, it occupies latitude 4° N to13° N (Onyiah, 1997). This covers all the six geo-ecological zones of the country and the disease has an overall prevalence in cattle, sheep and goats of 10%, 8.6% and 8.1% respectively (Onyiah, 1997). Similarly, horses and camels are affected. The asymptomatic to acute, sub-acute and chronic forms have been reported (Onyeyili & Egwu, 1997). The disease is characterized by fever, weight loss, abortion and reduced production (Ikede et al., 1988), leading to loss in revenue in the livestock industry in many parts of Africa (Onyeyili & Egwu, 1997).

Chemotherapy seems to be the only readily available measure for both curative and prophylactic management because no vaccine is available yet for the disease. Unfortunately, the existing drugs for trypanosomosis are toxic and/ or expensive (Ajagbonna et al., 1995; Atougwa & Costal, 1999). In addition to the unavailability of these drugs in rural areas, incidence of therapeutic failure and relapses from treatments with these drugs are known to occur (Onyeyili & Egwu, 1997; Atougwa & Costal, 1999).

This study investigated efficacy of *T. avicennoides* in the treatment of trypanosomosis. *T. avicennoides* is a tropical tree abundant in the Savannah region of West Africa. In Nigeria, the plant is commonly found in the North Central region where most of the country’s cattle are reared. It is locally known as *Baushe* among the Hausas, (Keay et al., 1960).

The plant is a durable wood, hard and yellowish brown in color. The extract from various parts of the tree (leaves, stem bark and roots) are claimed to be useful in treating dental caries (Gill & Akinwumi, 1986), skin infections and malaria. It is also claimed to be used locally against trypanosomosis (Bulus et al., 2008) in animals but this is yet to be ascertained.

Therefore, the aim of this study is to comparatively study the efficacy of *T. avicennoides* alone, and its combination with diminazene aceturate (Berenil®) an existing conventional synthetic trypanocide.
Materials and methods

Plant Material
Fresh plant materials (stem bark) were collected from users of this plant, *T. avicennoides*, in Sokoto metropolis with the aid of traditional practitioner. The botanical identity and authentication of this plant were carried out at the Botany Department, Usmanu Danfodiyo University, Sokoto. Samples were subsequently deposited in the herbarium of the Department of Veterinary Physiology and Pharmacology of the University.

Methods of Extraction
Hot extraction method was used in this study as described by Ajagbonna & Onyeyili (2003). The stem bark collected, was sun-dried and pulverized into powder using mechanical grinder. Two hundred grams of the pulverized materials was boiled in 500ml of distilled water for 30 minutes. This was filtered through pieces of Muslin cloth and the filtrate was again filtered using a piece of cotton wool placed in a funnel into a beaker and the filtrate collected and evaporated to dryness in an oven at 60°C for 12 hours. The dark brown extract obtained subsequently was used for this experiment.

Experimental Rats
Wistar albino rats of both sexes weighing between 250g and 260g were used for this study. The rats were obtained from Nigeria Institute for Trypanosomosis and Onchocerchiasis Research (NITOR), Vom, Jos, Plateau State, Nigeria. They were housed in metallic cages, allowed to stabilize for a week and fed with standard commercial rat feed and provided with clean water ad libitum.

Trypanosome Stock
*Trypanosoma b. brucei* used in this experiment was obtained from NITOR. Four rats were initially inoculated with the organism from NITOR. These rats served as donors from where other rats were inoculated intraperitoneally using 1.0ml blood containing 1x 10^6 T. b. brucei from donor rats.

Experimental Procedure
The rats were separated into six groups of five rats each in a cage and were treated as follows:–

- Group A - Infected and treated with 3.5mg/ kg IM of diminazine aceturate once, at the peak of parasitaemia.
- Group B - Infected and treated with 80mg/kg *T. avicennoides* orally for 6 days at peak parasitaemia.
- Group C - Infected and treated with 80mg/kg *T. avicennoides* (orally) + 1.75mg/ kg diminazine aceturate IM at the peak of parasitaemia.
- Group D - Infected and treated with 1.75mg/kg of diminazine aceturate alone IM at the peak of parasitaemia.
- Group E - Infected and untreated rats (positive control)
- Group F - Uninfected and untreated rats (negative control).

Inoculation of Animals
One millilitre of *T. b. brucei* infected blood was taken from the donor rat and diluted with phosphate buffered saline. The diluted blood containing approximately 1x10^6 parasites was inoculated intraperitoneally using “23G” needle (Onyeyili et al., 1994; Dina et al., 2002) into the rats in groups A, B, C, D and E.

Administration of the Drug
At the peak of parasitaemia, diminazine aceturate (3.5mg/Kg B.W) was administered intraperitoneally to group A using 23 gauge needle (Onyelili et al., 1994; Dina et al., 2002). At the peak of parasitaemia, 80mg/Kg of *T. avicennoides* was administered to rats in Groups B and C. A concentration of 1 gm *T. avicennoides* was prepared from powdered crude extract after weighing using Metler digital balance. This was dissolved in 100ml of water to obtain one percent solution. The dose was then calculated using the standard dosage of the plant. Standard dosages of the plant is 80mg/Kg (Gills & Akinwumi, 1986; Akinside & Olukoya, 1995).

Parasite Detection
Parasite was detected by wet film method from the tail blood collected from each rats in each of the test groups, the wriggling movement of trypanosomes was observed between the blood cells (Boyt, 1984) when fresh infected blood from each rat was placed on microscopic slide, cover slip and examined under the light microscope.

The Erythrocytic Changes
The packed cell volume was determined by the microhaematocrit method as described by Dacie & Lewis (1999). Briefly; this method involved filling capillary tubes with blood to about three quarter of the length of the tube with one end sealed with cristaseal. The capillary tubes were then spun in a Hawksley microhaematocrit centrifuge for 5 minutes at 10,000rpm and PCV values were read using microhaematocrit reader. Red blood cell (RBC) was estimated using Neubauer haemocytometer (Schalm et al., 1975).

Estimation of Parasitaemia
This was carried out using the microscopic field of wet preparations. About 1.0 ml of fresh blood was obtained from the tail, pre-sterilized with 70% alcohol. The number of parasites was determined microscopically using the ‘Rapid Matching’ method of Herbert & Lumsden (1976).
Statistical Analysis

Packed cell volume (PCV) was presented as mean ± SE. Test of significance between the mean parameters were done using ANOVA and significance was considered when p<0.05.

