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Effect of urea-fortified all concentrate corncob diets on serum biochemical and hematological indices of West African dwarf goats

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Abstract. The experiment was carried out to determine the effect of urea-fortified all-concentrate corncob diets on hematological indices and serum biochemical parameters of West African dwarf goats. Fifteen (15) West African dwarf goats (divided into 5 groups – one control and 4 experimental) with average weight of 9.33kg were used for the study, which lasted 70 days. The animals were weighed and randomly assigned to five (5) treatments in a complete randomized design (CRD). The treatments were with different levels (% 0, 1, 2, 3 and 4) of urea in corncob-based concentrate diets. Results of the hematological indices showed that packed cell volume and red blood cell values were significantly different (P<0.05) among treatment groups. Serum biochemistry showed that blood urea and albumen concentration were influenced (P<0.05) by dietary urea level. The other values of the blood biochemical indices and the parameters of hematology were similar (p>0.05) among dietary groups. The incorporation of urea in corncob diets has no negative effect on the animal and a 3% inclusion of urea showed good values for a healthy goat based on the blood biochemical and hematological indices.

Keywords: goats, corncob, blood biochemical and hematological indices

Introduction

In Nigeria, cereal crop residues of sorghum, maize, millet and rice are the most important in quantities which can be used to feed ruminants. Thus, several tons of crop residues capable of feeding millions of livestock such as cattle, sheep and goats are produced annually in Nigeria. However, improved utilization of crop residues can be achieved either through appropriate supplementation (legumes, urea, etc.) or chemical treatment (urea/ammonia) both of which facilitate the microbial breakdown of the cell wall of the crop residues.

The nutritive value of poor quality roughages like corncob can be improved by different methods of treatment and supplementation. Urea is an inorganic compound that contains 46.7% of nitrogen compared to 16% for most proteins. Urea treatment has, however, emerged as the method of choice for use at farm level in the tropics as it is best adapted to the conditions of smallholder farmers (Chenost, 1995). The key to improve the use of corncob for ruminants is to overcome the barriers to rumen microbial fermentation of lignocelluloses. The two well known factors of corncobs that limit bacterial digestion in the rumen are its high level of lignifications and low contents of nitrogen, vitamins and minerals. Therefore, in principle of urea use, there are two approaches, which should be taken in combination; corncob delignification treatment and nutrient supplementation, indicated there are improvements in digestibility from increasing the level of ammonia above 3 to 4% (Sundstøl et al., 1978; Chenost, 1995). However, Chenost (1995) recommended treating straw with 5% urea as it has produced satisfactory results in Africa and Asia. While urea supplementation is more commonly used in protein supplements, urea may often be broken down to ammonia in the rumen at a rate faster than the rumen microflora can utilize for the formation of proteins, amino acids, or other nitrogenous compounds. Therefore, there is need to reduce the rate of urea breakdown in the rumen. Coating the urea particles with waxes and similar substances has been tried but has been found ineffective (Dinesh Panday, 2010). Biuret has been studied in ruminant diets since the 1970s (Fonnesbeck et al., 1975). More recently, slow release of urea in the rumen has been achieved by binding urea to lignin (Castro et al., 1999).

Blood is a good indicator of physiological and pathological changes in an organism, that is used in assessing the body's ability to respond to hematological and serum biochemical upset (Okoruwa and Ikhimioya, 2014). These changes are of value in assessing response of animals to various physiological situations (Khan and Zafar, 2005). Ogunbajo et al. (2009) reported that nutritional studies should not be limited to performance alone, but the effect on the blood constituents is also a vital tool that helps to detect any deviation from normal in the animal's body. As reported by Isaac et al. (2013), animals with good blood composition are likely to show good performance. The analysis of blood gives the opportunity to trace the presence of several metabolites and other constituents in the body of animals and it plays a vital role in the physiological, nutrition and pathological status of an organism (Aderemi, 2004; Doyle, 2006). This study assessed the hematological indices and serum biochemical profiles of dwarf goats fed with urea-fortified corncob diets.

