



EFFECT OF HYDROPONIC MAIZE FODDER ON HEMATOLOGY AND SERUM BIOCHEMISTRY OF WEANER RABBITS

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ABSTRACT

This study investigated the effects of replacing conventional concentrate feed with hydroponic maize fodder on the hematological and serum biochemical parameters of weaner rabbits. Forty weaner rabbits were randomly assigned to five treatments: T1 (100% concentrate), T2 (75% concentrate + 25% hydroponic maize fodder), T3 (50% concentrate + 50% hydroponic maize fodder), T4 (25% concentrate + 75% hydroponic maize fodder), and T5 (100% hydroponic maize fodder) in a Completely Randomize Design (CRD). The experiment lasted for six weeks. Blood samples were collected at the end of the trial for hematological and serum biochemical analysis. Results showed no significant differences ($p>0.05$) in hematological parameters (PCV, Hb, WBC, RBC, MCV, MCH, MCHC, platelets, neutrophils, and lymphocytes) and serum biochemical parameters (total protein, glucose, albumin, urea, cholesterol, and total bilirubin) across all treatments. These findings suggest that hydroponic maize fodder can partially or fully replace conventional concentrate in weaner rabbit diets without adversely affecting their hematological and serum biochemical profiles.

Keyword: Rabbits, Hydroponic, Maize Fodder, Hematology, Serum Biochemistry

INTRODUCTION

Livestock production and science has been renewed through the extensively advertised hydroponic fodder industry worldwide (Farghaly *et al.*, 2019). The combination of concentrate in different forms with forage is vital towards achieving optimum performance and profit maximization for the sustainability of rabbit production. However, many feed products are often fed to rabbits usually with the aim of improving performance with less recourse to the health and physiological status of the animals (Etim, *et al.*, 2014). Emphasis by animal nutritionist has always been on nutrient digestibility, utilization and performance of farm animals without given much consideration to the future health status of the animals. There are factors in the blood whose levels are usually determined in order to assess the degree of well-being of an animal as deviation in these factors is used to access nutritional stress or other factors that predispose animal to stress. The commonest parameter for measuring these implications is through the haematology of the animals (Aro *et al.*, 2013). Haematological studies are important because the blood is the major transport system of the body, and an evaluation of the haematological profile usually furnishes vital information on the body's response to injury of all forms, including toxic injury (Ihedioha *et al.*, 2004). Moreover, the comparison of blood profile with nutrient intake might indicate the need for adjustment of certain nutrients upward or downward for rabbits (Rafiu *et al.*, 2013).



MATERIALS AND METHODS

Experimental Site

The experiment was conducted at the Rabbit Unit of the Teaching and Research Farm of Abubakar Tafawa Balewa University, Bauchi. Bauchi State is located between latitudes $9^{\circ} 30'$ and $12^{\circ} 30' N$ and longitudes $8^{\circ} 50'$ and $11^{\circ} 00' E$ of the Greenwich meridian with total land of 49,259.01 square kilometres. The State records annual rainfall of around 1300mm in the Sudan savannah zone and 700mm in the Sahel savannah (BASDP, 2003).

Establishment of Hydroponic System

The hydroponic system composed of wooden frame and shelves with the rectangular shaped aluminum trays put on the shelved wooden frames. In addition, each shelf of the system unit carried 4 planting trays. Aluminum trays with a length of 3m, a width of 2m, and a depth of 3cm were used for growing seeds to produce green fodder. These trays were obtained from the local aluminum artisan.

Sourcing of Plant Materials for the Experiment

Maize grains were purchased from Muda Lawal Market in Bauchi Metropolis.

Treatment of Seeds and Planting

Maize seeds were cleaned of debris and other foreign materials. The cleaned seeds were washed well. The seeds were soaked in tap water for 20 hours. Later water was drained, and the seeds were kept in gunny bags for 24 hours for germination as described by Jemimah *et al.*, (2018). After germination, seeds were placed onto different trays. The seeds were irrigated manually twice daily (early in the morning and late in the afternoon) with enough tap water to keep the seeds/ seedlings moist. The maize seeds were grown under hydroponic system and used as experimental materials during the study. The maize plants were allowed to sprout for 8 days, after which the fodder was harvested, weighed and then fed to rabbits.