Results

The summary of the trypanocidal efficacy of the extract (T. avicennoides), diminazine aceturate (Berenil®) and their combination in T. brucei infected rats is shown in Table 1.

Table 1: Total number of deaths, cured animals and average survival periods in the berenil® and T. avicennoides treated and untreated groups

<table>
<thead>
<tr>
<th>Indices determination</th>
<th>Uninfected untreated (Control)</th>
<th>Infected not treated</th>
<th>Infected + (treated with 3.5mg/kg berenil®)</th>
<th>Infected + 1.75mg/kg berenil®</th>
<th>Infected treated with 80mg plants</th>
<th>Infected treated berenil® 1.75mg/kg + plants.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total No. of death</td>
<td>0</td>
<td>5</td>
<td>0</td>
<td>5</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>No. of animal cured</td>
<td>5</td>
<td>0</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Average survival in days</td>
<td>28</td>
<td>13</td>
<td>28</td>
<td>19</td>
<td>18</td>
<td>28</td>
</tr>
</tbody>
</table>

Parasitological examination of the blood samples obtained 5 days post-inoculation with T. brucei showed that all rats exhibited peak parasitaemia within 5 days. The group treated with 3.5mg /Kg berenil became completely free of the parasites 3 days post-treatment while those treated with the plant extract and sub-therapeutic dose of berenil® became free 5 days post-treatment. The rats in the two groups remained parasite free throughout the 25 days of observation. However, in animals treated with 1.75mg/Kg berenil® alone, the rats were parasite inactivation for 2 days only, before relapse occurred which eventually resulted into the death of all the rats before the end of the experiment.

Rats treated with the plants extract alone (80mg/Kg) survived for 18 days, with reduced parasitaemia was (about ¾ of its peak value). The extract alone did not completely clear the rats of the parasite. In the infected not treated group, the infected rats exhibited progressive parasitaemia that resulted in early deaths on or before day 13 post-inoculation.

Effects of various treatment regiments on erythrocyte values

Results of haematological study showed that there was a significant decrease (p<0.05) in PCV and RBC of untreated parasitaemic rats within five days of inoculation when compared with the values of uninfected (control group) or in the infected but treated group (Table 2).

Table 2: The Effects of Terminalia avicennoides, diminazine aceturate (Berenil®) and its combination on some haematological values

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Uninfected untreated (Control)</th>
<th>Infected not treated</th>
<th>Infected + 3.5mg/kg berenil®</th>
<th>Infected + 1.75mg/kg berenil®</th>
<th>Infected treated 80mg plants</th>
<th>Infected treated 1.75mg/kg berenil® + plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCV</td>
<td>48 ± 2.3 x</td>
<td>32±1.8xx</td>
<td>45±1.7x</td>
<td>35±1.2xx</td>
<td>34± 2.5x</td>
<td>43 ± 2.2x</td>
</tr>
<tr>
<td>RBC</td>
<td>8.5 ± 0.3</td>
<td>43±0.2</td>
<td>8.2±06</td>
<td>5.2±0.3</td>
<td>5.0±0.4</td>
<td>8.0 ± 02</td>
</tr>
</tbody>
</table>

xx represent p< 0.05 compared to control
x represent p> 0.05 compared to infected not treated group

There were significant increases in PCV and RBC in the control group, berenil® treated group and its combination with the plant extract when compare with the infected untreated group. In the group treated with the extract alone and those treated with sub-therapeutic dose of berenil®, there was an insignificant increase (p>0.05) in both the PCV and RBC values compared with the infected untreated group.

Discussion

The parasitological findings of this study show that rats treated with 3.5mg/Kg berenil® alone and its combination with plant extracts were cured and cleared of the parasites three days post-treatment till the end of the experiments. Similarly, in rats treated with the plant extract alone, there was a significant increase in the average survival time (18 days) before they all died of parasitaemia. Although the plant extract alone was not able to clear the rats of the parasites, however in the group, where the rats were treated with a combination of the plant extract and half- therapeutic dose of berenil®, there appears to be some synergism that resulted in complete clearance of the parasites, a result...
that was not seen when the plant extract alone and half-therapeutic dose of berenil was used separately. This is in line with the work of Onyeyili et al. (1994).

In the infected, untreated group there was progressive parasitaemia, which resulted in early death of the animals in this group, showing the lethality of this infection without the plant extract or berenil or their combinations. Thus confirming therapeutic effectiveness of the agents employed in this study.

Following treatment, the haematological results obtained from this study showed that PCV and RBC increased almost at the same rate and later fell, but not to the pre-inoculation level as in the berenil-treated group, this is similar to that reported by Akinwale et al. (1999). This also in agreement with the established fact that trypanosomosis is usually accompanied by haematological depression (Anosa,1988; Ajagbonna et al.,2003; Ajagbonna et al., 2005) and this also supports the suggestion that PCV and RBC values could be used as an index of the severity of the disease (Midachi et al.,1995; Van den & Rowland, 2001). In view of these, the combination of plant extract and berenil had better efficacy when compared with the individual agents studied (berenil or the extract).

Drug combination is one of the few optimum suggestions by some workers (Ajagbonna & Olaniyi, 1999; Atougwa & Costa, 1999) to minimize current drug failure due to drug resistance and or toxicity on the face of the parasite acting either on the respiratory chain or on the cellular defence against oxidative stress (Pinto & Castro, 2009). The aromatic diamidines including berenil are known to cause hypoglycaemia in the treated animals (Laha et al., 1991). Trypanosomes as blood parasite depend on the host glucose for aerobic glycolysis (Marshall, 1948) and so the use of berenil during infection deprives them of this necessary glucose and this is responsible for their trypanocidal action. It is therefore suggested that the synergistic action observed in this study between the berenil and the plant extract of *T. avicenniodes* when used in combination might be through these mechanisms.

