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# Responses of Growing West African Dwarf (Wad) Goats to Two Levels of Dietary Copper Sulphate or Copper Nitrate Supplements

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## Abstract:

The responses of growing West African Dwarf (WAD) goats to dietary copper sulphate or copper nitrate supplements were studied. Twenty (20) WAD goats having an average initial weight of 5.85kg were randomly allocated to five treatments comprising of four goats each, $T_1$ (control) $T_2$ (0.15% $CuSO_4$), $T_3$ (0.20% $CuSO_4$), $T_4$ (0.15% $CuNO_3$) and $T_5$ (0.20% $CuNO_3$). The 2 salts were obtained from the laboratory while the other feeding stuffs were bought from the market. Northern Gamba grass (*Andropogon gayanus kunth*) was fed to the goats in addition to the copper-based diets. Serum parameters such as blood protein, cholesterol, globulin and creatinine were analysed. The internal organs (Heart, Liver, Kidney, Spleen, Lungs, full/empty Small intestine, full/empty Large intestine, and full/empty Stomach) were collected, weighed and calculated as percentage life weights. The by-products (Blood, Abdominal fat, Stomach content, Horn, Hooves, Small and Large intestine, Gall bladder) were collected and weighed. The results obtained showed that the inclusion of copper sulphate or copper nitrate up to 0.20% did not show significant differences ($P>0.05$) among treatments in any of the parameters (serum, weight of internal organs and by-products) studied. This means that the copper salts containing diets were as good as the control diet in sustaining the serum parameters, internal organ and by-product weights of the goats. Further studies involving the use of higher levels of these copper salts are recommended.

## Keywords:

WAD Goats, Copper Sulphate, Copper Nitrate, Serum, Internal Organs and By-Products

## 1. Introduction

Copper has been recognized as dietary essential in ruminant nutrition and is indispensable in the formation of haemoglobin [1]. Copper is involved in numerous body physiological functions in animals including haemoglobin formation, iron absorption and mobilization, connective tissue metabolism usually through its involvement in enzyme function where it alters reproductive performance and various immune suppression processes [2].Copper (Cu) is an essential trace element necessary for various enzymatic functions in the body [3]. It is an essential element required by lambs and other animals for a number of biochemical functions [4]. It is required for skin pigmentation, proper functioning of the central nervous system, immune and cardiovascular system [5].

In the tropics, [6] observed that, native rangelands though provide the cheapest source of nutrients for ruminants, for a greater part of the year, grassland do not supply sufficient minerals and other nutrients to stock for greater productivity. Minerals likely to be highly involved are Magnesium and Copper [7]. Both dietary nickel and copper supplements have a role to play in enhancing the feeding value of low-protein diets in the ruminant livestock [8].

In an experiment which monitored the effects of different dietary copper salts on the performance of WAD goat [9], copper acetate significantly promoted the fastest growth rate (67.35g/d) and copper balance (8.83ppm) but the least serum Cu concentration (0.01mmol/d), followed by copper sulphate (57.14g/d) while the control group (zero dietary Cu salt) exhibited the least growth rate (20.41g/d). Water intake and serum Cu concentration were not affected by the type of copper salt in the diet. [10] reported that the incorporation of copper salt up to 30 mg Cu/kg in the diets of goats did not result in significant difference in serum enzymes. [11] reported that copper salt inclusion up to 20mg/kg in the feed of lamb did not significantly affect average daily gain, average daily feed intake, gain: feed and cholesterol. Copper supplementation up to 40% mg Cu/kg did not affect average daily gain, average daily feed intake and gain: feed compared with the control in steers [12,13,14].

The aim of this study was to assess the efficacy of Copper Sulphate and Copper Nitrate as dietary supplements in improving utilization of WAD goat's feed made with mostly non-conventional feeding stuffs.

## 2. Materials and Methods

### *2.1. Experimental Location*

The experiment was conducted at the Sheep and Goat Unit of the Teaching and Research Farm of Kogi State University, Anyigba. The study site is located on Latitude 7°30'N and Longitude $7^0$ 09'E and with an average altitude of 42m above sea level. The area falls within tropical wet and dry climate region and savanna with average annual rainfall of 1600mm, the daily temperature range is 25 °C – 35 °C [15].

### *2.2. Preparation of Experimental Diets*

Two different Cu salts ($CuSO_4$ and $CuNO_3$), were obtained together with other feedstuffs including brewer's dried grain, bambaranut waste, maize offal, rice milling waste, palm oil, maize, table salt and bone meal. The two Copper salts, copper sulphate ($CuSO_4$) and copper nitrate ($CuNO_3$) were used as supplements to form 5 treatments comprising of $T_1$ (control) $T_2$ (0.15% $CuSO_4$), $T_3$ (0.20% $CuSO_4$), $T_4$ (0.15% $CuNO_3$) and $T_5$ (0.20% $CuNO_3$).