Experimental Diets, Animals and Management

Forty (40) weaner rabbits were used for the experiment which lasted for six (6) weeks. The weaner rabbits were subjected to one-week acclimation whereby they were treated against internal and external parasites by subcutaneous injection of Ivermectin and broad-spectrum antibiotic. The experiment had five (5) treatments and four (4) replications with two (2) weaner rabbits per replication arranged in a Completely Randomized Design (CRD). The rabbits were placed on concentrate feed (grower's mash and groundnut haulms mixed together) for one week before assigning them to the experimental diets. Feed and water were provided *ad libitum*. Subsequently feed offered and left over was weighed and recorded on a daily basis.



Table 1: Composition of Concentrate Diets Fed to Experimental Rabbits

Ingredient	Inclusion
Maize	36.50
Soybean meal	10.80
Wheat offal	30.00
Bone meal	2.00
G/nut haulms	20.00
Premix	0.25
Salt	0.25
Lysine	0.10
Methionine	0.10
TOTAL	100
Calculated analysis	
Crude Protein (%)	16.00
Crude Fibre (%)	9.46
Ether Extract (%)	3.49
Ash (%)	4.39
ME (Kcal/kg)	2209.95

Feeding Trial

Maize hydroponic fodder replaced the concentrate diet (on ratio to weight basis) of weaner rabbits. The trial had five treatment groups namely, treatment 1 (100% Concentrate mixture), treatment 2 (75% concentrate + 25% maize hydroponic fodder), treatment 3 (50% concentrate + 50% maize hydroponic fodder), treatment 4 (25% concentrate + 75% maize hydroponic fodder) and treatment 5 (100% maize hydroponic fodder).

Table 2: Feeding Schedule of Maize Hydroponic Fodder

Type of fed	T1(0%) Control	T2 25% Replacement of concentrate	T3 50% Replacement of concentrate	T4 75% Replacement of concentrate	T5 100% Replacement of concentrate
Concentrate	125.00g	31.25.00g	62.50g	93.75g	0
Maize hydroponic fodder	0	93.75g	62.50g	31.25g	125.00g

Data Collection

Blood Collection

At the end of the experiment, blood samples were collected from one rabbit per replicate for determination of hematological and serum biochemical components as described by (Uko *et al.*, 2021). 2.5ml of blood was collected through the jugular vein and allowing free flow of blood into labeled sterile universal bottle containing 1.0mg/ml ethylene di amine tetra acetic acid (EDTA) as anticoagulant to determine the haematological component according to the methods described by (Ajagbonna *et al.*, 1999; Jain 1986). Another 2.5ml was also collected into a labeled sterile sample bottles without anticoagulant to determine the biochemical components (Uko *et al.*, 2021; Ajagbonna *et al.*, 1999). Haematological parameters analyzed were packed cell volume (PCV), haemoglobin concentration (Hb), white blood cell counts (WBC), red blood cell counts (RBC), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC). Serum



biochemical parameter analyzed were Total protein, albumin, glucose, urea, cholesterol and total bilirubin.

Data Analysis

Data collected was subjected to Analysis of Variance in Completely Randomized Design using SPSS package, differences between means was separated using Duncan's Multiple Range Test.