In conclusion, *T. avicenniodes* alone can serve as trypanocidal to some extent, but not completely as the berenil group, but prolong the life span of the animals. This study has highlighted the potential trypanocidal effect of *T. avicenniodes* bark extract, even though it could not eliminate the parasite completely, but it reduces the level of parasitaemia and improved the status of anaemia. Therefore, *T. avicenniodes* and its combination with conventional drug (Berenil) can completely clear the parasite. In this case, *T. avicenniodes* extracts serve as a potential, alternative and cheap in cost as natural product for the treatment of trypanosomosis by the local people.

The findings in this study showed that if the plant extract alone is given at higher dose than 80mg/Kg as used in this study, an appreciable result may be achieved. Thus it is recommended that further work should be carried out to determine the toxicity of the drug at a dose higher than 80mg/Kg and determination of LD50 will be of importance and enhances the acceptability of the *T. avicenniodes* extract as a trypanocide scientifically.

References


Replacement value of cassava peels for maize in the diets of broiler finisher chickens

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Abstract
A study was conducted to investigate the effects of replacing maize (MZ) with cassava peels (CSP) on the performance characteristics of broiler finisher. Five diets were formulated where MZ was replaced with CSP. The diets were diet 1 (100% MZ : 0% CSP), diet 2 (75% MZ : 25% CSP), diet 3 (50% MZ : 50% CSP) diet 4 (25% MZ : 75% CSP) and diet 5 (0% MZ : 100% CSP). Diet 1 served as control treatment. A total of 150 birds were used for the experiment. Thirty birds were assigned to each treatment and each treatment replicated three times with ten birds per replicate. The birds (arbor acre strain) were fed ad libitum for 28 days. Data on feed consumption, daily weight gain, feed conversion ratio, nutrient retention, water intake and cost benefit ratio were recorded. Results showed that average feed intake (AFI) and body weight gain (BWG) were significantly higher (P<0.05) for birds fed diet 3. Feed conversion ratio (FCR), nutrient retention and cost of feed consumed/bird decreased as CSP level increased. Water intake showed no significant difference (P>0.05) among birds for all treatments. The cost per kilogram live weight gain was lower (P<0.5) for birds fed diet 3. Cost-benefit ratio showed a reduction of 20.6% in the cost of production of birds fed diet 3 over that of control group. Average mortality of 6.67 % was recorded for birds fed diets 1, 3 and 5. It was concluded that CSP can replace MZ without any adverse effects on the performance characteristics of finisher broilers.

Keywords: broiler finisher, cassava peels, cost-benefit, maize replacement value.

Introduction
Broiler birds tend to consume large quantity of feed with increase in age especially at the finisher stage and thus their diet demands the use of large quantities of ingredients especially energy yielding ingredients. Maize is one of the most popular and commonly used ingredients in the diets of poultry. The cost of this ingredient has increased drastically due to competition between man and his livestock, problems associated with weather fluctuation, and money devaluation (Tewe, 2004). To this end, there is need to exploit the use of potential feedstuff and agro-industrial by-products such as cassava peels that are abundant in Nigeria for inclusion in the diet of poultry. Hahn (1988) reported that about 4 – 6 tons of CSP is produced in the country annually. Cassava peel constitutes 11-12% of total cassava root. Its chemical and proximate composition reveal high gross energy value of (3810 kcal/kgME), low protein (4.0%), digestible fat (0.9%), crude fiber (4.7%), ash (1.9%), and nitrogen free extract (88.5%) that could be efficiently utilized by poultry (Obioha, 1992). However, the CSP contains high levels of hydrogen cyanide and high fiber which is the most limiting factors restricting its use in the diets of poultry. On the other hand, adequate processing methods such as sun drying and inclusion of additives such as methionine, cystine and Roxazyme-G enzyme in the diets have been reported to enhance its utilization (Bashar, 1997; Ohiaege, 1999; Ojo & Deane, 2002).

Materials and methods
Study area
The study was conducted at the Poultry Production Unit of the Department of Animal Science Teaching and Research Farm, Usmanu Danfodiyo University, Sokoto. Sokoto State is located in the Sudan Savannah zone in the extreme north western part of Nigeria, between Longitudes 4° 8’ and 6° 54’E and Latitude 12° 0’ and 13° 58’N (Mamman et al., 2000). The State has a semi-arid climate, which is characterized by low rainfall of 750mm, potential evapo-transpiration rate of 162cm and long dry season from January to May and sometimes June (SSMIYSC, 2001). The average annual temperature is 34.9°C, with the highest temperature (41°C) occurring in April and lowest temperature of 13.2°C in January (Mamman & Udo, 1993).

Management of experimental birds
One hundred and fifty (150) four weeks old broiler birds were randomly assigned to five dietary treatments D1, D2, D3, D4, and D5 with 30 birds per treatment and
each treatment was replicated three times with 10 birds per replicate. Diet 1 served as the control treatment. Diets and water were fed ad libitum to the chicks for 28 days between the hours of 8.00am and 9.00am.

Preparation of experimental diets
The cassava peels (MR-8083) were obtained from Mange village of Tambuwal local government area of Sokoto state. The cassava peels were sun-dried for 10 days and spread in an open room with good air circulation for 20 days. The sundried CSP was used for feed formulation. The yellow maize, wheat offal, groundnut cake, soybean meal, fishmeal, salt and groundnut oil were purchased from Sokoto Central Market. Bone meal and blood meal were obtained from Sokoto Central Abattoir, while vitamin premix, methionine and lysine were obtained from reliable poultry and allied products company in Ibadan with their office in Sokoto. Five diets were formulated with cassava peels (CSP) and maize (MZ) replaced at levels 0, 25, 50, 75 and 100% (for Diets 1, 2, 3, 4 and 5) respectively. Diet 1 with 0% CSP served as the control diet. The diets were iso-nitrogenous and iso-caloric in composition. The gross, calculated and analyzed chemical compositions of the experimental diets are shown in Table 1.