Material and methods

Experimental Site

The study was conducted at small ruminant unit of the Teaching and Research Farm, University of Ilorin, Ilorin (82° 9'N, 43° 5'E) located at an elevation of 305 m above the sea level in the North
Central zone of Nigeria. The average annual rainfall of the area is 1234.4 mm while the mean annual ambient temperature is 27 °C. Relative humidity is between 35% and 80% (the higher values are during the rainy season), (Olofintoye and Salami, 2011).

**Experimental Feeds**

Diets were formulated using corn cob, cotton seed cake, mineral/vitamin, salt and urea for 51.5, 46.5, 1.0, 1.0 and T1 0 to T5 4%, respectively. Corn cob was collected from Teaching and Researcher Farm, University of Ilorin. After harvesting and processing, the corn cob was sun-dried and milled into small particles suitable for mixing with other feed ingredients.

**Experimental Animals, Feeding and Management**

Fifteen (15) growing West African dwarf goats, with average weight of 9.33 kg were used for the study. The animals were given prophylaxis against internal and external parasites and were allotted to five dietary treatments in a completely randomized manner with three animals per treatment. The animals were fed for seven (7) days as an adaptation period before measurement commenced and the study lasted 70 days. Experimental diets were fed to the animals once daily by 8.00 h AM at the rate of 5 % of their body weight with free access to water (ad libitum).

**Blood Samples Collection and Analysis**

At the end of the feeding trial, two goats were randomly selected from each replicate. The blood samples were collected from two animals per treatment at the last day of the study before terminating the experiment. Blood samples were collected from each animal by jugular-venipuncture using disposable syringes and sterile needles (18 gauge). Prior to feeding in the morning, bleeding was done and an average of 10ml of blood was collected from each animal. The blood samples were placed in two vacutainers. One contained ethylene diamine tetra-acetic acid (EDTA) for hematological studies as described by (Al-Eissa and Alkahtani, 2011), the second bottle contained no anticoagulant and it received the remaining blood which was allowed to stand for about 2 hours at room temperature. The universal bottles were thereafter centrifuged at 700xg for 15 minutes, the serum separated was decanted and stored in a freezer at -10ºC for blood biochemical analysis as reported by Gambo et al. (2011). MCV, MCH and MCHC were deduced according to Jain (1986) as follows:

\[ MCV (fl) = PCVX10/RBCX10; \]
\[ MCH (pg) = HbX10/RBC (10^6); \]
\[ MCHC (%) = HbX100/PCV. \]

From the centrifuged blood sample in plain bottles, serum was collected for biochemical assay. Total protein and albumin were determined by the Biuret method and Bromocresol Green method, respectively. Blood Urea Nitrogen (BUN), Creatinin, Bilirubin as well as activities of the liver enzymes (AST and ALT) were determined by Standard Enzymatic method as outlined by Bush (1991). Serum Cholesterol was determined by Burchad reaction.

**Chemical and Statistical Analyses**

Samples of the experimental diets were analyzed for proximate analysis using the procedures of AOAC (2002). Data generated from the hematological indices and serum biochemical profile were subjected to one way analysis of variance (ANOVA). Significant difference between treatments means were separated using Duncan’s Multiple Range Test (Steel and Torrie, 1980).

**Results**

**Hematological parameters**

The hematological parameters of West African dwarf goats fed all-concentrate corn cob diets are shown in Table 1.