RESULT AND DISCUSSION

Effect of Feeding Maize Hydroponic Fodder on Hematological Parameters

The effects of varying levels of hydroponic maize fodder on the hematological parameters of weaner rabbits are presented in Table 3. No significant differences ($p>0.05$) were observed in any of the measured parameters across all treatments, suggesting that hydroponic maize fodder can replace up to 100% of the concentrate in weaner rabbit diets without adversely affecting their hematological profile. This finding aligns with Nozad *et al.* (2012), who reported similar results when evaluating alternative feed sources for rabbits. Packed Cell Volume (PCV) values ranged from 35.50% to 41.00%, while Hemoglobin (Hb) concentrations ranged from 8.45 g/dl to 10.30 g/dl. These values fall within the normal physiological ranges for rabbits (30-50% for PCV and 8.0-15.0 g/dl for Hb) as reported by Özkan *et al.* (2012). The consistency of these values across treatments indicates that the replacement of concentrate with hydroponic maize fodder did not negatively impact the oxygen-carrying capacity of the blood. White Blood Cell (WBC) counts ranged from 2.70×10^9 /dl to 5.60×10^9 /dl, while Red Blood Cell (RBC) counts were between 3.91×10^9 /dl and 4.69×10^9 /dl. These values are within the normal ranges for rabbits (2.50 - 12.5×10^9 /dl for WBC and 4.0 - 8.0×10^9 /dl for RBC) as established by Burnett *et al.* (2006). The stability of these parameters across treatments suggests that the immune function and oxygen-carrying capacity of the rabbits were not compromised by the dietary changes. This supports the findings of Gebremedhin *et al.* (2015) on the effects of alternative feeds on rabbit health. Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH), and Mean Corpuscular Hemoglobin Concentration (MCHC) all remained within normal physiological ranges across treatments. This indicates that the quality of red blood cells was maintained regardless of the level of hydroponic maize fodder in the diet, corroborating the results of Omer *et al.* (2018) on the hematological effects of non-conventional feed sources in rabbits. Platelet counts and the proportions of neutrophils and lymphocytes showed no significant differences ($p>0.05$) between treatments and remained within normal ranges for rabbits, as defined by Chineke *et al.* (2006). This suggests that the blood clotting function and the distribution of white blood cell types were not affected by the dietary treatments, aligning with the observations of Etim *et al.* (2014) on the hematological responses of rabbits to dietary changes. The maintenance of normal hematological values across all treatments indicates that the nutritional quality of hydroponic maize fodder is comparable to that of the conventional concentrate diet in terms of supporting normal blood cell production and function. This could be attributed to the high nutritional value of hydroponic fodder, which has been reported to have increased protein content and improved digestibility compared to conventional feeds (Naik *et al.*, 2015). The consistency in erythrocyte indices (MCV, MCH, MCHC) across treatments further supports the conclusion that hydroponic maize fodder can adequately meet the nutritional requirements for normal erythropoiesis in weaner rabbits. This is crucial for maintaining optimal oxygen-carrying capacity and overall health of the animals, as emphasized by Njidda *et al.* (2014) in their study on the hematological parameters of rabbits fed varying diets.

Table 3: Haematological indices of Weaner Rabbits Fed Maize Hydroponics Fodder

Parameters	Treatment					SEM	Normal range
	1(0%)	2(25%)	3(50%)	4(75%)	5(100%)		
PVC (%)	41.00	40.00	35.50	37.00	36.50	10.17NS	30.0-50.0
Haemoglobin (g/dl)	10.30	9.95	8.45	8.95	8.80	3.38 NS	8.0 – 15.0
WBC ($\times 10^9/l$)	3.45	5.60	2.70	3.20	3.00	2.57 NS	2.50 – 12.5
RBC ($\times 10^9/l$)	4.63	4.69	3.91	3.91	4.05	1.59 NS	4.0 – 8.0
MCV (fl)	76.15	75.20	76.75	81.10	74.50	3.29 NS	58.0 –95.0
MCH (pg)	22.75	21.35	22.10	22.60	22.45	0.72 NS	18.55-25.52
MCHC (g/dl)	29.90	28.45	28.80	27.85	30.10	1.26 NS	27.0 –37
Platelets ($\times 10^9/dl$)	121.00	199.50	148.00	225.50	129.50	186.22 NS	201-716
Neutrophil (%)	52.50	42.50	50.50	43.50	50.00	17.41 NS	34.0-70.0
Lymphocyte (%)	43.00	46.50	46.00	47.50	42.50	21.37 NS	40.0-80.0

PVC-Packed cell volume, **WBC**- White blood cell, **RBC**-Red blood cell, **MCV**-Means corpuscular volume, **MCH**-Mean corpuscular haemoglobin, **MCHC**-Mean corpuscular haemoglobin Concentration, **NS**- not significant ($p>0.05$)