| Table 1: Composition of the finisher diets |
|-------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Ingredients                   | Levels of replacement of maize with cassava peel (%) |
|-------------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Maize                         | 0               | 25              | 50              | 75              | 100             |
| Cassava peels                 | 54.00           | 40.50           | 27.00           | 13.50           | 0.00            |
| Wheat offal                   | 0.00            | 13.50           | 27.00           | 40.50           | 54.00           |
| Groundnut cake                | 9.20            | 8.20            | 7.05            | 5.55            | 4.20            |
| Groundnut oil                 | 22.22           | 24.10           | 26.05           | 27.95           | 29.80           |
| Others*                       | 2.60            | 1.70            | 0.90            | 0.50            | 0.00            |
| Total                         | 12              | 12              | 12              | 12              | 12              |
| Calculated analysis           |                 |                 |                 |                 |                 |
| Crude protein (g kg$^{-1}$)   | 20.02           | 20.12           | 20.23           | 20.27           | 20.31           |
| ME (Kcal kg$^{-1}$)           | 3005            | 3011            | 3020            | 3046            | 3067            |
| Crude protein (g kg$^{-1}$)   | 22.03           | 22.63           | 20.21           | 21.75           | 21.41           |
| Crude fibre (g kg$^{-1}$)     | 3.00            | 3.75            | 4.65            | 5.81            | 6.97            |
| Ether extract (g kg$^{-1}$)   | 3.00            | 2.50            | 2.50            | 2.50            | 2.00            |
| Cost/kg (N)**                 | 43.29           | 40.33           | 38.68           | 37.93           | 34.38           |

* Vitamin premix (1.0g kg$^{-1}$), blood meal (5.0 g kg$^{-1}$), bone meal (4.0g kg$^{-1}$), methionine (0.5g kg$^{-1}$), Lysine (0.5g kg$^{-1}$), salt (1.0 g kg$^{-1}$)

** Feed cost per kg was calculated on the basis of prevailing market prices of ingredients as at the time of experiment.

Nutrient retention trial
At the end of the feeding trial, nutrient retention trial was conducted using 3 birds from each replicate. The birds were fed their respective experimental diets. The trial lasted for 7 days, with 3 days for adaptation and 4 days of faecal collection. The faecal record was conducted using 3 birds from each replicate. The birds were fed their respective experimental diets. The trial lasted for 7 days, with 3 days for adaptation and 4 days of faecal collection. The period, records of daily feed intake were kept. Total faecal output from each animal was recorded daily and 20 grams of each sample of the five experimental diets and faecal samples were oven dried at 80°C and analyzed for proximate composition as outlined by AOAC (1990).

Data collection
Daily records of feed intake were taken throughout the 28 days by weighing the feed offered in the morning and the stale feed (left over) the following day in the morning, before offering the next feed. Mortality record was recorded as it occurs; body weight was recorded on weekly basis while feed conversion ratio was calculated from the records of feed intake and body weight gain. The trial was terminated at the age of eight week.

Experimental Design and Statistical Analysis
The experimental design was a completely randomized design (CRD) and data generated were subjected to analysis of variance (ANOVA) using SPSS (1999) package. Means separation was done by Duncan’s New Multiple Range Test (DNMRT) following the procedure outlined by Steel & Torrie (1980).

Results and discussion
Results of the performance characteristics of broiler finishers are shown in Table 2. The final body weights showed significant difference among treatment diets. Birds fed diet 3 recorded the highest (p<0.05) final body weight of 1,683.3g, while birds fed diet 5 recorded the least final body weight of 1,270.0g. Birds on treatments 1, 2 and 4 had similar final body weight (p>0.05). The least final body weight of 1,270.0g. Birds on treatments 1, 2 and 4 had similar final body weight (p>0.05). The final body weights of the birds following the procedure outlined by Steel & Torrie (1980).
was similar (p>0.05) for birds on diets 1, 2, 3, and 4 while birds on diet 5 recorded a significantly (p<0.05) higher FCR (2.77) compared to birds on diets 1, 2, and 3. This could be due to high level of crude fiber content of the diet which might have reduced the digestibility of nutrients. Oyebimbe et al. (2006) reported that high fiber diets usually tend to inhibit protein utilization at high inclusion levels, leading to low FCR and body weight gain. Mortality of birds did not differ significantly (p>0.05) for birds on diets 1, 3, and 5. However, the values were significantly higher (p<0.05) than those recorded for birds on diets 2 and 4.

**Cost-benefit analysis**

Table 3 showed the cost of feed (₦/kg) to progressively decrease from 43.29 in diet 1 down to 38.38 in diet 5 even though not significant. The percentage cost reduction increased as cassava peels concentration increased from 0% for diet 1 to 20.60% for diet 5. Cost of feed consumed per bird showed no significant difference among all the treatment diets. The cost of feed per kg live weight gain (₦94.50/kg) was significantly higher (p<0.05) for birds fed diet 5 and lower (p<0.05) for those fed diet 3 (₦69.20/kg). This showed that more meat could be obtained at less cost for using diet 3. However, an inclusion of cassava peels up to 75% showed no adverse effect on the performance of broiler finishers and could lead to greater reduction in cost.

**Apparent nutrient retention**

Table 4 shows the results of the nutrient retention. From the results, birds fed diets, 1, 2, 3 and 4 were similar (p>0.05) for dry matter retention. However, those on treatments 1 and 5 recorded significantly (p<0.05) different dry matter retention with control birds having better retention. The CP and CF retention followed similar pattern with the DM, while EE and Ash retention of birds were not affected by the levels of CSP. Soluble carbohydrate and NFE followed similar pattern with CP and CF.

### Table 2: Performance characteristics of broiler finisher birds

<table>
<thead>
<tr>
<th>Parameters (average/bird)</th>
<th>Levels of replacement of maize with cassava peel (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Initial weight (g/b)</td>
<td>590.3</td>
</tr>
<tr>
<td>Final weight (g/b)</td>
<td>1510.018</td>
</tr>
<tr>
<td>Body weight gain (g/b)</td>
<td>920.018</td>
</tr>
<tr>
<td>Total feed intake/bird (g/b)</td>
<td>1603.3</td>
</tr>
<tr>
<td>FCR</td>
<td>1.72</td>
</tr>
<tr>
<td>Total water intake/bird (ml)</td>
<td>6718.0</td>
</tr>
<tr>
<td>Mortality (%)</td>
<td>6.67</td>
</tr>
</tbody>
</table>

a, b, c. means not followed by same letters along the same row are significantly different (p<0.05).