***Table 1.*** *Composition of Experimental Diets.*

| **Ingredients** | **Treatments** | | | | |
|---|---|---|---|---|---|
| | **1(0%Cu)** | **2(0.15%CuSO$_4$)** | **3(0.20%CuSO$_4$)** | **4(0.15%CuNO$_3$)** | **5(0.20%CuNO$_3$)** |
| Brewer's Dried Grains (BDG) | 49.25 | 49.25 | 49.25 | 49.25 | 49.25 |
| Bambara Nut Waste (BNW) | 29.25 | 29.10 | 29.05 | 29.10 | 29.05 |
| Maize Offal (MO) | 4.00 | 4.00 | 4.00 | 4.00 | 4.00 |
| Rice Milling Waste (RMW) | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Palm Oil | 4.50 | 4.50 | 4.50 | 4.50 | 4.50 |
| Maize | 9.00 | 9.00 | 9.00 | 9.00 | 9.00 |
| Table Salt | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Bone Meal | 2.00 | 2.00 | 2.00 | 2.00 | 2.00 |
| Copper Sulphate | - | 0.15 | 0.20 | - | - |
| Copper Nitrate | - | - | - | 0.15 | 0.20 |
| **Total** | **100** | **100** | **100** | **100** | **100** |
| **Calculated Assay** | | | | | |
| Crude Protein (CP)% | 17.11 | 17.09 | 17.08 | 17.09 | 17.08 |
| Crude Fibre (CF)% | 16.28 | 16.26 | 16.25 | 16.26 | 16.25 |
| Energy (Kcal/kg) | 2733.3 | 2728.91 | 2727.42 | 2728.91 | 2727.42 |

***Table 2.*** *Proximate Composition of Andropogon gayanus Kunth.*

| **NUTRIENT(%)** | |
|---|---|
| Crude Protein | 8.51±0.11 |
| Crude Fibre | 11.55±0.15 |
| NFE | 57.30±0.30 |
| Ether Extract | 6.94±0.06 |
| Ash | 2.55±0.50 |
| Moisture Content | 13.15±0.15 |
| Dry Matter | 86.85 |
| ME (Kcal/kg) | 2911.16 |
| NFE- Nitrogen Free Extract, ME – Metabolisable Energy | |

### *2.3. Blood Sample Collection*

At the end of the study, blood samples were collected (via the jugular vein of the goats) from 2 replicates per treatment for serum biochemical analysis. Blood samples were collected in bottles without Ethylene diamine tetra-acetate or tetra acetic acid (EDTA), in order to allow blood clot, so as to harvest the serum separately. Blood indices measured were Total protein, cholesterol, globulin and creatinine.

### *2.4. Internal Organs and By-Products Collection*

At the end of the experiment, two (2) goats were randomly selected from each treatment. The goats were left without food (fasted) for about 12 hours prior to slaughter. The internal organs (Heart, Liver, Kidney, Spleen, Lungs, full/empty Small

intestine, full/empty Large intestine and full/empty Stomach were collected, weighed and calculated as percentage life weights. The by-products (Blood, Abdominal fat, Stomach content, Horn, Hooves, Small and Large intestine, Gall bladder) were collected and weighed.

### *2.5. Statistical Analysis*

Collected data were subjected to a one way Analysis of Variance (ANOVA). Significant means were separated using Least Significant Difference (LSD) using SPSS package (version 16).

***Table 3.*** *Effect of Copper Salts Inclusion on the Serum Biochemistry of WAD Goats.*

| | **Treatments** | | | | | |
|---|---|---|---|---|---|---|
| **Parameters Treatments** | 1(control) | 2(0.15% $CuSo_4$) | 3(0.20%$CuSo_4$) | 4(0.15%$CuNo_3$ | 5(0.20%$CuNo_3$) | LOS |
| Protein (g/l) | 4.80±2.20 | 5.10±1.00 | 4.35±0.65 | 5.00±0.80 | 4.85±0.45 | NS |
| Cholesterol (mg/dl) | 135.50±35.50 | 121.00±1.00 | 108.00±32.00 | 104.00±38.00 | 96.50±14.50 | NS |
| Globulin (g/l) | 3.30±0.80 | 2.45±0.85 | 4.90±1.10 | 1.57±0.64 | 6.10±3.10 | NS |
| Creatinine (mg/dl) | 1.00±0.10 | 2.25±0.15 | 2.85±0.75 | 3.00±2.00 | 4.00±2.20 | NS |
| LOS = level of significance, NS= not significant | | | | | | |