Normal range: Amaza, et al., 2020

Effect of Feeding Maize Hydroponic Fodder on Serum Biochemical Parameters

The effects of varying levels of hydroponic maize fodder on the serum biochemical parameters of weaner rabbits are presented in Table 4. The results indicate that replacing concentrate with maize hydroponics fodder had no significant effect ($P>0.05$) on any of the measured serum biochemical parameters. This finding aligns with the observations of Farghaly *et al.* (2019), who reported that hydroponic fodder could be successfully used in livestock nutrition without negative impacts on animal health. All parameters fell within or close to the normal physiological ranges for rabbits, suggesting that the dietary treatments did not adversely affect the health status of the animals. Total protein levels (6.45-7.80 g/dl) and albumin levels (2.65-3.85 g/dl) were within their respective normal ranges of 5-7.5 g/dl and 2.5-4 g/dl. These results indicate that protein metabolism was not negatively impacted by the inclusion of maize hydroponics fodder, suggesting adequate protein utilization across all treatments. Glucose levels (3.90-4.20 mmol/l) were at the lower end of the normal range (3.9-16.5 mmol/l) for all treatments, indicating that the energy provided by the diets was sufficient for normal metabolic functions without excess. This aligns with the emphasis placed by Issa and Omar (2012) on the importance of balanced energy provision in non-ruminant diets. Cholesterol levels (3.80-5.05 mmol/L) remained within the normal range of 1.40-5.44 mmol/L across all treatments, suggesting that the replacement of concentrate with maize hydroponics fodder did not adversely affect lipid metabolism in the rabbits. Total bilirubin levels (9.35-13.1 μ mol/L) were within the normal range of 0-17.10 μ mol/L across all treatments, indicating that liver function was not impaired by the dietary treatments. This finding supports the overall health status of the rabbits, as emphasized by Aro *et al.* (2013) in their discussion of the importance of hematological studies in assessing an animal's response to dietary changes. Urea levels showed considerable variation among treatments (1.85-5.95 mmol/l), with some treatments exceeding the normal range of 1.1-2.5 mmol/l. However, the lack of statistical significance suggests that these variations may be due to individual animal differences rather than treatment effects. As noted by Etim *et al.* (2014), blood parameters can be indicators of an animal's physiological status, and further investigation may be warranted to understand the cause of elevated urea levels in some treatments. The consistency of these biochemical parameters across treatments



suggests that maize hydroponics fodder can be used as a partial or complete replacement for concentrate in rabbit diets without negatively impacting the animals' metabolic status or overall health. These findings support the potential of hydroponic fodder as a sustainable feed option in rabbit production, as proposed by Farghaly *et al.* (2019).

Table 4: Serum Biochemical Parameter of Weaner Rabbits Fed Maize Hydroponics Fodder

Parameters	Treatment					SEM	Normal range
	1(0%)	2(25%)	3(50%)	4(75%)	5(100%)		
Total Protein (g/dl)	6.45	6.70	6.45	7.80	6.75	0.75 NS	5.0-7.5
Glucose (mmol/l)	4.15	4.20	3.95	3.90	4.00	0.67 NS	3.9-16.5
Albumin (g/dl)	3.25	3.85	2.65	2.90	3.35	0.66 NS	2.5-4.0
Urea (mmol/l)	5.30	5.95	1.85	5.80	2.70	2.49 NS	1.1-2.5
Cholesterol (mmol/L)	4.57	4.73	3.80	4.56	5.05	0.55 NS	1.4-5.44
Total Bilirubin (umol/L)	11.10	12.80	9.35	13.1	12.05	1.56 NS	0-17.10

NS- not significant ($p>0.05$)

Normal range: Amaza, *et al.*, 2020

CONCLUSION AND RECOMMENDATION

Based on the results of this study, it can be concluded that hydroponic maize fodder can partially or fully replace conventional concentrate in weaner rabbit diets without negatively impacting their hematological and serum biochemical profiles. This suggests that hydroponic maize fodder is a suitable alternative feed source that maintains the health status of weaner rabbits while potentially reducing feed costs.

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