### Table 3: Cost-benefit analysis

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Levels of replacement of maize with cassava peel (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Cost of fed (₦/kg)</td>
<td>43.29</td>
</tr>
<tr>
<td>Cost reduction (%)</td>
<td>0.00</td>
</tr>
<tr>
<td>Cost of Feed Consumed/bird (₦)</td>
<td>69.44</td>
</tr>
<tr>
<td>Feed Cost/kg weight gain (₦/kg)</td>
<td>75.48</td>
</tr>
</tbody>
</table>

a, b, c. means not followed by same letters along the same row are significantly different (p<0.05).

### Table 4: Apparent nutrient retention of broiler finishers

<table>
<thead>
<tr>
<th>Nutrient retention (%)</th>
<th>Levels of replacement of maize with cassava peel (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
</tr>
<tr>
<td>DM</td>
<td>71.86b</td>
</tr>
<tr>
<td>CP</td>
<td>74.96b</td>
</tr>
<tr>
<td>CF</td>
<td>81.77d</td>
</tr>
<tr>
<td>EE</td>
<td>72.40</td>
</tr>
<tr>
<td>ASH</td>
<td>68.64</td>
</tr>
<tr>
<td>NFE</td>
<td>75.54b</td>
</tr>
</tbody>
</table>

a, b, c. means not followed by same letters along the same row are significantly different (p<0.05).
The performance parameters revealed that cassava peels could be satisfactorily included in broiler ration without any negative effects on the performance but could affect the retention of DM, CP, and CF at higher levels of inclusion. Birds could also be raised at cheaper rate if cassava peels replace up to 50% of maize.

References


Serodiagnosis of hydatidosis in sheep slaughtered at Sokoto abattoir, Sokoto state, Nigeria

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\textsuperscript{1}Faculty of Veterinary Medicine, Usmanu Danfodiyo University, P.M.B. 2346, Sokoto
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Abstract
Serological screening for hydatidosis was carried out on sheep slaughtered at the Sokoto abattoir, Northwestern Nigeria. A total of 186 serum samples obtained from randomly selected animals were analysed for antigen-antibody responses using \textit{Echinococcus granulosus} IgG Enzyme Linked Immunosorbent Assay (ELISA) kit (RIDASCREEN\textsuperscript{\textregistered}). Postmortem inspection for the presence of cyst was also carried out on the selected animals. The study did not observe any antigen-antibody reaction in any of the samples screened and no cyst was found at post-mortem inspection of the selected sheep. The zero prevalence recorded suggests the need to employ some other more sensitive diagnostic techniques to ascertain the result obtained in this study.

Keywords: abattoir, hydatidosis, serodiagnosis, sheep, sokoto.

Introduction
Parasitic diseases, including hydatidosis are limiting factors in food animal production and hamper the realization of meat supply to meet the ever increasing demand for animal protein by human population (Srivastava \textit{et al.}, 1983). Hydatidosis is a parasitic zoonotic disease caused by the metacestode of the tapeworm \textit{Echinococcus spp} (Soulsby, 1982). The larval stage has a wide range of domestic and wild mammals (NAHIS, 2004). In the intermediate hosts, the larval stage develop to a large fluid filled cysts referred to as hydatid cyst (Soulsby, 1982). The lungs and liver are the most favoured predilection sites for the developing cyst (CAB International, 1989; Schantz, 1990; Biu & Abagwe, 2001). Other organs often affected are the brain and bones (Shantz, 1990). Three forms of hydatidosis are known to occur, these include Cystic, Alveolar and Polycystic hydatidosis with \textit{Echinococcus granulosus}, \textit{Echinococcus multilocularis}, \textit{Echinococcus vogeli} as the respective etiologic agents. \textit{E. oligarthrus} is also reported to cause Polycystic hydatidosis (NAHIS, 2004). Dogs become infected by eating infected carcass of the affected intermediate host. Hydatidosis has a worldwide distribution. Agricultural practices, indiscriminate home slaughtering and poor disposal of cysts from livestock, lack of adequate control policy, uncontrolled movement, trading of animals and their products and difficulty in early diagnosis enhance the distribution of the disease (Dada and Belino, 1979). Infection is often associated with economic losses due to livestock mortality, morbidity, and organ and meat condemnation at meat inspection. It also poses a serious threat to public health where close association exists between dogs, man, and food animals (Blaha, 1989). Several studies have shown that these diseases are significant concern to public health and are regarded as the current emerging or re-emerging diseases (Dada \textit{et al.}, 1979).

In Nigeria, there is paucity of information on hydatidosis in domestic livestock and most of the documented reports are based on postmortem findings from abattoir. The prevalence of this infection in domestic livestock varies from one...
Abattoir records are important source of information during hydatid studies. This is particularly important because ante-mortem inspection of animals for hydatid cyst is unreliable, because most infections are asymptomatic especially at early phase. Postmortem inspection is valuable when cyst has develop to a size that can be visualized or palpated.

Serological tests for diagnosis of hydatidosis are useful because of ease of performance and sensitivity. The ELISA is considered an effective method overall to evaluate the immune status of animal and human. This diagnostic approach is more reliable and gives more correct disease prevalence when employed as a diagnostic tool.

In this study, the Enzyme Linked Immunosorbent Assay (ELISA) technique using a commercially prepared *E. granulosus* IgG ELISA kit (RIDASCREEN® of r-biopharm, Germany) was used for sero-epidemiological study of ovine hydatidosis along side with a postmortem examination for cystic lesion on randomly selected sheep slaughtered at the Sokoto abattoir.

**Materials and methods**

**Study Area**

The study was conducted in Sokoto state, Nigeria. The State shares common borders with Niger Republic to the North, Kebbi state to the South, and Zamfara state to the East. The Sokoto abattoir is a slaughterhouse that serves Sokoto town and neighbouring villages.

**Sample collection and Postmortem Examination**

The animals used for the study were randomly selected at slaughter. The sex, age and breed of each slaughtered animal were recorded. Following slaughter each animal undergo a thorough postmortem examination for the cystic lesion. Blood samples were collected from each selected sheep into labeled sample bottles accordingly. The blood samples were then transported to Veterinary Public Health laboratory of Usmanu Danfodiyo University, Sokoto, Nigeria. The sera were harvested for the qualitative determination of IgG antibodies against *E. granulosus*.