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**Table 1. Influence of urea-fortified all-concentrate corn cob diets on hematological indices of dwarf goats**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCV (%)</td>
<td>33.5*</td>
<td>25.5**</td>
<td>28.0*</td>
<td>27.5*</td>
<td>16*</td>
<td>2.406*</td>
</tr>
<tr>
<td>HB (g/dl)</td>
<td>9.35</td>
<td>7.65</td>
<td>9.35</td>
<td>9.20</td>
<td>7.0</td>
<td>0.7835*</td>
</tr>
<tr>
<td>WBC (x109/L)</td>
<td>7.90</td>
<td>12.2</td>
<td>8.9</td>
<td>10.1</td>
<td>11.3</td>
<td>0.6588*</td>
</tr>
<tr>
<td>RBC (g/dl)</td>
<td>6.2*</td>
<td>5.45*</td>
<td>5.05*</td>
<td>6.40*</td>
<td>4.15*</td>
<td>0.3263*</td>
</tr>
<tr>
<td>MCV (fl)</td>
<td>54.85</td>
<td>46.34</td>
<td>55.5</td>
<td>44.85</td>
<td>38.7</td>
<td>3.8716*</td>
</tr>
<tr>
<td>MCH (pg)</td>
<td>15.7</td>
<td>13.95</td>
<td>18.55</td>
<td>15.0</td>
<td>17.05</td>
<td>1.6992*</td>
</tr>
<tr>
<td>MCHC (%)</td>
<td>27.95</td>
<td>28.35</td>
<td>33.40</td>
<td>33.45</td>
<td>43.10</td>
<td>2.5706*</td>
</tr>
<tr>
<td>WBC Differentials</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lymphocytes (%)</td>
<td>52.50</td>
<td>54.50</td>
<td>54.50</td>
<td>55.00</td>
<td>56.5</td>
<td>0.9092*</td>
</tr>
<tr>
<td>Neutrophiles(%)</td>
<td>46.0</td>
<td>43.5</td>
<td>44.5</td>
<td>42.5</td>
<td>44.5</td>
<td>0.6960*</td>
</tr>
<tr>
<td>Monocytes (%)</td>
<td>1.5</td>
<td>2.0</td>
<td>1.0</td>
<td>1.0</td>
<td>0.5</td>
<td>0.3590*</td>
</tr>
</tbody>
</table>

a,b= Means in the same row with different superscript differ significantly (P<0.05)

NS= Not significant

* = Significant (P<0.05).

SEM=Standard error of means

PCV=Packed Cell Volume;

HB=Haemoglobin;

RBC=Red Blood Cell;

WBC= White Blood Cells;

MCV=Mean Corpuscular Volume;

MCH=Mean Corpuscular Haemoglobin;

MCHC=Mean Corpuscular Haemoglobin Concentration;
There were significant (P<0.05) differences among the treatments in Packed Cell Volume (PCV) and Red Blood Cell (RBC) values, while Hemoglobin (Hb), White Blood Cell (WBC), Mean Corpuscular Volume (MCV), Mean Corpuscular Haemoglobin (MCH), Mean Corpuscular Haemoglobin Concentration (MCHC) and White Blood Cell differential values were not influenced (P>0.05) by treatment. The Packed Cell Volume (PCV) of the WAD goats fed all-concentrate corncob diets were significantly (P<0.05) different among the treatment groups. The PCV value of the WAD goats fed all-concentrate corncob diets ranged from 16 to 33.5%. The haemoglobin of the WAD goats ranged from 7.0 to 9.35 g/dl and depended on the percentage inclusion of urea. The haemoglobin values of the WAD goat fed all concentrate corncob diets were similar (P>0.05) among treatment groups. The haemoglobin values were in the normal range (8 - 12 x 10^6 /L) for goats (Ikhimioya and Imasuen, 2007). The WBCs of the WAD goat ranged from 7.9 to 12.2 x 10^6 /L while the lymphocyte (one of the WBC precursors) in the WAD goats was comparably the same (P > 0.05) among treatment groups. The lymphocytes values ranged from 52.5 to 56.5 % for 0 % and 4 % urea inclusion diets, respectively. The Neutrophiles (one of the WBC precursors) of the WAD goats values ranged from 42.5 to 46.0 %. The RBC count ranged from 4.15 to 6.40 g/dl; the Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH) and the Mean Corpuscular Hemoglobin concentration (MCHC) values ranged from 38.7 to 55.5 (fl) of MCV, 13.95 to 17.05 (pg) MCH and 27.95 to 43.10 (%) of MCHC for goats fed all-concentrate corncob diets.