***Table 4.*** *Internal Organ Weights of WAD Goat Fed Copper Salts Based Diets.*

| | **Treatments** | | | | | |
|---|---|---|---|---|---|---|
| Parameters (%LW) | $T_1$ (0%Cu) | $T_2$ (0.15%CuSO) | $T_3$ (0.20%CuSO) | $T_4$ (0.15%$CuN_3$) | $T_5$ (0.20%$CuN_3$) | LOS |
| Heart | 0.62±0.10 | 0.65±0.07 | 0.54±0.07 | 0.71±0.04 | 0.59±0.08 | NS |
| Liver | 1.85±0.03 | 2.11±0.36 | 1.71±0.06 | 2.05±0.10 | 1.91±0.12 | NS |
| Kidney | 0.56±0.04 | 0.46±0.05 | 0.43±0.05 | 0.50±0.07 | 0.55±0.09 | NS |
| Spleen | 0.16±0.01 | 0.25±0.03 | 0.19±0.05 | 0.20±0.01 | 0.27±0.01 | NS |
| Lungs | 1.49±0.12 | 1.24±0.13 | 1.45±0.21 | 1.30±0.01 | 1.33±0.02 | NS |
| SLIF | 9.92±0.06 | 9.58±0.70 | 11.05±0.41 | 9.54±0.54 | 8.85±1.08 | NS |
| SLIE | 5.43±0.83 | 5.86±0.67 | 6.01±0.66 | 5.81±1.19 | 4.84±0.20 | NS |
| Stomach Full | 16.35±2.5 | 16.77±0.65 | 19.85±1.16 | 19.34±0.11 | 21.50±0.01 | NS |
| Stomach Empty | 3.11±0.45 | 3.38±0.27 | 3.26±0.03 | 3.60±0.06 | 3.16±0.103 | NS |
| %LW- percentage Life Weight, SLIF – Small and Large Intestine Full, SLIE – Small and Large Intestine Empty, NS – Not Significant L/S – Level of Significance | | | | | | |

***Table 5.*** *Effect of Copper Salts Inclusion on By Products of WAD Goats.*

| | **Treatments** | | | | | |
|---|---|---|---|---|---|---|
| Parameters | 1(control) | 2(0.15% $CuSo_4$) | 3(0.20%$CuSo_4$) | 4(0.15%$CuNo_3$ | 5(0.20%$CuNo_3$) | LOS |
| Horns (g) | 3.50±0.50 | 3.00±1.00 | 2.50±0.50 | 2.00±0.00 | 3.50±0.50 | NS |
| Hooves (g) | 17.00±3.00 | 16.00±2.00 | 18.50±1.50 | 12.50±5.50 | 16.00±2.00 | NS |
| GB (g) | 3.50±0.50 | 2.50±0.50 | 3.00±0.00 | 4.50±1.50 | 5.00±0.00 | NS |
| SC (g) | 835.00±155.00 | 645.00±85.00 | 960.00±60.00 | 760.00±60.00 | 1070.00±40.00 | NS |
| SLC (g) | 242.50±80.50 | 185.50±84.50 | 291.00±13.00 | 176.50±16.50 | 231.00±66.00 | NS |
| BW (g) | 255.00±55.00 | 182.50±12.50 | 205.00±55.00 | 200.00±0.00 | 270.00±20.00 | NS |

| | | | | | | |
|---|---|---|---|---|---|---|
| Ab/f (g) | NP | NP | NP | NP | NP | NS |
| KEY: SC = stomach content, SLC = small and large intestine content, BW =blood weight, Ab/f = abdominal fat,<br>NP = not present, GB = gall bladder, LOS = level of significance. | | | | | | |

## 3. Discussion and Conclusion

As observed from Table 3, Table 4 and Table 5, none of the parameters measured was significantly affected. This shows that copper salts had no adverse effect on the parameters studied. The non-significance of the serum in this study agrees with the study of [10]. This study also agrees with the work of [11] who reported that copper salt inclusion up to 20mg/kg in the feed of lamb did not significantly affect cholesterol. The non-significance of the organ weights in this study agrees with that of [16]. The result of this study shows that the copper salts containing diets were as good as the control diet in sustaining the serum parameters, internal organ and by-product weights of the goats. Further studies involving the use of higher levels of these copper salts are recommended.

## Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

## Author Contributions

Carried out the practical on the farm: A.T.A.; S.S.A.; T.O.; Supervision, funding, Formal analysis, Writing – review and editing: U O.; fund acquisition: W.P.M.

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