**Enzyme Linked Immunosorbent Assay (ELISA)**

RIDASCREEN® *E. granulosus* IgG micro well ELISA test is an immunoassay for the qualitative determination of IgG antibodies against *E. granulosus* in serum. The micro well plates are coated with purified antigens from *E. granulosus* cysts commercially obtained. Fifty (50) ml of the washing buffer (phosphate-buffered NaCl solution) was dissolved in 950mls of distilled water and stored at room temperature. Ten (10) µl of the serum samples were diluted in a 490µl of the sample buffer solution (phosphate-buffered NaCl solution), one hundred (100) µl of each of the diluted samples in buffer solution was placed on micro titre well plate coated with specific *E. granulosus* antigens. One hundred (100) µl of each of the positive controls (IgG positive control, human serum) and negative controls (IgG negative control, human serum) were pipetted into each of the corresponding wells and incubated at a temperature of 25°C for 15 minutes. The plate was washed 5 times after incubation using washing buffer. One hundred (100) µl of the conjugate (anti-human IgG conjugate) was pipetted to each of the wells and incubated at 25°C for 15 minutes and the plates were washed 5 times. Fifty (50) µl of each of the substrate (urea peroxidase) and chromogen (tetramethylbenzidine, TMB) were pipetted into the wells and incubated at 25°C for 15 min and 50µl of the stop reagent (0.5M sulphuric acid) was added to each of the wells. There was a colour change from blue to yellow in each of the control wells only. The optical density (OD) values were read in a microplate reader (Dynatech MR 5000) at 450nm, ELISA cut off values of all serum samples were set at the mean OD values. OD reading greater than 0.9 were considered to be positive, those less than 0.3 were considered negative and those in between were interpreted as equivocal.

**Results**

A total of 186 sheep were sampled and screened during the study. This comprised of 123 (66.13%) males and 63 (33.87%) females. No antigen-antibody reaction was observed in all of the samples. The breed of sheep involved in the studies were Ouda, Balami, Yankasa and Sudanese cross and the age variation range from less than a year to above five years (Table 1). No hydatid cyst lesion was found during postmortem examination of the corresponding carcasses. Therefore, the overall prevalence of *E. granulosus* IgG antibodies in sheep slaughtered at Sokoto abattoir during this study was found to be zero.
Table 1: Serodiagnosis of Echinococcus granulosus in Sheep slaughtered at Sokoto abattoir

<table>
<thead>
<tr>
<th>Breed</th>
<th>No. Sampled</th>
<th>No. Positive</th>
<th>Prevalence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ouda</td>
<td>174</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>Balami</td>
<td>7</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>Yankasa</td>
<td>3</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>Sudanese cross</td>
<td>2</td>
<td>0</td>
<td>0.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sex</th>
<th>No. Sampled</th>
<th>No. Positive</th>
<th>Prevalence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>123</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>Female</td>
<td>63</td>
<td>0</td>
<td>0.00</td>
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</table>

<table>
<thead>
<tr>
<th>Age group</th>
<th>No. Sampled</th>
<th>No. Positive</th>
<th>Prevalence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1 yr</td>
<td>81</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>≥1 - &lt;2 yrs</td>
<td>59</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>≥2 - &lt;3 yrs</td>
<td>10</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>≥3 - &lt;4 yrs</td>
<td>12</td>
<td>0</td>
<td>0.00</td>
</tr>
<tr>
<td>≥4 - ≥5 yrs</td>
<td>24</td>
<td>0</td>
<td>0.00</td>
</tr>
</tbody>
</table>

Discussion

Hydatidosis is an important zoonotic disease and is currently tagged a disease of unrecognized increasing importance (Jenkins, 1998). The application of serodiagnostic techniques for epidemiological studies of hydatidosis provides more accurate information on the prevalence of this infection because the technique could detect asymptomatic cyst carriers. This study found a zero prevalence of E. granulosus IgG antibodies in sheep slaughtered at Sokoto abattoir. The result contradicts similar studies on sheep conducted in Yobe state, north eastern Nigeria, where Tijjani et al. (2010) reported a prevalence of 0.01%. It also contradicts the results of Luka et al. (2009) who reported a prevalence of 36.2% in Kano, Nigeria. Ouda and Balami were the most predominant breed of sheep found to be infected in this reported studies (Tijjani et al., 2010). The result also disagree with earlier studies conducted in this area where Dada and Belino, (1979) observed a prevalence of 18.9%.

The zero prevalence recorded in this study may be attributed to several factors. This may be due to the fact that natural intermediate host animals produce very poor antibody responses to infection due to antibodies of the parasite produced at early stage compared with the relatively high levels of specific antibodies seen in human infection (Lightowlers & Gottstein, 1995). The zero prevalence in this study may also be as a result of periodic treatment of small ruminants with anthelmintics by the pastoralists who now patronize veterinary services (Tijjani et al., 2010) due to increase awareness on the benefits of deworming their animals, sheep brought in for slaughter are usually in good body condition, since they are slaughtered in order to fetch more money for subsistence. Dogs serve as the definitive host of the parasite and a prevalence of 26.69% of the parasite was recorded in dogs at Sokoto (Magaji, 2011), they get infected when they feed on infected offals from the intermediate hosts thrown away from abattoir or slaughter slabs or during festivities.

In conclusion, the zero prevalence obtained suggests low prevalence of the disease in the study area, however, an alternative and more sensitive diagnostic technique should be employed to ascertain the status of the disease in other food animals and humans in the study area.

References


linked immunosorbent assays (ELISAs) for the detection of serum antibodies in sheep infected with *Echinococcus granulosus*. Veterinary Parasitology, 110:57-76.


Prevalence of *Cysticercus tenuicollis* cysts in sheep slaughtered at Sokoto abattoir, Sokoto state, Nigeria

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Abstract
A prospective study was conducted based on the principle of post mortem examination on sheep slaughtered at Sokoto abattoir for the presence of *Cysticercus tenuicollis* cysts. A total of 261 sheep were examined with 34 (13.03%) infected. Prevalence of infection increased with the age of the animals. Males had relatively higher prevalence than females. Infection was recorded in several visceral organs with omentum having the highest prevalence (35.29%) and the lungs the least (11.76%). The results suggest that *C. tenuicollis* is common and may constitute a health problem in sheep and a source of economic loss in the meat industry, thus emphasizing the need for proper meat inspection and handling of offals in the study area.

Keywords: *Cysticercus tenuicollis*, sheep, slaughter, sokoto, nigeria.