**Blood biochemistry parameters**

The serum biochemistry of West African dwarf goats fed all-concentrate corncob diets are presented in Table 2.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>% Urea inclusion</th>
<th>SEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total protein (g/dl)</td>
<td>0.7200</td>
<td>0.6000</td>
</tr>
<tr>
<td>Urea (mg/dl)</td>
<td>1.0150</td>
<td>2.340</td>
</tr>
<tr>
<td>Creatinine (mg/dl)</td>
<td>1.0750</td>
<td>1.1350</td>
</tr>
<tr>
<td>Albumin (g/dl)</td>
<td>2.035a</td>
<td>2.305</td>
</tr>
<tr>
<td>Bilirubin (mg/100ml)</td>
<td>0.7550</td>
<td>2.340</td>
</tr>
<tr>
<td>ASI (iu/L)</td>
<td>5.6950</td>
<td>0.7200</td>
</tr>
<tr>
<td>ALT (iu/L)</td>
<td>8.2350</td>
<td>4.6650</td>
</tr>
</tbody>
</table>

a, b, means in the same row with different superscript differ significantly (P<0.05); NS = Not significant.

SEM = Standard error of means, AST = Aspartate Aminotransferase, ALT = Alanine Aminotransferase.

The blood urea and albumin were significantly (P<0.05) different among the treatment groups. Total protein, Creatinine, Bilirubin, Aspartate Aminotransferase and Alanine Aminotransferase were not statistically (P>0.05) different among the treatment groups. The total protein of the WAD goats ranged from 4.665 to 5.900 g/dl for diets with 1 - 3 % urea inclusion. In the goat studied, blood urea (mg/dl) ranged from 13.955 to 19.390; creatinine was between 0.72 and 1.135 (mg/dl); albumen (g/dl) ranged from 2.035 to 2.650 while bilirubin (mg/100ml) was between 0.2750 and 1.7900. The Aspartate Aminotransferase and Alanine Aminotransferase studied in blood of the West African dwarf goat were not significantly (P>0.05) different among treatment groups. The AST and ALT of the West African dwarf goats ranged from 4.650 to 8.425 iu/L and from 7.305 to 14.895 iu/L, respectively.

**Discussion**

**Hematological parameters**

The Packed Cell Volume (PCV) values (24 to 48%) observed in this study for the WAD goats were within the normal range as reported by Banerjee, (2004) ranged from for healthy goats. The goats on 4 % urea had less than normal values, perhaps due to high inclusion of urea. The values of hemoglobin reported for the WAD goat fed the urea-fortified diets were relatively good and seemed to be capable of supporting high oxygen carrying capacity of blood in the animals (Ikhimioya and Imasuen, 2007). The WBC counts were comparable with the range of values (9.42 to 13.08 x 10^6 /L) (Waziri et al., 2010) for goats. However, following the report of Aiello (2000) WBC values fell within the normal range (4 to 13 x 10^6 /L) for healthy goats. The higher WBCs count recorded in the WAD goats fed 1% and 2% urea inclusion diets may be due to the response of the animals to report of Bush (1991) and may be due to differences in diets occasioned by urea inclusion. Lymphocytes play an important role of imparting immunity (Sembulingam and Sembulingam, 2002). The Neutrophiles normal range (14.5 – 41.5%) for goat reported by Mitraku and Rawnsley (1977) is slightly above the values observed in this study. The RBC was below the normal range of values reported by Daramola et al. (2005) for West African dwarf goat. The MCV, MCH and MCHC values reported for the goat in this study were within the normal range of 28.4 – 31.6 fl, 9.20 – 9.80 pg and 30.0 – 34.4%, respectively, reported by Mitraku and Rawnsley (1977). These parameters were used to measure the size and hemoglobin content of erythrocytes and the values are useful in diagnosing various forms of anemia.
Blood biochemistry parameters