Introduction
Livestock may act as the intermediate hosts for the tapeworms of humans and other animals. Cestodes of the family *Taeniidae* which infect the dog (definitive host) are transmitted to a range of intermediate host species where they may cause hydatidosis, cysticercosis or coenurusosis (Flisser et al., 1982; Eckert et al., 1984; Thompson & Lymbery, 1995). The larval tapeworms (metacestodes) develop as fluid-filled cysts that may act as space-occupying lesions and cause organ condemnation at meat inspection (Radostits et al., 2007).

The mature tapeworm, *Taenia hydatigena*, lays eggs which pass out in the faeces of the host and are ingested by the ruminant intermediate host during grazing. Ingested eggs hatch in the small intestine and later migrate to reach the liver and other visceral organs like the, lung, heart, kidney and intestines of the intermediate host in which they may not be a major cause of concern. There may be only signs of abdominal pain, colic, loss of appetite, emaciation and unthriftiness (Singh et al., 2003) although the migration of cysticerci in the liver may also cause hepatitis cysticercosa leading to haemorrhagic and fibrotic tracts and serofibrinous peritonitis (Soulsby, 1982; Blazek et al., 1985) and in very heavy infections, the migrating larvae destroy the hepatic cells with eosinophilic infiltration and severe inflammation that may prove to be fatal. *Cysticercus tenuicollis* infection may constitute a health problem to sheep and thus a source of economic loss in the meat industry (Flisser et al., 1982; Abidi et al., 1989).

Previous studies suggest that inspection of sheep at abattoirs represent one of the perfect and accurate methods of diagnosis of metacestodes infections (Gracey et al., 1999).

Materials and methods
The study was conducted in Sokoto state, Nigeria. The state shares borders with Niger Republic to the North, Kebbi state to the South, and Zamfara state to the East. Sokoto abattoir serves Sokoto town and neighboring villages with meats.

A total of 261 sheep comprising 183 males and 78 females were examined postmortem for the detection of *C. tenuicollis* during slaughter and evisceration at the abattoir. Heart, esophagus, diaphragm, liver, kidneys, lungs, masseter muscle (internal and external), the peritoneal cavity and skeletal muscles were examined, palpated and incised for detection of *C. tenuicollis*. Positive samples were taken to Public Health and Preventive Medicine laboratory, Faculty of Veterinary Medicine, Usman Danfodiyo University, Sokoto for examination.

The samples collected were confirmed to be *Cysticercus tenuicollis*.
tenuicollis cysts using their predilection sites, size and morphology. Pictures of the cysts were captured using digital Camera (Sony, Carl Zeisis, Optical Zoom 4X, 7.2 megapixels), modified and resized using computer program Microsoft office (2007 version).

**Results**
Post mortem inspection of 261 sheep carcasses at Sokoto abattoir revealed *Cysticercus tenuicollis* cysts in 34 (13.03%) of the animals. Out of 184 male and 78 females examined, 25 (13.66%) and 9 (11.54%) were respectively infected. Among age groups, the prevalence of infection was 10.17%, 11.18% and 24.39% for sheep aged 6-12 months, 12-24 months and above 24 months respectively. Prevalence of cysts at various sites were liver, 11 (32.35%); omentum, 12 (35.29%); mesentery, 7 (20.59%) and lungs, 4 (11.76%) (Table 1).

<table>
<thead>
<tr>
<th>Table 1: Prevalence of <em>Cysticercus tenuicollis</em> in sheep slaughtered at Sokoto, Nigeria</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number examined</strong></td>
</tr>
<tr>
<td>All animals</td>
</tr>
<tr>
<td>Sex</td>
</tr>
<tr>
<td>Male</td>
</tr>
<tr>
<td>Female</td>
</tr>
<tr>
<td>Age (months)</td>
</tr>
<tr>
<td>&lt; 12</td>
</tr>
<tr>
<td>12 - 24</td>
</tr>
<tr>
<td>&gt; 24</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2: Prevalence of <em>Cysticercus tenuicollis</em> in different organs of sheep (n=261)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Omentum</strong></td>
</tr>
<tr>
<td>No. positive (%)</td>
</tr>
<tr>
<td>12 (35.29)</td>
</tr>
</tbody>
</table>

Plate I: *C. tenuicollis* in mesentery of sheep (arrow).
Plate II: *C. tenuicollis* in lungs capsule of sheep (arrow).
Discussion
The prevalence of 13.03% recorded in this study is relatively high probably because most sheep in the study area are reared in company of dogs the definitive hosts of the parasite. Dada & Belino (2006) recorded a higher prevalence of 21.4% in Kano in essentially the same geographical zone as the study area. Also, relatively higher prevalence of 16.7% and 23.27% were respectively reported from Turkey (Hasslinger and Weber-Werrington, 1988) and Egypt (El-Masry, 1986). On the other hand, similar or lower prevalence of 12.8% and 1.25% were respectively recorded in sheep in Iran (Radfar et al., 2005) and Saudi Arabia (El–Metenawy, 1999). As observed by Radfar et al. (2005), the grazing behavior and management system of the animals may be responsible for the differences in prevalence between this and the other studies. The present study suggest that the prevalence of infection increases with age of the animals, thus agreeing with the findings of Abu-Elwafa et al. (2009) which showed higher prevalence in aged than young animals. However, in the present study, there was no significant difference in prevalence between the sex groups.
Although C. tenuicollis is not zoonotic, it may be an important cause of economic loss in the meat industry since viscera harbouring them may be rejected for aesthetic reasons (Jibat et al., 2008). The threat these parasite poses to the small ruminants meat industry in Nigeria is evident due to the present situation of improper disposal of offal at abattoirs and backyard slaughter. The presence of freely roaming stray dogs on grazing land and the deep rooted habit of feeding dogs with ruminant offal, including are important risk factors. This may lead to the perpetuation of infection in the environment (Jibat et al., 2008). The financial loss from condemnation in the abattoir is considered high. The results of this study suggest that infection of sheep with Cysticercus tenuicollis is common in Sokoto, Nigeria and that this may constitute economic and health problems in the meat industry.

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Hasslinger MA & Weber-Werringhen R (1988). Fecal surveys in pastured sheep and the occurrence of
Oral choristoma in one and a half year-old ouda ewe: a case report

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Abstract
A one and a half year old ouda ewe was presented with a firm, solid mass on the inner lateral wall of oral cavity attached to the gingiva. Histopathological findings indicate oral choristoma. The condition was managed surgically by excising the mass, flushing the oral cavity with mild chlorhexidine gluconate, administration of broad spectrum antibiotic, steroidal anti-inflammatory and multivitamin injection.

Keywords: choristoma, ewe, histopathology, oral cavity, ouda.

Introduction
Choristoma are tumor-like masses of normal cells or tissue that develops in an ectopic location (Neville et al., 1995). Several different tissue types may occur in the mouth as choristomas. These include bone, cartilage, gastric mucosa, glial tissue, and tumor-like masses of sebaceous glands (Chou et al., 1991). However the most frequently observed choristomas of the oral cavity are those that consist of bone (Shimono et al., 1984; Tohill et al., 1987). These lesions have also been called soft tissue osteomas, but osseous choristoma is a more accurate term as the lesions are not true neoplasms (Kroll et al., 1971). Choristomas occur most frequently in the tongue (Vander Wall, 1987) and less commonly in other sites such as buccal mucosa (Long and Koutnik, 1991; Gaitán-Cepeda et al., 2003) and alveolar mucosa (Sheridan, 1984; Tohill et al., 1987).

Monserrat was the first to report an osseous lesion in the tongue in 1913 and he labeled it as ‘lingual choristoma’, the term that normally describes neoplastic pathology (Naik et al., 2009). Krolls changed this term later to ‘osseous choristoma’ in 1971, which means a mass consisting of normal cells in an abnormal location. He used this term as he noticed that these lesions were not osteogenic in origin and not progressively enlarging like benign lesions (Kroll et al., 1971). Clinically, these lesions were described as a hard mass, either pedunculated or sessile (Andressakim et al., 2008). All lesions were treated by surgical excision with uneventful healing. Recurrence or malignant transformations were not reported.

Case report
A one and a half year old Ouda ewe weighing 24 kg was presented to the large animal clinic of Usmanu Danfodiyo University, Sokoto Veterinary Teaching Hospital with a complaint of swelling around the base of the mass was crushed with two heavy artery forceps and ligated with Becton® chromic catgut size 0, atraumatic; ½ circle taper point needle (Anhui Kangning Industrial Groups, China) before transection. The
Plates I: The patient at presentation, with oral mass (arrow)

Plate II: Ewe with subcutaneous thick mass

Plate III: Surgical exposure of the mass (arrow)

Plate IV: The skin closure with ford-interlocking suture patterns (arrow)

Plate V: Photomicroscopic appearance of the mass with collagen deposit (CD) and neutrophilic infiltrates (NI) suggestive of microscopic features of skin with normal mitotic index x200 stained with H&E

Plate VI: Photomicroscopic appearance of the mass Collagen fibres (CF) suggestive of skin microscopic skin feature with normal mitotic index x200 stained with H&E
transected mass was then preserved in 10% buffered formalin solution for histopathological examination. The skin was closed with Agary® Nylon size 0, atraumatic; 1/4 curved cutting needle (Agary Pharmaceutical LTD, Xinghui, China) using ford-interlocking suture pattern (Plate IV).

Post surgically, the following treatment was instituted: Penstrep® injection (Aether Centre, Beijing, Biological Co., LTD) procaine penicillin 200mg and dihydrostreptomycin 250mg at dose rate of 20,000 IU/kg\(^1\) and 10 mgkg\(^{-1}\) respectively intramuscularly for five days, 0.2% dexamethason injection (Aether Centre, Beijing, Biological Co., LTD) at 2 mgkg\(^{-1}\) intramuscularly for two days, multivitamin injection (Aether Centre, Beijing, Biological Co., LTD) 3ml intramuscularly for five days and daily dressing and flushing of the surgical site for seven days.

Histopathological section of the mass revealed normal cell morphology at abnormal site, the mitotic index were within normal range microscopic features observed were inflammatory infiltrates, collagen deposit and collagen fiber, suggestive of skin located in an abnormal site (Plate V and VI). Based on the histopathological finding, diagnosis of choristoma was made. The patient was hospitalized throughout the period of treatment; it was discharged after sutures were removed at day 14 post surgery.

**Discussion**

Choristoma is histologically an island of normal tissue that occurs in an abnormal location. In contrast, a hamartoma is a mass composed of histological normal cells in an anatomically normal location (Steinbach et al., 2004).

The pathogenesis of lingual choristoma is still uncertain but it is not a debatable entity because its existence is well recognized (Vered et al., 1998). Several theories have tried to explain the pathogenesis of these lesions. In general, these theories can be divided into two main categories; the developmental malformation theory and the reactive (posttraumatic) theory (Kroll et al., 1971; Supiyaphun et al, 1998).

**References**


The first developmental theory is based on the anatomic location of the lesion in the foramen cecum. Embryologically, the anterior two-thirds of the tongue originate from the first branchial arch and the posterior one-third originates from the third branchial arch. The union takes place in the region of the foramen cecum and the sulcus terminalis. Both of these arches also give rise to normal bony structures such as the middle ear bony ossicles and the hyoid bone. Therefore, it was suggested that pluripotential cells from these branchial arches might give rise to these osseous lesions (Benamer and Elmanagoush, 2006). Supiyaphun, et al., (1998) reported that, the second developmental theory is associated with remnants of thyroid tissue. The foramen cecum is the site of the development and the descent of the future thyroid gland in the neck and it was suggested that the remnants of the undescended thyroid tissue might produce osseous proliferating lesions later in life.

The reactive (posttraumatic) theory is based on the fact that there is frequent and constant irritation by different lingual activity such as swallowing and articulation. This frequent trauma can lead to local inflammation, similar to what happens in the case of ‘myositis ossificans’. However, this theory cannot explain the formation of fully developed bone with the haversian system and not the zonation seen in myositis ossificans (Vered et al., 1998).

We reported a case from an ewe with an oral choristoma that closely resembles a hamatoma described in literatures. To the best of our knowledge this is the first report of choristoma in animal in Sokoto. We recommend histologic sectioning of all mass grossly suspected to be neoplastic in nature for proper and accurate diagnosis.

**Acknowledgment**

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