The established total protein values were close to the average value (7.30 g/dl) reported by Taiwo and Ogunsanmi (2003) for West African dwarf goats. The levels recorded in this study fell within the range of the reference values (12.6 – 25.8 mg/dl) reported by Aiello (2000). The higher value obtained in serum urea for animals on 4 % urea inclusion diet was an indication of poor efficiency of utilization of nitrogen and urea recycling and could affect the amino acid balance. The blood urea levels in the study were within the recommended limits and suggested that the kidneys and liver in the body of the West African dwarf goats were functioning well. The levels of creatinine in serum recorded in this study were in the normal range and compared with the average value (0.94mg/dl) for Sahel goat (Waziri et al., 2010) but significantly (P<0.05) higher than the values reported by Ikhimioya and Imasuen (2007) for WAD goats, so the muscle mass and kidney function of the animals were normal (Prvulovic et al., 2012). Dairo (2005) reported that albumin is an important blood clot factor due to its ability to prevent haemorrhage, therefore the higher the value, the better it is to the animals. This could be the reason why the goats have comparable total protein content among the different groups. The observation is agreed with Allison (1955) and Anon (1980) who found changes in the protein reserve in animals as indicated by serum total protein to be associated with alteration in the albumin fraction. Okonkwo (2010) reported mean total bilirubin of 0.65mg/dl in the blood of West Africa dwarf goat, a value that is slightly above the result of this research. Bilirubin tests measure the amount of bilirubin in the blood sample and it is considered the true test for the liver function as it reflects the ability of the liver to take up, process and secrete bilirubin into the bile (Franson, 1981; Singh, 2004). The values of AST below and ALT obtained fell within the normal ranges of 43–132 IU/L and 7–24 IU/L, respectively (Sirois, 1995). ALT is a liver-specific hepatocellular enzyme that is used to assess liver damage (Mahgoub et al., 2008).

Conclusion

The utilization of the crop residues has no deleterious effects on the nutritional and health conditions as determined by the blood analysis of the West Africa dwarf goats. Results of the hematological indices showed that Packed Cell Volume and Red Blood Cell values were significantly different (P<0.05) among treatment groups. Serum biochemistry showed that blood urea and albumen concentration were influenced (P<0.05) by dietary urea level. The other values of the blood biochemical indices and the parameters of hematology were similar (p>0.05) among dietary groups. The inclusion of 3% of urea concentrate diet showed the best result. It is therefore recommended for use by goat producers as dry season feedstuffs.

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The manuscript should be structured as follows: Title, Names of authors and affiliation address, Abstract, List of keywords, Introduction, Material and methods, Results, Discussion, Conclusion, Acknowledgements (if any), References, Tables, Figures.

The title needs to be as concise and informative about the nature of research. It should be written with small letter/bold, 14/without any abbreviations.

**Names and affiliation of authors**

The names of the authors should be presented from the initials of first names followed by the family names. The complete address and name of the institution should be stated next. The affiliation of authors are designated by different signs. For the author who is going to be corresponding by the editorial board and readers, an E-mail address and telephone number should be presented as footnote on the first page. Corresponding author is indicated with *.

**Abstract** should be not more than 350 words. It should be clearly stated what new findings have been made in the course of research. Abbreviations and references to authors are inadmissible in the summary. It should be understandable without having read the paper and should be in one paragraph.

**Keywords:** Up to maximum of 5 keywords should be selected not repeating the title but giving the essence of study.

The introduction must answer the following questions: What is known and what is new on the studied issue? What necessitated the research problem, described in the paper? What is your hypothesis and goal?

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**Results** are presented in understandable tables and figures, accompanied by the statistical parameters needed for the evaluation. Data from tables and figures should not be repeated in the text. Tables should be as simple and as few as possible. Each table should have its own explanatory title and to be typed on a separate page. They should be outside the main body of the text and an indication should be given where it should be inserted.

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**Conclusion:** The most important consequences for the science and practice resulting from the conducted research should be summarized in a few sentences. The conclusions shouldn’t be numbered and no new paragraphs be used. Contributions are the core of conclusions.

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Papers shall be submitted at the editorial office typed on standard typing pages (A4, 30 lines per page, 62 characters per line). The editors recommend up to 15 pages for full research paper (including abstract references, tables, figures and other appendices).

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**Conclusion:** The most important consequences for the science and practice resulting from the conducted research should be summarized in a few sentences. The conclusions shouldn’t be numbered and no new paragraphs be used. Contributions are the core of conclusions.

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